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King County

INSTREAM PROJECT CHECKLIST

For Construction and Maintenance of Flood and Erosion Protection Facilities and Habitat Restoration Projects that may include large wood elements

Project Name: Upper Carlson Floodplain Restoration Project

Project Manager: Dan Eastman

River/River Mile/Bank Snoqualmie River/RM 33 Date Aug 27, 2013 (60% revisions incorporated Nov 2013)

This checklist was updated in November 2013 to reflect the design changes incorporated into the attached 60% design plans. The narrative provided in the checklist at 30% is preserved here for reference. Changes in the design at 60% are reflected in this document in two ways:

- **Section I (Pages 1-21)** – Changes to the design and the rationale for the change are noted in separate paragraphs within the original text from the 30% checklist. The new text is labeled as such and highlighted in gray, whereas original 30% checklist text is labeled but not highlighted.

- **Section II (Pages 22-27)** - More specific information requested at the Pre-Construction stage is provided in this information, which begins on page 22.

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

(Provide general information at a conceptual level)

1. **Describe the goals and objectives of the project and its relative importance to the success of DNRP program goals and mandates. (Note: If the project is comprised of emergency work, then fill out and file this form within 30 days of completion of emergency work.)**

There is no change in this section at the 60% design stage.

Original Response @ 30%

The primary goal of the Upper Carlson Floodplain Restoration project is to restore floodplain functions and processes that provide for natural development of riverine habitat and aid salmon recovery. The proposed levee removal and set-back will achieve this goal within ~50 acres of public land on the right bank of the Snoqualmie River. The project will remove approximately 1,600 feet of existing levee and allow the river to expand, migrate and reconnect with former channels within this reach.

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 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 juvenile 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.

Although habitat restoration is the primary goal of this project, other important objectives include:

- Maintain or improve current levels of flood hazard protection of private property and public infrastructure; and
- 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.

2. Describe the existing (and historic, if relevant) site and reach conditions, including structural features, channel form, and the presence of *naturally-deposited large wood.*

There is no change in this section at the 60% design stage.

Original Response @ 30%

The Upper Carlson site has been heavily modified by river straightening, road construction, farming activities and associated flood and erosion control measures (Figure 1). In the 1930's, an existing side channel was dredged across the 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). By the early 1950's the mainstem of the river abandoned the meander bend and sinuous alignment along Neal Road in favor of the dredged channel visible in the 1936 photo.

The levee and revetment on the right bank (the right bank is the bank on the viewer's right when facing downstream) is approximately 1600 feet in length, while the left bank (the left bank is the bank on the viewer's left when facing downstream) facility is over 3000 feet long. Both flood facilities range in height from 1 to 10 feet above the surrounding floodplain. The right bank levee does not prevent inundation of the site because water flows around the facility when the active side channel (old 1936 channel) engages at approximately an annual flood event. However, the rock toe associated with the right bank levee is very effective at preventing lateral channel migration into the forested floodplain. The right bank is the "outside-bend" of the river throughout the project reach. The left bank facility (Aldair levee) provides substantial flood protection as well as arresting channel migration into the left bank floodplain, though it is on the "inside-bend" through this project reach. Both levees have been damaged and repaired.

The constraints posed by the levees result in minimal recruitment or retention of sediment and wood in the river or floodplain of the Upper Carlson reach. 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 right bank levee have been protected from erosion and recruitment to the river for over 80 years by the rock revetment. The few trees that have been recruited from the levee faces in this reach are typically quickly swept downstream or swung parallel to flow along the adjacent banks.

From a boating perspective, the project reach is currently fairly easy to navigate at moderate to low flows (<2500 CFS). The mainstem river adjacent to the levee removal area is comprised of one long (>2000ft long), deep (3-15 ft), slow (1-3 ft/second) pool that has formed due to the constriction posed by the levees at higher, channel-forming flows. There is minimal wood in the mainstem channel for the same reason. There

are several saturated logs visible and stable on the bottom through the site, but they are fairly deep. Both banks are lined with large angular rock.

The former 1936 channel is now a side channel with a series of beaver ponds and is not navigable nor is it used by recreational boaters.

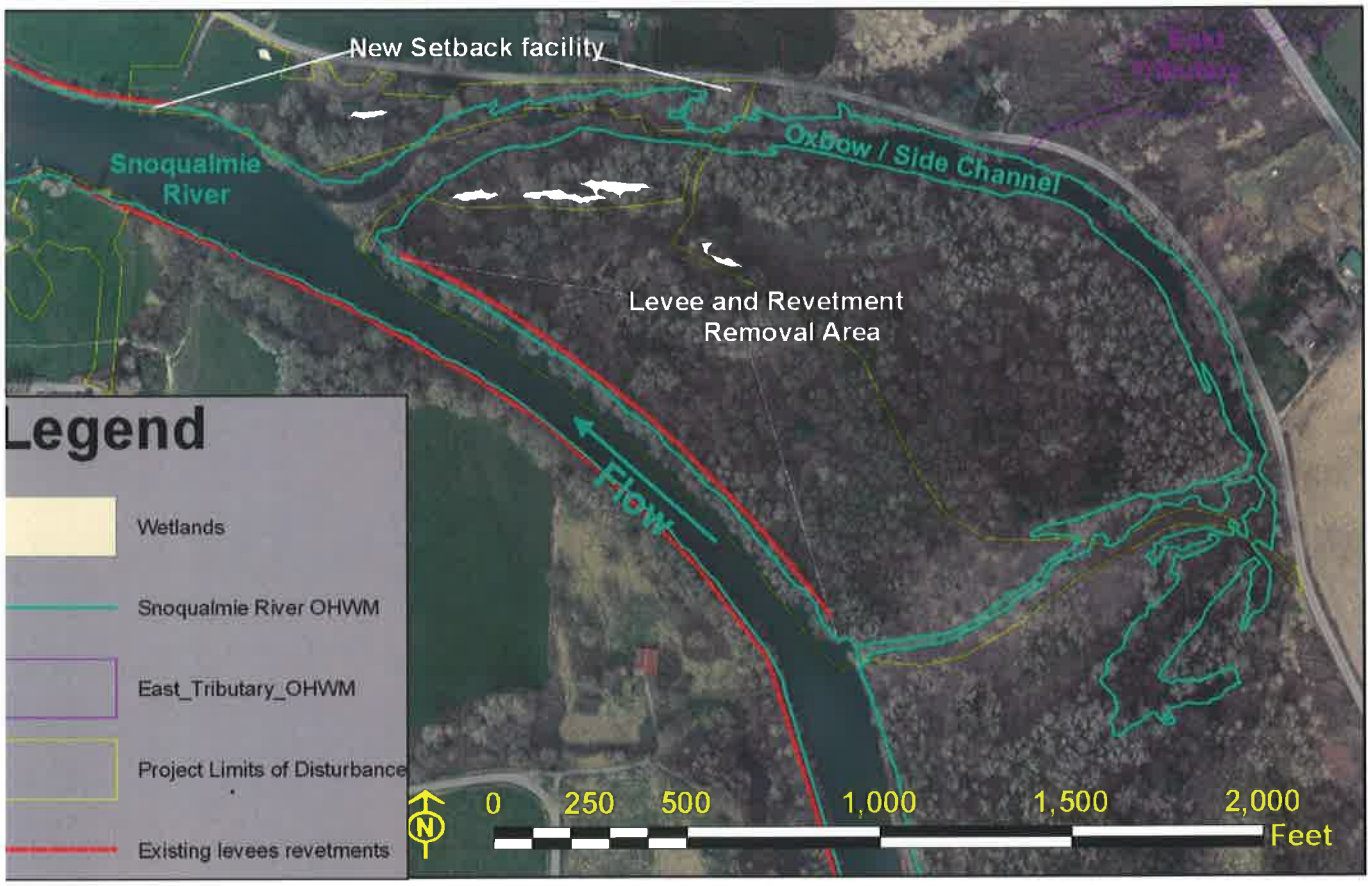

Figure 1. Existing Conditions within the Upper Carlson Reach. The right bank (Upper Carlson) and left bank (Aldair) levees are shown (red dashed lines).

Figure 2. 1936 aerial photo showing that the current side channel on the Upper Carlson site carried the majority of the mainstem river at that time. The right bank levee proposed for removal was recently constructed in this photo, as was armoring along Neal road. By the early 1950's the mainstem of the river abandoned the sinuous alignment in favor of the dredged cut-off channel shown in this photo.

3. 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?

Original Response @ 30% design [to be superceded or supplemented by the 60% Design Update below]
Adjacent land is privately owned and used for agricultural and residential purposes. The Fall City Natural Area and the Washington State Department of Fish and Wildlife parking lot and river access trail are used for passive recreation, including walking and fishing. The parking lot is small and the trail is not well maintained, so this is not a well-known or popular access point for recreational boaters to launch or haul-out. The site is also not within walking distance of other trails, schools and parks. Observations to date and discussions with local community members, Deputy William Akers from the King County Sheriff's Office Marine/Dive Unit, and other local sources reveal that the Snoqualmie River in the Fall City area is regularly used by recreational boaters. Jet boats, drift boats and rafts are common in the reaches upstream and downstream of the SR 202 bridge during salmon and steelhead runs. Inexperienced boaters, often in rafts or inner tubes are also common in the reach above the SR 202 bridge during the summer months. This latter user group is hereafter referred to as "floaters".

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. Most inexperienced floaters do not float through the project reach (Figure 3).

The primary launch point for floaters in this reach is considerably upstream of the project reach near Tokul Creek. Popular take-outs include a formal boat launch at the mouth of the Raging River and another take-out point just downstream of the SR 202 bridge in Fall City. Though most unskilled floaters do not float the section of river downstream of the SR 202 bridge adjacent to the project site, some floaters do continue on or put-in at the Raging River boat launch or the bridge and float downstream past the Upper Carlson site. These floaters either take-out at the Neal Road boat launch (an approximately 3 mile trip from the bridge), continue downstream to informal, haul-out locations between the Neal Road boat launch and Carnation or continue all the way to Carnation where there is a haul-out at the Tolt River confluence.

King County conducted a survey of aquatic recreational use in this reach of 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 project area and to inform project design and the post-project adaptive management plan.

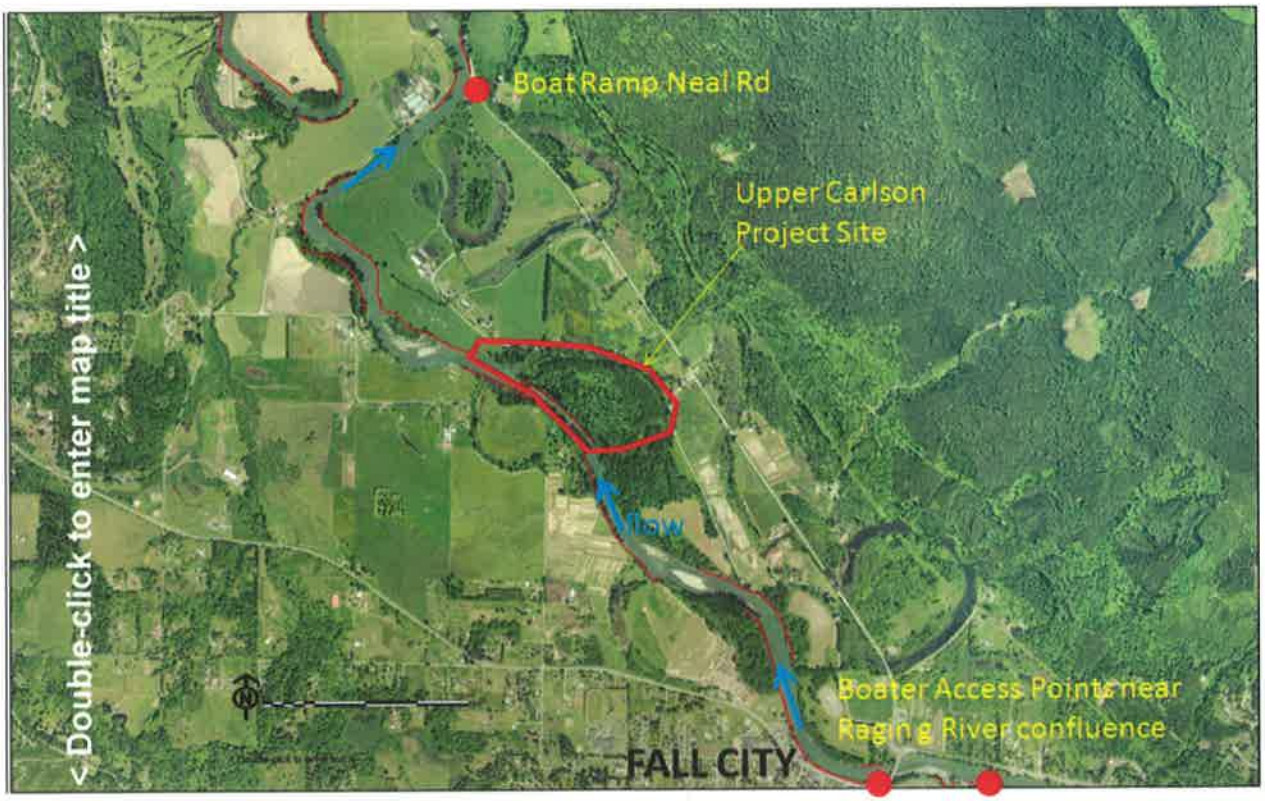

Figure 3. Snoqualmie at Fall City Reach showing common access points for recreational boaters. Most unskilled users float the reach upstream of Fall City and haul-out near the confluence of the Raging River.

60% Design Update

Preliminary results from the recreational use study confirmed the patterns described above. There is very high recreational use above the bridge in Fall City during the summer months, with up to several hundred users per day who put-in above the bridge and float to the bridge where they haul-out. A very high percentage (>~85%) of these users above the bridge were in less maneuverable boats (inner tubes or rafts) and most (>~75%) did not have any paddles.

In the reach downstream of the bridge, there were typically fewer than 10 users per day who either put in at the Fall City bridge or who bypassed the pull-out at the bridge and continued downstream to the Neal Road boat ramp to haul-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.

The preliminary results of this study confirm that there is a lower number of floaters in the project reach than observed in other heavily used reaches on the Snoqualmie River and other rivers in King County (e.g. Cedar, Green). It also confirms that many of the users in the project reach may be able to avoid modest wood hazards. These factors will make the risk that additional wood hazards pose to public safety lower than in other areas, but they do not eliminate that risk.

4. **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.**

Original Response @ 30% [to be superceded or supplemented by the 60% Design Update below]

The right bank levee and revetment is referred to as the Upper Carlson Levee and is proposed for removal as part of this project. Several hundred large trees (50-120-ft long) will be removed from the top of the levee with rootballs intact (Table 1). These trees and additional imported wood will be used to construct floodplain roughness features and engineered logjams (ELJ's) that function like natural logjams as the river migrates into the right bank floodplain after removing toe rock from the levee (Figure 4). No large wood will be placed within the low-flow channel of the Snoqualmie River during construction; however, large wood and engineered log jams (ELJ's) will be placed or constructed within the floodplain and immediately adjacent to the low-flow channel along the right bank. As the river migrates after removal of the levee, it will encounter at least some of the log placements and ELJs. Some of the placed logs will be mobilized and move downstream as the river migrates laterally. However, a portion of the floodplain logs and all engineered logjams will create periodic stable jams along the right bank margin over time. Additional live trees are also expected to be recruited from the right bank, and the site is likely to recruit and retain wood from upstream sources.

Table 1. Trees to be removed from Upper Carlson Levee

Upper Carlson Levee - Trees to be removed						
Diameter at Breast Height	< 6"	6"-12"	12"-18'	18"-30"	> 30"	Total >12"
Totals	**105**	**76**	**75**	**87**	**52**	**214**

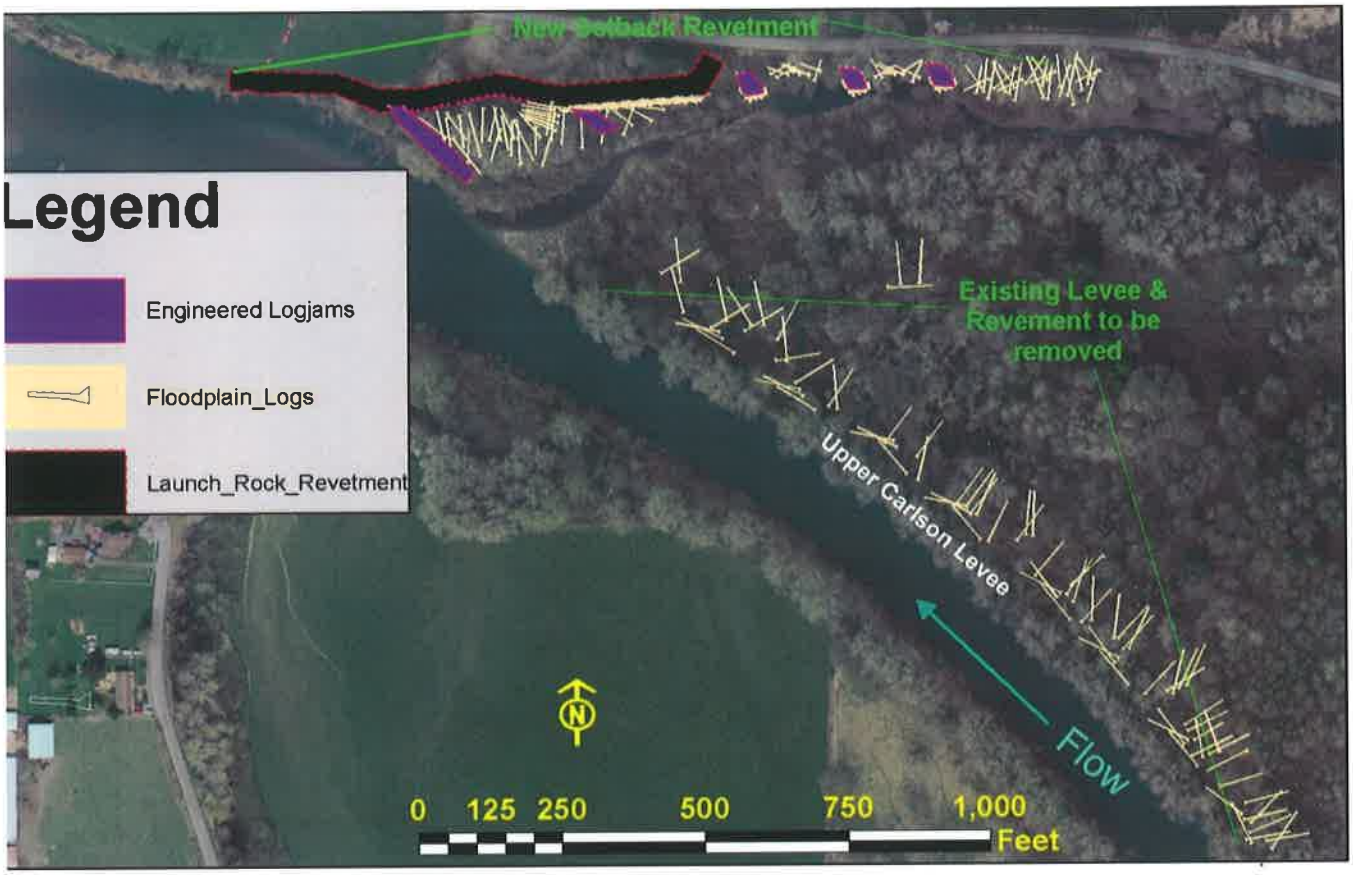

Figure 4. **Proposed Primary Actions graphic - showing 30% design concepts for all specific actions to be implemented in 2014. THIS FIGURE HAS BEEN UPDATED TO REFLECT THE 60% DESIGN CONCEPT. PLEASE SEE ATTACHED 60% PLAN SET FOR ACTUAL DESIGN DETAILS. THIS FIGURE IS A CONCEPTUAL OVERVIEW OF THE 60% DESIGN PLANS.**

60% Design Update

The location of logs placed in the floodplain has been changed in the 60% plans. Logs shown being placed in the floodplain adjacent to the levee removal will not be placed "*immediately adjacent to the low-flow channel along the right bank*". Upon further consideration of tree location data, predictions of site evolution and comments from various reviewers, the design team revisited the location of floodplain logs to allow for considerable (>40ft) channel widening to occur before placed wood or live trees would recruit to the river in this area. Trees cleared from the area where rapid channel widening is expected after construction will be placed further landward, beyond the area where the most rapid widening will occur. The design team also considered the need to have the wood be recruited to the river and contribute to complex mainstem edge habitat within the project site before it decomposes. Consequently, additional design considerations resulted in some floodplain wood moving farther waterward than shown in 30% design and some moving farther landward.

Allowing channel widening to occur prior to substantial wood recruitment is relevant to recreational boater safety. It will likely take several years or flood events to recruit substantial trees or placed wood to the low-flow channel, allowing users to become accustomed to change at the site through their own observations and signage placed by King County. The design allows for an increase in wetted-channel width before substantial wood recruits to the river, which should allow users to more safely navigate around any fallen wood when it is recruited. Finally, the rapid erosion of the right bank is expected to result in rapid deposition and bar

formation along the left bank, thus creating a potential easy portage route around any future wood hazards along the right bank.

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]
The amount, location, orientation, elevation and anchoring techniques of large wood placements are shown on the attached plans and conceptual graphics. Placement and stability assessments of all the wood planned for the site are based on a combination of two dimensional hydraulic modeling, geomorphic response analysis, reference reach conditions and professional judgment. The 2-D model (RiverFLO-2D software program (Hydronia 2012)) provides estimates of depth, velocity and direction of flood flows. These parameters help designers make decisions about placement, orientation and anchoring needs. All of the wood placed as part of the project will be within the floodplain and will not be in contact with water users until the site evolves and the placed wood and additional standing trees are recruited to the river during high flow events. More detail on each placement area is provided below.

60% Design Update
It should be noted that in the 60% design plans, approximately 175 of the approximately 400 trees will be removed and placed in the floodplain adjacent to the levee removal area. The remainder of the trees are to be used in the setback revetment structures along Neal Road. Also, of these 175 trees placed near the levee removal area, approximately 80 will be less than 12" diameter alder and cottonwood trees.

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]
A reference reach located 1.5 miles downstream of the project site has been used by the design team to consider wood quantity, orientation and mobility. This reference reach experiences on-going, active recruitment of floodplain trees and has experienced unconstrained channel migration into the forested right bank for over 80 years (Figure 5). While there are some subtle differences between the project area and this reference site (row of pilings and the wide channel), it is a good example of what conditions are like in the Snoqualmie where the river is able to migrate into forested floodplains. However, due to the existing constraints at the Upper Carlson site (relative to this unconstrained reference site), the distance that wood is projecting from the right bank at the reference reach is likely considerably greater than that expected at Upper Carlson, at least in the short-term. The reference site also has a row of pilings running down the middle of the river that will not exist at the Upper Carlson site.

Figure 5. Reference reach 1.5 miles downstream depicting the expected and targeted future right bank conditions at the Upper Carlson site. Note that given the existing constraints at the Upper Carlson site (relative to this unconstrained reference site), the distance that wood is projecting from the right bank in this photo is likely considerably greater than that likely at Upper Carlson. Also, this reference site has a row of pilings (Black Line) running down the middle of the river that will not exist at Upper Carlson.

60% Design Update

This reference reach has also been informative for the development of a post-project site management plan. In particular, this reference reach provides good examples of the types of logjams and instream conditions that might develop over time in the project area. The notes on the additional image provided below indicate the types of jams and the timeframe over which they might develop at the Upper Carlson site after levee removal.

This is a new, zoomed-in image of the reference reach inserted for the 60% design update.

A) Wood clusters and buried logs in leading edge of floodplain in potential channel migration areas.

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]

Six or seven large wood clusters will be placed in the waterward edge of the floodplain area. The purpose of the log clusters is to increase surface roughness on the floodplain and improve the quality of mainstem edge habitat along the banks as the river migrates laterally into them, thereby reducing flow velocities and moderating channel migration rates. The objective is to create conditions similar to an unarmored, forested channel bank that will provide high quality edge habitat for salmonids (such as the conditions shown in Figure 5). Each cluster will contain approximately 8 to 15 large logs. The logs will be laced in-between existing trees and oriented in such a way that the force of the water at flood stage makes them relatively stable in the floodplain. The standing trees in this area will help stabilize the clusters; the wood clusters will also be partially buried with levee removal spoils to provide additional ballasting and to resist rapid displacement during high water events.

60% Design Update

While the objective of the log placement in this area remains the same, the large logs are more evenly distributed throughout the floodplain area adjacent to the levee removal in the 60% design plans. This layout is more likely to achieve the primary project objective, without posing an additional risk to recreational safety. Also, see the note on Page 4 above regarding the location of these logs relative to the "rapid widening zone".

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]

Approximately seven large logs will be buried (6-10' deep) in the floodplain along the levee footprint to promote accumulation of large and small wood recruited from the project site or from upstream as the river migrates laterally into the right bank floodplain. Buried ancient logs are common in floodplain environments and are often exhumed by the river as it migrates through old logjams. These logs often create the foundation for large accumulations of wood along the outside bends of rivers. No hard-fixed, artificial anchoring system (e.g. chain, boulders, etc.) is proposed in this floodplain area. Wood in this area has the potential to move offsite and be recruited to the mainstem river over time. When that happens, wood will enter the river as single pieces and not have artificial tethers or anchors that may create additional concerns for recreational users or downstream infrastructure. Wood that is mobilized is expected to be trapped within other areas downstream where there is currently substantial wood within the active channel or in other floodplain areas downstream, such as at the reference reach, 1.5 miles downstream (Figure 5).

The buried logs will be buried to a depth that places the lowest portion of the rootball approximately 1-2'above the typical summer water surface elevation (~72-73'). They will be buried back from the immediate bank (~15-30' landward from the water's edge) and will thus not be exposed upon completion of the project. As the river migrates into these large trees (3-4' diameter x 60-100' long) they will be exposed, but will themselves pose only a modest above-water obstruction to "floaters" during the summer months because they will be above the low flow elevation. They may, however, be encountered during typical spring run-off flows of greater than 3000 CFS, when the water surface elevation is higher.

After several flood seasons of being exposed, it is very likely that large and small wood will have racked on the upstream face of these logs and extend down to and below the low flow water surface elevation. It is also possible that this racked wood could extend out into the mainstem considerably (20-30' from the bank) as the bank continues to migrate laterally. As substantial lateral migration (>40-60') into the bank occurs, these logjams (and associated racked wood) will likely become prone to dislodging as more length of the large buried log is exhumed, making it prone to breaking or pulling out of the bank.

The design team is considering comments received on the orientation of these buried logs during the LWD public meetings in June of 2013. Comments expressed concern over the upstream-facing orientation of the logs. The design team is considering a modification to the 60% design plans based on this input.

60% Design Update

Upon further consideration of onsite tree data and maps, predictions of site evolution and comments from various reviewers, the design team removed the buried logs from the 60% design plans. Logs will not be deeply trenched into to the floodplain (6-10') as originally proposed; they will be placed on the existing floodplain and partially buried with spoils from the levee excavation. There is still no artificial anchoring proposed in this area. The design team determined that the project's habitat objectives (mainstem edge) could be achieved without deep burial of logs in the floodplain, which several reviewers believed might increase the risk to recreational boaters.

While the buried logs were removed from the 60% plans, these logs (very large cottonwoods) will be placed on the floodplain in similar locations, close to where they are currently growing on the levee. The orientation of these large logs was also revisited since 30%; most of the largest logs will be placed perpendicular to flow or facing slightly downstream. Large logs will have similar effects to that described for buried logs in the

original 30% response above. However, the lowest portion of the rootwads will initially be several feet higher in elevation than described above. As a result, when these logs are initially encountered by the river (before any substantial shifting occurs as a result of bank erosion around them) it will take fairly high flows (>6000 CFS) for these logs to pose an above-water obstruction to floaters. As a result, relative to the original design, it is less likely that these logs will be encountered by floaters in the short-term. Logs placed in the floodplain during project construction will eventually be recruited to the river through channel migration and bank erosion processes. At that point in time, this recruited logs are likely to extend into the low flow channel

B) Bank Deflector Engineered Log Jams

The purpose, location, design, and recreational relevance of these ELJ structures has not changed substantially since 30% design.

Original Response @ 30%

Three large, robust bank deflector type ELJs will be constructed into the bank of the former river channel along Neal Road at the upstream end of the new setback revetment. The purpose of the ELJs is to protect the roadway. The ELJs are designed to be erosion-resistant hard points that provide large-scale bank roughness to deflect flow and scour away from the bank, thereby protecting the roadway prism in the event the mainstem flow becomes aligned alongside it.

The ELJs will be structurally supported and anchored using deeply embedded timber piles. Logs in the ELJs will be ballasted to counteract buoyancy and prevent displacement during floods. Logs used in the ELJs will be imported from off-site. The ELJs will incorporate racking logs and slash material to:

- Minimize flow piping and straining into the structure that could otherwise be a recreational user hazard and reduce functional performance of the structure;
- Absorb erosive forces of impinging flow; and
- Prevent bleed out of finer backfill included in the ballast material.

The tops and sides of the ELJs will be planted with native vegetation to establish root cohesion amid the finer backfill material to increase structure stability and enhance establishment of riparian vegetation. The need for chain or cable to fasten some or all logs to the piles will be evaluated during subsequent design phases, as will the pile design. The ELJs will protrude from the Neal Road bank approximately 30 feet, will be approximately 45 feet long along their waterward face, and will be spaced approximately 160 feet apart.

The engineered log jams will not be in contact with the river upon completion of construction; however, flows are anticipated to engage the former main channel more frequently and with higher flows after levee removal. These logjam placements will be 500 to 800 feet off of the main channel and will be partially buried and secured with ballast sufficient to hold them in place and resist the forces of buoyancy. Backwater areas are expected to be low energy environments that would not likely present attractive or hazardous flow path for recreational users. While these placements could be encountered by future recreational floaters, users would likely have to make a concerted effort to access these areas during typical summer recreational flows (1000-2000 cfs) and even then should have ample opportunity to exit prior to encountering the wood. Conditions are expected to change in these side channel environments in response to high flow events, so post- construction monitoring and adaptive management strategies are important components of future site management.

C) Floodplain roughening logs with and without piles

The purpose, location, design, and recreational relevance of these ELJ structures has not changed substantially since 30% design.

Original Response @ 30%

Between the two ELJs and upstream of the upstream-most ELJ, simple log roughening structures will be constructed along the bank of the abandoned channel meander using shallow timber piles, felled logs and standing trees. The purpose of the roughening structures between the ELJs is to provide a secondary level of bank roughening that discourages flow from entraining along the bank and buffers the bank from erosive flow conditions in between the ELJs. The purpose of the upstream-most log roughening structure is to provide low cost hydraulic roughening within the 125-foot-wide vegetated floodplain area to buffer potentially erosive flow along the bank adjacent to Neal Road. The proposed roughening and ELJ structures located beyond the 20-year (and perhaps the 50-year) channel migration boundary (projected by the County) will continue to be evaluated during subsequent design phases to determine if they are necessary. Each location has different placement and anchoring approaches based on the desired function, anticipated flow conditions, and potential for recruitment to the river via flood waters, channel migration or side channel formation and evolution.

These roughening areas have a similar likelihood of being encountered by floaters as the bank deflector ELJ's described above in "B". There were no concerns raised at the LWD public meetings in June, presumably due to the low likelihood of encounter by floaters.

D) Timber piles - This timber-pile structure was changed to an ELJ in the 60% design plans. See below.

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]

Two rows of deeply embedded structural timber piles will be installed along the downstream edge of the floodplain immediately south of the rock and log revetment. The rows will be spaced ten feet apart. Piles in each row will be spaced 15 feet apart. The rows will be offset to create a linear matrix of piles spaced 7.5 feet apart. The row of piles will begin at the downstream end of the log revetment and extend along a line oriented upstream (to the southeast) to the current alignment of the river. The resulting configuration of piles and the log revetment will create a pocket of structural elements that serves to accumulate, trap and stabilize large wood debris from the project site and upstream sources. Large and small logs felled during levee removal work will also be placed in the pocket and arranged in a manner that promotes racking against the line of piles or pinning against existing large trees if they are mobilized during a large flow event.

The purpose of this floodplain roughening and logjam is to discourage the river from flowing along the setback rock revetment, provide a location for additional stable wood accumulation, and thus provide high quality edge habitat for salmonids over the short and long term The proposed rock revetment landward of this "pocket of structural elements" is intended to protect the road and private property from erosion; however, a rock structure alone, provides little to no habitat value.

The design team received comments on these Timber Piles during the LWD public meetings in June of 2013. Comments expressed concerns with the location of the structure (outside bend), type of structure (porous

piles) and potential to be exposed in the low flow channel through erosion. The design team is considering modification to this design feature as a result of this input.

60% Design Update

This design feature was changed considerably between 30% and 60% design stages. Comments from various stakeholders resulted in further consideration of how risk to boaters could be reduced while also achieving the other objectives of bank protection and habitat benefits in this downstream area. The KCSO, a professional boater and members of the River Safety committee raised concerns early in the 30% design process regarding the downstream structure's potential to be a hazard given its location on an outside bend, the piling-based design and the length of the structure.

While the location was not changed because it is essential to achieving bank protection and fish objectives, the structure was shortened by 30 feet and substantially redesigned to be less porous. The original, more porous, piling-based design was replaced with a more ballasted ELJ with rock and wood placed low in the water profile to minimize flow under and through the jam. The ELJ will consist of two rows of deeply embedded structural timber piles. Riprap and small logs (18 inches in diameter and 15 to 25 feet in length) will be placed approximately 10 to 15 feet below the floodplain ground surface (between elevation 65 feet and 73 feet) along the bottom of the ELJs between the rows of piles. This will make the ELJ virtually non-porous and will minimize flow under and through it, which will significantly reduce the risk of boaters being swept into it.

These design changes reduce risks to floaters at this location. Further risk reduction measures are being developed through close attention to this location in the Site Management Plan. The river's interface with this structure will be monitored due to its important function for bank protection and habitat, but also because of its significant location with respect to recreational use. The management of this structure will be dependent on site conditions that evolve after the levee is removed and on the level and type of users over the long-term.

E) Log Revetment

Original Response @ 30% [to be superceded or supplemented by the 60% Design Update below]

The setback rock revetment will be fronted with a log revetment consisting of deeply embedded structural timber piles and a matrix of large logs placed between the piles. The piles will be installed near the toe of the rock revetment section and will extend a few feet above the predicted 100-year flood elevation to collect flood-borne woody debris. The piles and logs are arranged in a manner to allow the rock revetment to fall underneath the logs and armor the bank with angular rock in the event the river becomes entrained along the log revetment. The log revetment will be approximately 8 to 12 feet tall depending on the diameter of logs installed.

The purpose of the log revetment is to substantially roughen the "hydraulically smooth" rock revetment to reduce flow velocities and prevent the river from entraining along it. This will buffer the rock revetment from erosive flow conditions while providing some modest edge habitat. The piles are also intended to trap trees recruited from upstream so that they do not interfere with farming activities on the agricultural property immediately downstream.

60% Design Update

This linear feature was eliminated from the 60% design plans and replaced with a shorter version of the non-porous ELJ described immediately above in the Section D. Relative to the original design in this location,

this non-porous ELJ design will provide equal bank protection and better habitat in this area, while not posing an additional risk to boater safety in this area. However, it is likely to be more than a decade until this structure is in contact with the mainstem at low to moderate flows and has any potential for interaction with floaters. By then, we expect substantial accumulations of wood upstream along the right bank that will encourage floaters to move towards the left bank or portage around this location. It is also likely that after a decade of widening, there will be a large gravel bar on the left bank, making it easy to portage around wood on the right bank. This general trend of increasing upstream wood accumulations and increasing left bank bar growth over time will reduce the likelihood that floaters will encounter the constructed ELJ structures on the right bank. This location will be an area of focus and receive greater detail in the Site Management Plan.

5. **What is the intended 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 woody debris that may be floating in the river?**

There is no change in this section at the 60% design stage.

Original Response @ 30%

The purpose of each specific design element that involves placement of wood is described above.

Large wood harvested from the levee prior to removal will be strategically placed within the floodplain to help direct overbank (flood) flows and 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 Upper Carlson 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 and some deeply submerged wood, but no persistent, large jams.

If the Upper Carlson reach responds to levee 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 (Figure 6). The river will also widen considerably and accumulate sediment on the left bank as it migrates into the right bank, making for a considerably wider, broader cross-section. It is likely over time that a gravel bar will be exposed during low flow along the left bank through the reach. During future flood events, the site will also contribute additional wood as the bank erodes, but this effect is expected to be moderated by the reach trapping greater quantities of wood from upstream reaches. 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 (Figure 5).

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 located in a "primary restoration" (i.e. first priority) mainstem sub-basin. As part of the Snohomish River Basin Salmon Conservation Plan (Snohomish 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 Snoqualmie

River in the Fall City Reach (Raging River confluence to Patterson Creek confluence) 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 this Fall City 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.

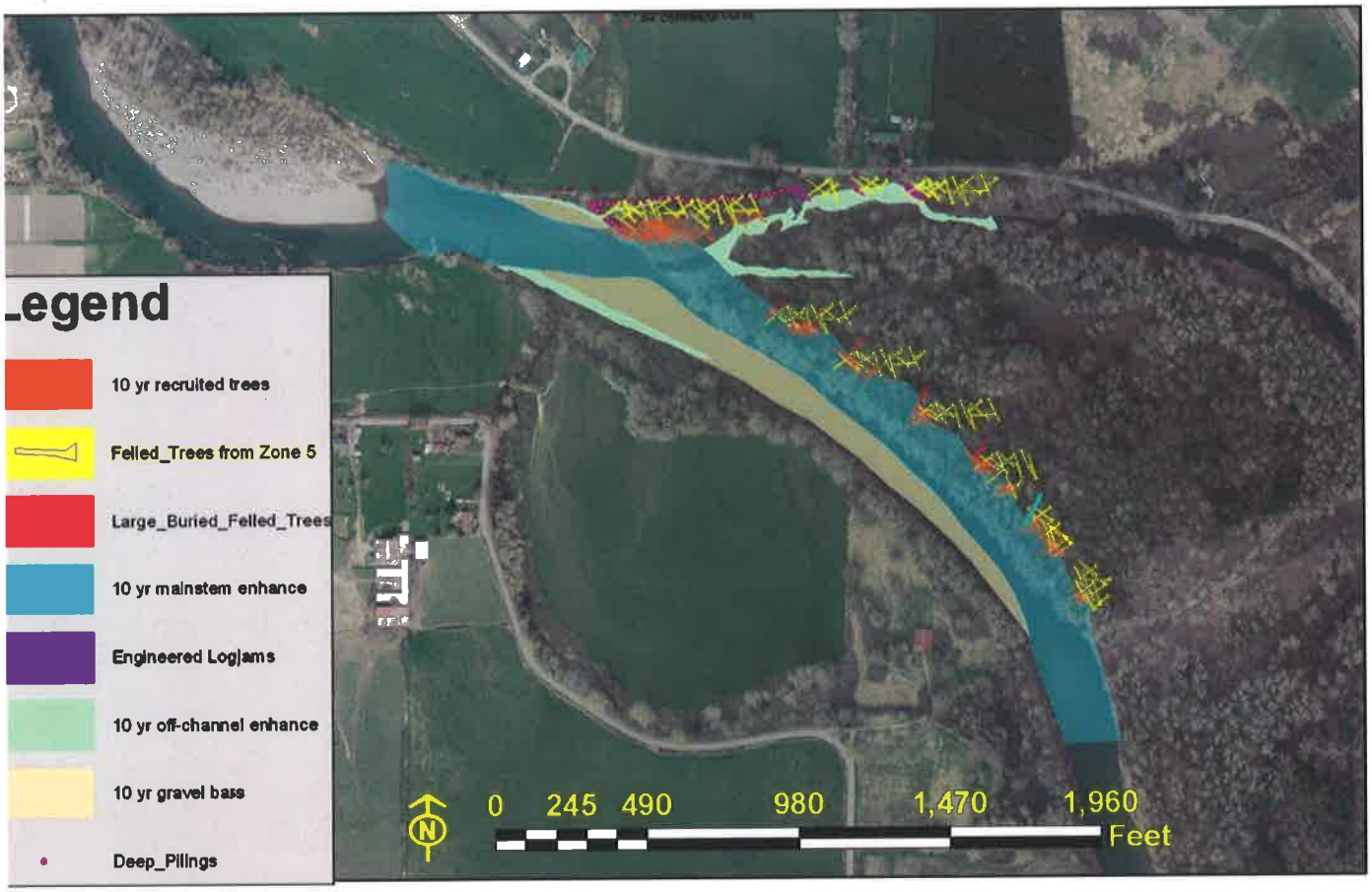

Figure 6. Estimated geomorphic response after 5 to 10 years (or several moderate to large flood events) of site evolution. Note that this is one of several potential outcomes possible at this site. NOTE – THIS GRAPHIC WAS NOT UPDATED AS A RESULT OF THE 60% DESIGN PLANS. IT IS STILL REPRESENTATIVE OF FUTURE CONDITIONS. AS DISCUSSED ABOVE, NO FLOODPLAIN LOGS WILL BE DEEPLY BURIED INTO THE FLOODPLAIN.

6. **Describe how public safety considerations have been incorporated into the project design [see section 1.B.2 of Ordinance 16581] and include a description of how the six (6) key steps provided in Public Rule LUD 12-1, Appendix A. (Rule) Section V.2.A. i)-vi) have been addressed.**

i) *In designing the placement of wood in the project, the project team will gather available information and take into account the expected type, frequency and seasonality of recreational uses as an important element in its overall consideration of impacts to public safety of the proposed project.*

Original Response @ 30% [to be superceded or supplemented by the 60% Design Update below]

The level of recreational use of the project reach is based on input from the Sheriff's office, users and community members; staff observations to date; and the 2013 study of recreational use on the Snoqualmie River (Herrera Environmental Consultants, Inc.). The study will focus on summer use and floaters/boaters, and will provide a detailed characterization of the types of users and level of use. The study, in combination with anecdotal observation from the King County Sheriff's Office and long time river users, verify that there is a wide range of skill and ability among Snoqualmie River users. Please see the response to question 3 above and the study for more detailed information. The project design and associated Site Management Plan (under development) incorporates many elements to avoid or reduce potential impacts to this broad range of recreational users, while still achieving the other project goals. It is important to note that rivers are by their nature dangerous places. Restoring dynamic 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 after high flow events.

60% Design Update

Additional information from the summer 2013 recreational use survey is provided above in Section 3.0.

ii) *Consideration of public safety in the conceptual design will include but not be limited to the following factors: the location, orientation, elevation, and size of the wood placement, the method of anchoring or securing the wood placement, the degree of interaction between flowing water and the placed wood during projected flow regimes, including flows commonly experienced in the recreational seasons, and input received through the public outreach process.*

Original Response @ 30%[to be superceded or supplemented by the 60% Design Update below]

As noted in responses above, the design team has been attentive to potential safety hazards from the beginning of the project and will continue to do so throughout the design; however, significant design changes are unlikely after the 60% design phase is completed in order to ensure efficient completion of the project. Please see response to question 4 regarding placement of wood relative to anticipated flow conditions. Because of the dynamic nature of the floodplain's response to the project, there is limited ability to make design modifications to accommodate all concerns. As a result, King County is developing a Post-Project Adaptive Management Plan that will address how this site will be managed over time.

The following design elements have been considered to date, specifically in consideration of public safety:

- Removal of large trees within and immediately adjacent to the existing levee footprint. If these trees were left in place, they would be recruited to the river at an unnaturally rapid rate as the river expands to its natural width in this constrained reach, immediately after levee removal. The design team considered removing toe rock from a barge, leaving trees in place, but moved away from that option due primarily to this inevitable rapid recruitment of wood to the river that could quickly create significant hazards to boaters within and downstream of this reach.

- All wood in the mainstem will be placed back (landward) from the immediate river margin and not within the Ordinary High Water Mark of the Snoqualmie River. This will allow for some site evolution and increase in channel width before logjams are within the active low-flow channel. The wider channel may provide more opportunity for safe passage by recreational boaters.

- All wood elements have been designed using a natural analogue (reference reach downstream) so that resulting logjams appear and function naturally when they form (or are "built") and are not out of character with what recreational boaters are accustomed to while boating this and other rivers.

As noted above, the following elements of the 30% design plans are being considered and will likely be modified at the 60% design stage to address concerns raised at the LWD public meetings in June 2013 and during the recreation focus group meetings:

- The design team received comments on the orientation of the Buried Logs during the LWD public meetings in June of 2013. The concern with the upstream-facing orientation is being considered and may result in a modification to the 60% design plans.

- The design team also received comments on the Timber Piles The concerns with the location (outside bend), type of structure (porous piles) and potential to be exposed in the low flow channel through erosion, all of which could pose a greater hazard to floaters, is being considered and may likely result in a modification to the 60% design plans.

60% Design Update

Buried logs were eliminated from the 60% design plans. The remaining large logs in these locations are also reoriented with their axis in a more perpendicular or downstream-facing direction relative to flow.

The ELJ design was replaced with a shorter, non-porous ELJ structure that will minimize flow under and through this logjam over time and significantly reduce the risk for boaters being swept into it.

iii) In designing the specific placement of large wood, the design team will seek to maximize achievement of stated project goals and objectives while minimizing potential public safety risks, including risks to recreational users, and will seek to ensure that the procedures and design options affording the greatest safety for river users are of primary consideration in design concerns involving a balancing of important public purposes as it addresses safety issues.

Original Response @ 30% [to be superceded or supplemented by the 60% Design Update below]

The design team has been mindful of recreational users throughout the design process and has incorporated numerous elements into the preliminary design intended 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 spawning, rearing and refuge habitat for salmonids.

A site specific post-project adaptive management plan is also being developed to outline a series of responses that can be employed to help address recreational safety and site specific hazards that may evolve after the project is constructed within a reasonable post-project timeframe. The current 30% plan includes a number of specific measures to address potential impacts to recreation as discussed above, including:

Design - Wood Placement

Selective tree removal

No placed wood in active channel

Placement back from initial migration area

- Some logs installed as individual pieces
- Strategic anchoring (burial and using existing trees) in most areas adjacent to the mainstem –i.e. no chains/cables

Site Management – Post Project

Warning/Advisory Signs

Public outreach and education to increase floater awareness

Post-Project Site Management Plan

- Clear roles and responsibilities
- Progressive management strategy driven by future conditions

60% Design Update

As noted in sections above, the following additional design modifications were made after further consideration of public safety during the 60% design process:

- Shorter, non-porous ELJ structures in higher risk areas;
- Removal of deeply buried logs from the design in the floodplain area;
- Reorientation of very large logs with their axis in a more perpendicular or downstream-facing direction relative to flow.

The Site Management Plan is currently being developed with substantial input from a local workgroup. Initial recommendations from the workgroup included extensive signage, targeted outreach, enforcement and hazard removal with the following primary objectives:

- To increase boater safety awareness and reduce hazards in the upstream reach (from Plum Creek to the bridge in Fall City) where there is currently intense recreational use and less focus on large-scale mainstem habitat restoration.
- To discourage use by "floaters" downstream of the Fall City bridge and in the Snoqualmie at Fall City reach in particular where removal of levees will restore natural and dynamic river processes, which will increase the amount of wood in the mainstem river.

iv) *Conceptual project designs will be informed by standard design practices with input from professional designers with expertise in fluvial geomorphology, ecology, river hydraulics and civil engineering with hydraulic analysis expertise.*

There is no change in this section at the 60% design stage.

Original Response @ 30%
The design team consists of multidisciplinary team of engineers, ecologists, and geologists with extensive knowledge of northwest rivers and many years of experience designing stream and river restoration projects. The team is supported by a consultant team with technical experts from Herrera Inc., who bring extensive hydraulic modeling expertise as well as practical large wood design experience in rivers throughout the US.

v) *All projects that incorporate large wood in rivers and streams will undergo review and approval of engineering plans and analysis from a Licensed Professional Civil Engineer.*
There is no change in this section at the 60% design stage.

Original Response @ 30%
The project design is being prepared by the multi-disciplinary team noted above, but overseen and directed by licensed professional engineers, as well as licensed geologists/geomorphologists.

vi) All projects that incorporate large wood with the stated objective of providing ecological benefits will undergo review and approval from a professional ecologist (i.e., persons with an advanced degree in aquatic and/or biological sciences from an accredited university or equivalent level of experience).
There is no change in this section at the 60% design stage.

Original Response @ 30%
The team includes several ecologists meeting those criteria, and the senior ecologist on the team is a fisheries biologist with both an advanced degree and thirteen years of experience planning, designing, implementing and monitoring stream and river restoration projects. The project plans are also being reviewed by the Unit Manager with over thirty years experience in the field of ecological restoration.

What is the anticipated schedule for completing project milestones (30-40% design, final design, major construction/earthmoving) and for soliciting public input)?

The schedule milestones below have been updated to reflect the current schedule as of Nov 21, 2013

Distribution of 30% plan for public comment	August 2013
Public review and comment on the 30% plan	Date of distribution through October 5th 2013
Permit submittal (using Permit Set)	August 2013
Completion of 60% plans	Early December, 2013
Permit Plan set update to regulators	Early December, 2013
SEPA Process	Sept – December 13th, 2013
Final Plan completion	February 2014
Construction	May -October 2014

11/21/13.

Project Manager — Date

11/21/13

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*

7. 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.

Feedback from the KC Sheriff's office, a boater safety professional, the Snoqualmie Tribe, members of the River Safety Committee, and other stakeholders during the 60% design process resulted in several modifications to the design that are relevant to recreational boating.

Answers to questions above have been revised where necessary and are highlighted in gray. Figure 5 above has also been updated to roughly reflect the 60% design. No other figures were updated. The most recent design plans (60%) are attached with this checklist and show the updated wood design in greater detail.

8. The Rule requires project review and approval by a Licensed Professional Civil Engineer. The Engineer will ensure appropriate application of engineering studies and design standards. Describe the design review and approval process for the project, including review by the licensed professional engineer, as well as reviews by other licensed technical staff such as 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. Was the review and approval completed?

Yes, engineering review is conducted throughout all design phases. In addition to review by the engineering supervisor (Will Mansfield, P.E.), the design team includes a licensed design engineer (Ian Mostrenko P.E.) and a licensed geologist (Todd Hurley, LG). The engineer of record has been directly involved in the wood design throughout the design process and supports the design and analysis.

9. The Rule requires project review and approval 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. The Ecologist will 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? Please describe steps undertaken by the Ecologist.

Yes – this review is occurring during all design phases, both by the professional fish biologist/ecologist on the design team and by the supervising ecologist. The fish biologist/ecologist (Dan Eastman) has been directly involved in the wood design and supports the design and analysis.

10. 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 permits required for this project are listed below. While we have not completed communications with permit agencies over permit contents at this time, we do not expect to have extensive permit conditions associated with large wood at this site. This is a habitat restoration project and has no compensatory mitigation associated with it.

However, WDFW has indicated that they will be looking closely at the project design package to ensure that the primary habitat objectives are met and that there is a clear site management plan in place that describes how wood will be managed at this site after the project is implemented. WDFW

has indicated that part of their role on this project will be to ensure that Salmon Recovery Funding associated with the project is spent appropriately – meaning that the project objectives with respect to habitat benefits are realized and maintained over time. The design team is confident that the proposed design and developing site management plan will meet WDFW's expectations.

Permits and approvals required for this project include:

- Clean Water Act Section 404 Permit (U.S. Army Corps of Engineers)
- Endangered Species Act (ESA) Section 7 Consultation (National Oceanic and Atmospheric Administration Fisheries and United States. Fish and Wildlife Service)
- National Historic Preservation Act Section 106 Review
- National Pollutant Discharge Elimination System (NPDES) Permit for Construction (Washington State Department of Ecology)
- Coastal Zone Management Consistency
- Section 401 Water Quality Certification (Washington State Department of Ecology)
- Washington Department of Fish and Wildlife Hydraulic Project Approval
- King County Clearing and Grading Permit
- Shoreline Management Substantial Development Permit Exemption (Washington State Department of Ecology)
- King County Flood Hazard Certification
- Aquatic Use Permit (Washington State Department of Natural Resources)
- Procedures for Considering Public Safety When Placing Large Wood in King County Rivers, Public Rule LUD 12-1, King County Ordinance 16581
- King County Administrative Procedures for Implementation of KCC 21A.24.381
- Approval Memo for Altering King County Park Division Properties. King County Department of Natural Resources and Parks
- National Environmental Policy Act, Categorical Exclusion, US Environmental Protection Agency.

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

See responses above (highlighted in gray) that describe modifications made to the design in consideration of public safety. While the project is currently undergoing review by permitting agencies, we do not expect substantial changes to the wood design.

King County is committed to the development and implementation of a site management plan. The plan, which is still in development and is being discussed with stakeholders, may include:

a. Site monitoring plan – Closely monitor the site as it evolves and inform decisions as wood is recruited;
b. Site signage plan – Use results of monitoring to develop, place and annually update signs identifying the location of onsite hazards and best route around them;
c. Snoqualmie at Fall City Reach "floater" access reduction plan. – Developed by the local workgroup to gradually reduce the number of "floaters" using this downstream reach while concurrently increasing awareness and safety of users upstream of the bridge;
d. Hazard assessment and decision-making framework – Will define and discuss a range of potential outcomes and responses and establish pre-project recommendations reviewed by both WLRD and KCSO for use on site when actual wood hazards develop;

e. Potential modifications to existing boater hazards - These hazards have been identified by the KCSO and other local boaters in the reach upstream of the bridge (golf course wood and concrete at bridge) and downstream (the piling hazard) of the project site.

12. Describe how the Public Outreach requirements in Rule Section V.3. Have been addressed.

The project manager attended and presented the Upper Carlson project at the following meetings:

- The two annual LWD meetings in June 2013;
- A public meeting held in Fall City to present and discuss the overall project in late August 2013;
- A series of local workgroup meetings in Fall City specifically focused on recreational boater safety at this site & reach;
    - Meeting # 1 (Sept 2013) – focused on discussing the 30% design and getting feedback
    - Meeting # 2 (Oct 2013) – focused on soliciting ideas for the Site Management Plan (SMP)
    - Meeting # 3 (Nov 2013) – will review the 60% design plans and continue discussion of the SMP.

13. Describe the input received from the public and how, if appropriate, the project team has responded to this input.

See responses above (highlighted in gray) which:

- Describe comments made by members of the public and other stakeholders regarding various design elements and their boater safety implications;
- Describe modifications made to the design in consideration of public safety.

In general, there has been a recognition by the public that the project design is most effective at reducing boater risk in the short-term at this site; however, the restoration of natural river processes, including erosion and channel migration will result in the recruitment of large wood and make the site less suitable for floaters. There has also been strong public support for development of a site management plan that includes a substantial outreach component to educate users about hazards and to discourage use of this reach below the bridge by floaters.

Numerous stakeholders commented that there is an existing piling hazard downstream (See Figure 7 below) where over 300 pilings currently span the river and create a near impassable obstacle for even skilled users. Several stakeholders suggested that the pilings should be removed to reduce overall risk to boaters in this reach. The County has initiated an effort to evaluate the site.

Figure 7. Shows double row of pilings (yellow dots) running across the river 1.5 miles downstream.

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

See responses above (highlighted in gray) which describe modifications made to the design in consideration of public safety.

See response to question #13 regarding the potential piling removal project downstream. While the County does not have funds committed to this piling removal project at this time, the project is under investigation and may be implemented in the future if funding can be secured.

The most effective "mitigation" for an increase in hazards at this site will be to find ways to reduce the number of floaters going by the project site in the future. If successful, such an effort will ultimately reduce the number of potential encounters with wood and reduce the risk of injury. Project team staff is currently working with the local recreational workgroup to determine the best ways to better educate local river users and reduce use of the reach below the Fall City SR 202 bridge. Recommendations from this workgroup have been forwarded to WLRD and KCSO management to determine the best course of action.

15. 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.

Permanent signage will be established at the project site and will be updated regularly to direct boaters around any developing hazards. In addition, signage is also being considered for other locations, depending upon the nature and scope of any developing hazard, including in Fall City and possibly upstream at the primary put-in locations to discourage floaters from using the reach downstream of the bridge. As discussed above, WLRD and KCSO staff is currently working with a local workgroup determine other methods of heightening local awareness of the project and overall river safety and stewardship.

Throughout the design process, updates will be posted on:

- The LWD website at http://www.kingcounty.gov/environment/watersheds/general-information/large-wood/project-list.aspx
- The Upper Carlson Project's website at http://edit.kingcounty.gov/environment/animalsAndPlants/restoration-projects/upper-carlson-floodplain-restoration.aspx

Project Manager — Date: 11/26/13

Supervising Engineer, Project Supervisor or Unit Manager — Date: 11/21/13

III. Post-Construction Actions or Project Modifications

16. 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.

17. In accordance with the requirements of Rule Section V.4., describe post-construction monitoring and inspection activities planned for the project.

18. If post construction monitoring or inspections result in modifications to the project, please describe the action taken and the rationale (See Rule Section V.4.).

Project Manager — Date

Supervising Engineer, Project Supervisor or Unit Manager — Date