North Fork Nooksack River
Maple Creek Reach Phase 1
Restoration Project
Project Implementation Memorandum
SRFB Project No. 19-1395

Prepared for:
Washington Salmon Recovery Funding Board
Recreation and Conservation Office
Olympia, WA

Prepared by:
Nooksack Indian Tribe
Natural Resources Department
Deming, WA

Approved by:
Nic Truscott, P.E.
Natural Systems Design

March 3, 2023
# Table of Contents

I. Introduction ....................................................................................................................... 4  
   A. Purpose ......................................................................................................................... 4  
   B. Project Goals ................................................................................................................. 4  
   C. Habitat Objectives ......................................................................................................... 4  
II. Design ................................................................................................................................. 6  
   A. Structure Design ............................................................................................................ 6  
III. Construction ....................................................................................................................... 8  
   A. INTORDUCTION ............................................................................................................. 8  
   B. Construction Sequencing and Timeline ...................................................................... 11  
   C. Water Management .................................................................................................... 13  
   D. Construction Techniques ............................................................................................ 18  
   E. Post Construction ........................................................................................................ 26  
IV. As-built Condition ............................................................................................................ 26  
   A. Field Fitting.................................................................................................................. 27  
   B. Photo Documentation ................................................................................................. 29  
I. Lessons Learned ............................................................................................................... 29  
V. Appendices ....................................................................................................................... 30  
   A. Appendix A: 100% Design Plans .................................................................................. 30  
   B. Appendix B: Redline Drawings .................................................................................... 30  
   C. Appendix C: As-built Photopoints .............................................................................. 30  
VI. ENGINEER CERTIFICATION ............................................................................................... 31  
VII. REFERENCES ..................................................................................................................... 32
LIST OF FIGURES

FIGURE 1 AS-BUILT ELJ LOCATIONS AND TEMPORARY BRIDGE CROSSING LOCATION .................. 12
FIGURE 2 LOG STRINGER BRIDGE SPAN OVER A SECONDARY BRAID CHANNEL ...................... 13
FIGURE 4 EXAMPLES OF DIVERSION CHANNELS AND ISOLATION AREAS AT MAPLE PHASE 1 ..... 16
FIGURE 5 FISH EXCLUSION FOLLOWING ISOLATION INSTALLATION ........................................... 17
FIGURE 6 UPRIGHT INSTALLATION .............................................................................................. 20
FIGURE 7 HORIZONTAL LOG LAYERING ....................................................................................... 21
FIGURE 8 LOG LASHING AND RACKING BUNDLE PLACEMENT .................................................... 22
FIGURE 9 BALLAST ROCK INSTALLATION ....................................................................................... 23
FIGURE 10 RACKING AND SLASH PLACEMENT ............................................................................ 24
FIGURE 11 TYPE 1 ELJ COMPLETED ............................................................................................... 24
FIGURE 12 TYPE 2 ELJ COMPLETED ............................................................................................... 25
FIGURE 13 TYPE 3 ELJ COMPLETED ............................................................................................... 25
FIGURE 14 FLOOD FENCE COMPLETED ......................................................................................... 25
FIGURE 15 POST-CONSTRUCTION WILLOW STAKE PLANTING .................................................... 26

LIST OF TABLES

TABLE 1. STRUCTURE TYPES AND KEY ELEMENTS AS DESIGNED .................................................. 8
TABLE 2 ADJUSTMENTS MADE TO ACCOMMODATE FIELD FITTING ................................................ 28
I. Introduction

A. Purpose
Nooksack Tribe Natural Resources Department (NNR) is submitting this report to document the implementation of the North Fork Maple Creek Reach (MCR) Phase 1 Restoration Project that was constructed between RM 49.8 and 50.1 in the summer of 2021.

Funding sources for project implementation included:
- Salmon Recovery Funding Board (RCO Grant #19-1395R: NF Nooksack Maple Reach Phase 1 Restoration)
- NRCS Environmental Quality Incentives Program (EQIP)
- NOAA Pacific Coastal Salmon Recovery Fund Fiscal Year 2016 administered through the Northwest Indian Fisheries Commission
- EPA Puget Sound Protection and Restoration: Tribal Implementation Assistance Program funding, Fiscal Years 2017 and 2018, (administered through the Northwest Indian Fisheries Commission
- Bureau of Indian Affairs Endangered Species Act

B. Project Goals
The primary goal of restoration in the NF Maple Creek reach is to address early chinook limiting factors of high channel instability, lack of key habitat, and reduced habitat diversity by restoring habitat conditions and addressing the root causes of habitat degradation, namely the lack of large stable log jams that form and maintain forested islands, floodplain and associated side channels. Restoration is designed to benefit Nooksack early chinook egg-to-emergence and early rearing survival by restoring stable side channels; there will be collateral benefits to other species that use the reach (steelhead, bull trout, coho, chum, sockeye, pink, cutthroat trout). In addition, structure locations and disturbed areas were also replanted through this project. Restoration is designed to benefit Nooksack early chinook adult (holding and spawning life stages), incubation, and juvenile life stages (post-emergence, oversummer, overwinter rearing), although there are collateral benefits to other species that use the reach (steelhead, bull trout, coho, chum, riverine sockeye, and pink salmon (odd- and even-year stocks), as well as cutthroat trout).

C. Habitat Objectives
The project is Phase 1 of the broader Maple Reach Restoration Project, which was designed to affect the following near-term and long-term objectives as quantified in the SRFB proposal:

Construct engineered log jams to: (1) increase length of secondary channels (near-term) and side channels (longer-term) relative to length of mainstem channels by 1,318 ft. after two bankfull discharge events; (2) increase quantity of pools in mainstem and secondary channels (form 6 new pools after two bankfull discharge events); (3) increase habitat unit diversity (# of habitat units) by 25% compared to
baseline conditions after two bankfull discharge events; (4) increase area of complex woody cover engaged with low-flow channel by 6,640 ft² immediately; (5) encourage persistence of tributary habitat in West Fork Maple Creek immediately; (6) increase area of floodplain forest vegetation (floodplain forest, forested islands) with stand age at least 25 years by 12.6 acres within 25 years; and (7) not increase risk of erosion of Glen bluff or risk of flooding to adjacent landowners. This project is expected to lead to measurable improvement in the following habitat indicators: number of pools, number of deep primary pools, area of wood engaged at low flow, number of stable log jams, wetted length of side channels available during spawning and rearing flows, area of floodplain reconnected at 2-year flow, pool frequency, area of floodplain forest, riparian forest stand age, forested island area, and ratio of side channels and braids to main channel.

The following are the refined objectives developed for our hired engineering firm as the basis of the project design:

GEOMORPHIC OBJECTIVES

- Maintain the ability for the channel to migrate in response to watershed changes such as sediment supply and peak flows.
- Promote revegetation of gravel bars to encourage development of mature floodplain forest (including forested islands).
- No increased risk of erosion of Glen bluff and no increased risk of flooding to adjacent landowners
- Reduce constraints on floodplain connectivity (if impaired by levee and lack of in-stream logjams)
- Evaluate (and address as appropriate) riprap constraints on channel migration

HABITAT OBJECTIVES

- Increase extent and age of floodplain forest vegetation (floodplain forest, forested islands)
- Near-term: Increase in secondary channel/main channel ratio (increase in length of secondary channels relative to length of mainstem channels in reach)
- Long-term: Increase in anabranching channel (side-channel) length relative to mainstem/braid channel
- Increase habitat unit diversity (# of habitat units in reach)
- Increase quantity of pools in mainstem and in secondary channels
- Increase in area of complex woody cover instream engaged with low-flow channel and extending through depth of water column
- Encourage persistence of tributary habitat in West Fork Maple Creek
• Balance restoration of natural processes with desire to maintain high use tributary habitat in Maple Creek (i.e. explicitly evaluate impacts of restoration to tributary habitat).

II. Design

The engineered design plan was developed by Natural Systems Design (NSD). Design was initiated in 2018 with Washington State Recreation and Conservation Office (RCO) Grant #16-2051, which resulted in preliminary and 90% design deliverables including a 90% Basis of Design report (NSD 2019). The Basis of design report includes 90% level design drawings for 2 project phases. The design was finalized in the months leading up to construction with funding from RCO Grant #19-1395 including an addendum to the 90% BOD report (NSD 2021). The Maple Reach Phase 1 Restoration Project 100% Design Plan set (Final Design) is provided in Appendix A of this report and the As-Built Design Drawings are provided as Appendix B of this report. A full description of the project design process can be found in the North Fork Nooksack Maple Creek Reach Habitat Restoration Project Basis of Design Report – 90% Design (August 1, 2019) and Phase 1 Final Design Update (May 27, 2021).

The Final Design included 28 ELJ structures and 6 Flood Fence structures strategically located, based on sequential hydraulic modeling, to maximize habitat benefit while minimizing negative flood impacts. Bids for the project came in higher than expected so the project was scaled to 22 ELJ structures and 5 flood fence structures (Appendix B).

The project reach sits within a mapped floodplain area classified as an Approximate Zone A by FEMA. Impacts of project actions on flood water surface elevations (WSEs) are therefore subject to Whatcom County Flood Ordinance requirements within Approximate A Zones. Maximum average WSE rise at any one cross-section is limited to one-foot under these requirements. Additionally, project actions were not allowed to cause a rise at any “insurable structure” (private residences in this case) (Whatcom County River and Flood). The design of the ELJs were modified to minimize backwater effects and limit the rise predicted by the hydraulic model while still meeting the habitat objectives of the project. The software program RiverFLO2D was used to develop a hydraulic model of the North Fork Nooksack River. The maximum water surface rise, averaged across the floodplain, was 0.18 feet and was within the allowable range for FEMA Region 10 (NSD Floodplain Compliance memo 2021).

A. Structure Design

Three ELJ structure types were designed and constructed for this phase of the project (Types 1, 2, 3) along with one flood fence design type; details of these structure types are listed in Table 1. Detailed ELJ-specific channel responses are summarized in the North Fork Nooksack Maple Reach Restoration Basis of Design Report which contains a hydraulic and Geomorphic Memo as an appendix, prepared by NSD (NSD 2021). From the report:

Type 1 ELJ
Type 1 ELJs are the largest proposed structures with a width of approximately 70-feet. Type 1 ELJs are intended to mimic historic stable logjams formed by large old growth trees in terms of their impact on geomorphic and hydraulic function as well as habitat benefit. When Type 1 ELJs interact with the main channel they are intended to form a scour pool on the upstream side of the structure. Type 1 ELJs are placed at locations where an opportunity exists to strategically split flow, increasing the total length of secondary channels within the reach. Type 1 ELJs are also used in strategic locations to promote creation of new and maturation of existing riparian vegetation, particularly on the river-right floodplain on the downstream portion of the reach and near the upstream portion of the project reach. Type 1 ELJs will be excavated into the channel bed and feature a scour apron which extends to anticipated scour depth to provide additional structural stability.

**Type 2 ELJ**

Type 2 ELJs are medium sized at approximately 50-feet wide. Type 2 ELJs will provide similar geomorphic, ecologic, and hydraulic benefits as their larger Type 1 counterparts, at a smaller scale. Type 2 ELJs are used in conjunction with Type 1 ELJs to maximize achievement of habitat and geomorphic objectives by working to support and enhance the benefits from Type 1 ELJs. Type 2 ELJs are often placed downstream of Type 1 ELJs in the anticipated split flow path from the upstream Type 1 ELJ; given this approach to placement, Type 2 ELJs are preferable to Type 1 given their reduced footprint and associated construction cost. Type 2 ELJs are also post-supported and feature a scour apron to achieve structural stability. Similar to Type 1 ELJs, Type 2 ELJs will be excavated into the channel bed.

**Type 3 ELJ**

Type 3 ELJs are smaller ELJs with a width of only 40-feet. They are intended to be used in conjunction with Type 1 or Type 2 ELJs are always placed on the downstream side of these larger structures near the edge of the hydraulic shadow. Type 3 ELJs are used to encourage the formation of preferred flow paths around larger structures and to provide complex instream cover during higher flows. Type 3 ELJs are placed on areas which are currently gravel bars or active floodplain. These ELJs also rely on a combination of vertical rootwad posts and boulder collars to withstand hydraulic forces. A large volume of racking material on the upstream face which is countersunk into the gravel bar/floodplain surface is held in place by two large key members.

**Flood Fence ELJ**

Flood Fence consists of two rows of embedded vertical rootwad posts. The intent of Flood Fence is to essentially tie together two other, larger and more prominent structures, effectively increasing the obstructed area of the larger structures. Two types of Flood Fence were identified for use on this project, differentiated based on their location relative to the current active channel. For Flood Fence which will be constructed within the active channel, a matrix of racking logs will be weaved into the rows of posts; the intent of the racking material is to provide some hydraulic roughness and jumpstart the process of naturally accumulating small racking pieces. Flood Fence constructed outside of the current active channel on the floodplain will be treated with a suite of plantings aimed
at jumpstarting establishment of riparian vegetation. A combination of live willow stakes, live cottonwood poles, and cottonwood nurse logs will be used for this purpose. Posts for Flood Fence will be excavated well below the active gravel bar or floodplain surface for stability.

The location, number and spacing of structures were adjusted during design to maximize habitat objectives while staying within Whatcom County Flood constraints.

Table 1. Structure Types and Key Elements as Designed

<table>
<thead>
<tr>
<th>Structure Types</th>
<th>Width (as designed)</th>
<th>Elevation (as designed)</th>
<th>Quantity</th>
<th>Jam #</th>
<th>Number of Posts</th>
<th>Number of Logs</th>
<th>Number of Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70’</td>
<td>6’ above thalweg elevation</td>
<td>8</td>
<td>1, 2, 3, 5, 7, 9, 18, 21</td>
<td>12</td>
<td>29</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>50’</td>
<td>5’ above thalweg elevation</td>
<td>6</td>
<td>4, 6, 8, 10, 17, 19</td>
<td>10</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>40’</td>
<td>5’ above thalweg elevation</td>
<td>8</td>
<td>11, 12, 13, 14, 15, 16, 20, 22</td>
<td>6</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Flood Fence Low (per 48’ Length)</td>
<td>25’</td>
<td>9’, above thalweg elevation</td>
<td>2</td>
<td>1 to 2, 17 to 18</td>
<td>14</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Flood Fence High</td>
<td>25’</td>
<td>9’ above thalweg elevation</td>
<td>3</td>
<td>2 to 3, 4 to 5, 6 to 7</td>
<td>14</td>
<td>14</td>
<td>1</td>
</tr>
</tbody>
</table>

III. Construction

A. INTRODUCTION

A Watershed Restoration Coordinator is responsible for Construction Oversight while the Engineer is not on site. While some organizations implementing projects choose to outsource the implementation, the NIT has always used in-house staff to implement Habitat Restoration projects. Because NIT has staff that have extensive construction experience and knowledge it is beneficial to have staff oversee construction with support from the engineer. Communication and coordination with staff and engineer is key to successful project implementation. We take the approach outlined by a main funder of our projects, Washington State Recreation and Conservation Office.
From RCO Manual 18:

“Some project sponsors may have extensive construction experience and knowledge, and may perform daily construction supervision. RCO recommends that the sponsor and the engineer agree to share construction supervision responsibilities with mutual confidence required of both entities. The engineer should be confident that the on-site construction inspector will recognize any problems before construction is complete and ensure daily communication between the construction inspector and engineer. The engineer should review and approve substantial changes during construction before implementation.”

During construction the NIT Project Manager coordinates a weekly meeting with key staff from the NIT team, construction contractor, and engineer. There is a standing agenda that covers the following:

- Status update on permits, materials, bridges, and other miscellaneous items
- Updated Schedule
- Submittals/RFI’s
- Safety and Security
- Progress payments
- Communications and Stakeholder Relations Issues
- Open Topics

At the weekly meetings the contractor, restoration coordinator, and engineer reviewed the previous week’s work and inspected any elements to ensure they were built to specifications and to request alterations if needed. The above group also reviewed the schedule for the upcoming week in order to coordinate timing of isolation installation and defishing with Nooksack staff. As issues arose that needed Engineers approval some site visits by the Engineer were conducted at times other than the weekly construction meeting. It was agreed that the engineer would take on oversight of the construction of the first of each type of ELJ (Type 1, 2,3, flood fence) and the restoration coordinator would shadow to make note of how to achieve building to the specifications. The Watershed Restoration Coordinator discussed and made notes to the plans in order to consistently convey what the engineer wanted beyond what is easily shown in the design drawings.

An Engineer or representative visited the site for portions of 8 days during construction and a construction memo was produced with observations and photos. It is understood that any departures from design that possibly impact structure stability require approval by the engineer while those not impacting stability that relate to as-built habitat quality or quantity can be made by the Watershed Restoration Coordinator. Examples of stability related departures include depth of posts, changes to log types within a layer, changes to log position in the layer, changes to lashings, as compared to the typical drawing in the design drawings and/or specifications in the contract. Examples of changes to habitat include the distance logs protrude from the front of the ELJ, additional placement of racking and slash material and
incorporation of on-site woody materials so long as these decisions do not negatively impact ELJ stability.

Other elements of the project that are the responsibility of the Watershed Restoration Coordinator include guidance on clearing limits, road and bridge locations, need for BMPs to protect water quality, locations of stilling basins, and generally assuring the contractor remains in compliance with permit conditions and environmental regulations.

Best Management Practices

Construction in sensitive habitats such as rivers, riparian areas, wetlands, and floodplains require great care and vigilance in order to minimize impacts to the ecosystem. The following are Best Management Practices (BMPs) for construction oversight of ELJ projects. They do not represent all BMPs listed in permits but rather those most frequently encountered and those developed from lessons learned during construction of previous ELJ projects.

Clearing limits should be kept to the minimum needed. Generally, clearing for temporary roads does not need to exceed 12 feet in straight sections and 25 feet on tighter turns. Special attention should always be made for large trees and to avoid disturbing them, when feasible. Also keep an eye out for rare and sensitive habitats and species such as small isolated wetlands. Attempt to salvage any young native conifer from areas prior to disturbance and transplant to areas in the riparian buffer that will not be disturbed. Disturbance to wetlands and their buffers should be avoided.

All grading should be kept to a minimum. The less grading that is done the easier it is to return to the preconstruction grade and compaction required. Grading of banks should be avoided if feasible alternatives exist that are less impactful to the area because they are nearly impossible to reconstruct.

Bridge placement should be prioritized for locations where line of site is maximized to minimize likelihood of harm to river users. Usually there are constraints on feasible crossing locations due to river conditions and the specific area needing to be accessed for construction. The general bridge crossing locations will need to be identified and shared with Washington DNR and DFW for a public safety checklist and minimization of harm to aquatic organisms, respectively. Signage upstream is extremely important to inform river users of construction and low bridges over the water and to guide people to safe areas for portage around them. There should be a minimum of two signs before one would encounter a bridge. Three or four signs are better. The most upstream sign is a warning that there is construction ahead. The next sign should warn of a low bridge over the water and the following sign should tell them to exit now.

Work area isolations should be kept to the minimum size needed to reduce the area of impact to aquatic organisms, especially ESA salmonids. Generally, around 25 feet from the furthest waterward post of the structure is all that should be needed for the half circle arc of the bulk
bag coffer dam. Coffer dam construction can take up to 1 day to construct and defishing can take an hour up to 3 days. Good communication and coordination with the contractor is essential and should help to establish expectations for the project schedule.

Stilling basins should be located far enough from the wetted edge of the river that if turbid water leaches out it will not run into the river. Have the contractor use areas that area already disturbed and an excavated pit is left from post installation and use small ditches to connect to other pits to create a series of small basins. Avoid allowing the contractor to clear vegetation to construct the basin and instead build on open gravel and cobble bars.

### B. Construction Sequencing and Timeline

Construction of the Maple Creek Reach Phase 1 Project took place on the North Fork Nooksack River from July 12th – September 15th, 2021. Log deliveries began in late April 2021 to the upland staging area on WLT property. Project personnel included Eric Stover as Project Manager Nooksack Indian Tribe, Nic Truscott as Project Manager and Principle Engineer Natural Systems Design, Jerry Curtis as Foreman Strider Construction. Equipment used included two 450 excavators, one 300 excavator, one 200 excavator, one off road dump truck, and one front loader.

The sequence of construction activities included establishing temporary access routes; installing temporary bridges and crossings and water management and work area isolation features; fish exclusion and rescue; excavating and embedding uprights; placing layer log layers, ballast rock, and racking and slash; lashing uprights and logs together; backfilling the structures; and planting disturbed areas.

One multi-span and multi-channel bridge was installed to access ELJ locations on the left (south) bank of the project site (Figure 1). The bridge to the south side of the river was established early in the project and was removed as soon as construction on that side of the river was completed. Construction of all ELJs on the south side of the river were prioritized so as to have the bridge in for as little time as possible to minimize risk to river users. The temporary bridges consisted of 30-40’ logs cabled together to create a log stringer bridge. Logs were laid perpendicular to the bridge deck logs directly on channel bed as abutments and mid span supports between span sections (Figure 2).
ELJ structures were constructed such that structures within 50 ft. of the wetted channel were scheduled for completion prior to the fish window closing for in-water work completed before the permitted expiration date of August 15th for the Hydraulic Permit Approval from Washington State Department of Fish and Wildlife. ELJ structures more than 50 ft. from the wetted channel were completed next and before the September 30th expiration date for this permit. Dates of work for a specific structure can be found on the project timeline (Figure 3).
Figure 2 Flat rack bridges span over a secondary braid channel (top) and the mainstem (bottom)

C. Water Management
Water management was a major component of the Maple Creek Reach Phase 1 Project. Close to 1/3 of the ELJ’s (7 of 22) were constructed within the low flow channel or floodplain tributary channel, requiring coffer dams and in some cases diversion channels and all requiring fish removal. Additionally, all Type 1 and Type 2 ELJs required water management due to the depth of the first log layers in relation to the groundwater table. The excavated pit had to have the water pumped out so the logs would not float and could be secured at the design elevation. The pumped water had to be kept away from all surface water and was pumped into receiving basins excavated in dry cobble/gravel bar areas of the active channel for infiltration into the groundwater table. All but 5 Type 3 ELJs and 4 flood fences required water management for a total of 19 ELJs and 1 flood fence out of the 22 ELJs and 5 flood fences constructed as part of phase 1.

Isolation techniques included placement of bulk bags to create coffer dams, to isolate the construction area from active flow, and diversion channels where sections of entire channel needed to be isolated. This was the first time NNR and Strider had worked together so there was a lot of support needed from NNR to inform isolation and diversion channels to minimize impacts to aquatic life including water quality (See lessons learned section). Adaptive management is necessary to account for changes in river flow and the groundwater table. The first isolation areas were installed on July 21st at ELJs 3-15 and 3-16 (Figure 4). The Nooksack Tribe has utilized bulk bags in previous projects and there are challenges with coffer dams as a water management tool. Shallow wetted channel depth and groundwater flow in side channels was especially difficult to manage for both dewatering and turbidity impacts. Pumping was required on most ELJ structures, which tends to start to dewater the channel adjacent including the established diversion channel around the isolation (Figure 4).

Turbidity was measured to comply with requirements of the Programmatic Biological Assessment Restoration Actions in Washington State, General Conservation Measures, Isolation of Work Site. Turbidity was measured 300 feet downstream of the construction zone during in-water work, within the distances identified in the WA Department of Ecology Surface Water Quality Standards, Part II Designated Uses and Criteria, Turbidity Protocol for the amount of discharge.

A detailed Fish Exclusion and Turbidity Monitoring Report describing the techniques implemented for each isolation area, results of the fish exclusion efforts performed by NNR staff, and the turbidity monitoring will be available as a separate report. Figure 4 shows examples of diversion channels excavated and work area isolation areas during construction and Figure 5 shows photos of the fish exclusion efforts performed by NNR fisheries staff.

The bulk bags were large sacks made of flexible fabric that were filled with sand and gravel from bars adjacent to the river. Each bag could accommodate up to 3000lbs. It took a minimum of two people to fill each bag: one person operating the excavator to fill it up and one or two to hold up the sides. Installation involved placing them directly on top of polyethylene plastic sheeting on the river bottom adjacent to each other and then wrapping
the fabric over the entire chain of bulk bags and placing standard sand bags or cobbles on top to hold the plastic sheet in place. The polyethylene plastic sheet wrap was used in an attempt to increase the “seal” and reduce the infiltration of water via the small gaps between each bulk bag, thereby increasing the effectiveness of the isolation. This process was difficult to maintain, as there often seemed to be several gaps between sections of fabric that allowed water to infiltrate.
Figure 3 Examples of Diversion channels and isolation areas at Maple Phase 1
Figure 4 Fish exclusion following isolation installation
After the sites at ELJs were isolated, fisheries crews removed all fish possible prior to construction by seining the area multiple times, followed by capturing fish using a backpack electrofisher. Fish exclusion activities and data have been documented in a Nooksack Indian Tribe report (NIT 2021), which can be provided upon request. In an effort to reduce the duration of turbidity impacts, a gravel berm was placed inside the isolation after defishing.

Turbidity was also measured in order to comply with requirements of the Programmatic Biological Assessment Restoration Actions in Washington State, General Conservation Measures, Isolation of Work Site. Turbidity was measured 300 feet downstream of the construction zone, within the distances identified in the WA Department of Ecology Surface Water Quality Standards, Part II Designated Uses and Criteria, Turbidity protocol for the amount of discharge. A Turbidity Report has been prepared by the Nooksack Indian Tribe and can be provided upon request.

D. Construction Techniques
The techniques used by the contractor to build ELJs is well established. The general sequence is as follows:

1. Engineer stakes two control post locations for each ELJ that establishes the location and orientation of the structure relative to the valley, flood flow, and current wetted channel position.
2. Contractor stakes remaining post locations and establishes offsets.
3. Contractor excavates to design depth to install posts and backfills so the post stays in place.
4. Backfill to the design depth of the first layer logs.
5. Pump water from excavation pit into stilling basin.
6. Install layer logs, lashings, slash, and racking as specified in the layering plan.
7. Backfill to the grade specified.
8. Cut posts to just above design grade and add cut ends to front of ELJ as additional racking.
9. Remove work area isolation (if necessary).
10. Reintroduce flow to the area and remove diversion channel (if necessary).

Any changes made to structure location and/or orientation during the staking process were recorded in the field and are summarized in the Record drawings (Appendix B) and Table 2 in the As-Built Conditions section of this report. Upright logs were 22-26-inch diameter at breast height (DBH), 30-feet long Douglas fir logs with rootwads attached. The depths the uprights were installed to were established before construction in the Final Design. All uprights were installed 15-feet below thalweg elevation of the channel cross section crossing through the front of the ELJ. This resulted in upright depths ranging from 15-23.6’ below existing grade. Any deviations from the specified upright depth are captured in the As-built drawings Table 2.

The log layering consisted of racking bundles (Type 1 and 2 ELJs), rootwad and non-rootwad logs of various lengths placed with an excavator and woven among the uprights (Figures 7 and 8). Layer logs were lashed with chain and bound with chain binders welded closed that were placed at strategic locations to pin all layer logs down and increase structure strength to meet stability goals. Layer logs were lashed to an adjacent upright log; logs that were not individually lashed were always “sandwiched” between a top and bottom layer that were lashed. Once the lashings were tight and secure around each upright log, crews would then use chain binders to secure the lashings in place (Figure 8). Ballast rocks with pre-drilled holes were chained and paired together in advance and were draped over the horizontal logs in layer 3 of Type 3 ELJs (Figure 9). The remaining log layers were constructed following the Layering Plan in the Final Design for the specific structure type, which included the placement of slash and racking between designated layers (Figure 10).
Figure 5 Upright installation
Figure 6 Horizontal log layering
Figure 7 Log lashing and racking bundle placement
Figure 8 Ballast rock installation
Figures 11-14 show examples of each structure type backfilled and completed. The alluvium provides a medium to allow for willow and cottonwood staking and planting of native conifers on the ELJ’s and around the construction vegetation disturbance areas. Willow and cottonwood stakes are harvested from trees on-site, while some young conifers are harvested from the site before clearing and others are bareroot stock sourced from a local nursery.
Figure 11 Type 2 ELJ completed

Figure 12 Type 3 ELJ completed

Figure 13 Flood fence completed
E. Post Construction

Post-construction activities included removing temporary access bridges, clean-up of unused materials, decommissioning cobble bar access roads and planting select structures and previously vegetated disturbed areas. Extra materials such as chain, rope, and trash were removed upon completion. Access roads along the cobble bars were decommissioned by using the excavator bucket to “roughen” up and decompact the compressed alluvium in areas where access would not be needed for Phase 2. Any extra logs or racking were placed over the lower main access road and in the staging area to help prevent recreational vehicle use. Planting the structures and disturbed areas (Figure 15), surveying as-built ELJ locations, drone aerial acquisition, and photo-point establishment proceeded after construction.

Figure 14 Post-construction willow stake planting

IV. As-built Condition

The Maple Creek Reach Phase 1 Project was constructed following the Final Plans, with some field fitting and on-site design changes made with the Engineer’s approval. The majority of as-built documentation is contained in Appendices A, B, and C.
A. Field Fitting

Field fitting was documented by the NSD PM/PE and the NNR PM who was onsite daily. If design and engineering questions or changes arose while NSD staff were not onsite, the NNR PM would discuss it with the NSD PM/PE and secure the PM/PE’s approval for any departures. Construction checklists were used by the NNR PM to guide construction oversight and ensure compliance with the Final Design specifications. All design changes or field fitting that occurred during construction, including reasons for adjustments, and as-built documentation are summarized in Table 2. Appendix B includes NSD’s as-built (record drawings) that identify structures that were moved from their original Final Design location. All changes or additions to the Design Plans are shown in red. Appendix B sheet 5 shows the original Final Design structure locations overlaid with the as-built structure locations. The as-built locations for the structure locations were taken using a Trimble RTK GPS unit for the control upright points and average ELJ elevation was taken in the center of the ELJ between the first and second row of uprights. These as-built control locations were used in AutoCAD to adjust locations and orientations of ELJs compared to the locations and orientations depicted in the final design plans and to update the tables “ELJ Structure Schedule” for each ELJ Type with as-built reference elevation, existing elevation, and depth to post embedment. The depth to post embedment is what was required after survey of reference elevation (thalweg elevation at channel cross section) and existing elevation (existing grade at ELJ center). It is not actual surveyed post embedment. Not depicted are any variances in backfill extent or footprint as the typical CAD line work for each ELJ Type was used. Overall, field changes made meet the original intent of the structure function and stability within the normal variance expected during large river construction projects and fall well within the engineered factor of safety and the Tribe’s restoration goals. Table 2 documents the field fitting that occurred on the project.
### Table 2 Adjustments made to accommodate field fitting

<table>
<thead>
<tr>
<th>Type of change</th>
<th>Structure Type</th>
<th>Original Specification</th>
<th>ELJ#</th>
<th>Changes Made</th>
<th>Other Notes</th>
<th>Implications as a Result of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes to Post Depth</td>
<td>Type 1, 2, 3</td>
<td>Install posts to depth Shown on Structure Schedule (Updated and supplied to contractor)</td>
<td>1-2-2-6, 1-7, 1-9, 3-20</td>
<td>Post was not excavated to depth specified in updated depth table.</td>
<td>1-9 upright 11 &quot;not to depth due to large boulder, unable to move&quot;; 1-2 upright 8 &quot;not to depth due to very large boulder, unable to move&quot;; 3-20 upright 5 not to depth &quot;huge root&quot;; 2-6 upright 6 &quot;not to depth large boulder&quot;; 1-7 upright 10 12&quot; high due to boulder.</td>
<td>Stability: Decrease, Habitat Function: No Change</td>
</tr>
<tr>
<td>Changes to Post Location</td>
<td>Type 1, 2, 3, FF</td>
<td>Install posts at location staked by Engineer and Strider</td>
<td>All</td>
<td>Post was not excavated at location specified in plans</td>
<td>Some posts were not spaced as shown in the dimension plans for that ELJ Type. Placement of all layer logs were uninhibited by the slight changes. Changes were not quantified as measurement would be very difficult in an open pit with groundwater.</td>
<td>Stability: No change, Habitat Function: No Change</td>
</tr>
<tr>
<td>Changes to Chain Lashing</td>
<td>Type 2</td>
<td>Lash structures as shown on Sheet 17 ELJ Details Chain Lashing 1/17 and as shown on layering plan (sheets 11 and 12)</td>
<td>2-4, 2-6, 2-8, 2-10, 2-17, 2-19</td>
<td>Engineer approved using 2 chain lashings on layer 3 and 4 rather than 6 lashings on layer 7.</td>
<td>All Type 2 ELJs had lashing added to layer 3 D-3 log connection to Posts 1 and 2 and deletion of lashing on layer 7 D-5 logs at Posts 4 and 8. This exchange of lashings from layer 3 to layer 7 helped with constructability to overcome buoyancy of lower layer logs and racking bundles in layers 1 to 3.</td>
<td>Stability: No change, Habitat Function: No Change</td>
</tr>
<tr>
<td>Changes to Structure Locations</td>
<td>Type 1, 2, 3, FF</td>
<td>Build structures at locations shown on Site Plan (Sheet 5) and as described in control data (Sheets 6, 10, 14, 16)</td>
<td>2-6, 1-7, 2-6, 1-9, 2-10, 3-12, 3-14, 3-16, 2-19, 3-20, 3-22</td>
<td>Structures were moved compared to location shown on 100% Design Drawings</td>
<td>Structure locations were field fit during Engineer staking of control locations. Reasons for field fitting included: better align with existing low flow channel location, avoidance of constructing in wetland, to reduce need for or size of isolation area, and for groups of ELJs to maintain original function.</td>
<td>Stability: No change, Habitat Function: Depending on ELI either increased or decreased as-built function do to change in connectivity to low flow channel</td>
</tr>
<tr>
<td>Changes to Structure Height</td>
<td>Type 1, 2, 3</td>
<td>Build structures to the depth shown on Structure Schedule (Sheets 6, 10, 14, 16)</td>
<td>Deeper: 1-1, 1-5, 2-6, 1-7, 1-9, 2-10, 3-11, 3-12, 3-13, 3-14, 3-15, 1-18, 1-21 Shallower: 1-2, 2-8, 2-17, 2-19, 3-20</td>
<td>Fourteen structures were built higher and six were built lower compared to heights shown on 100% Design Drawings</td>
<td>Comparing As-built top log height above ground with the same in the 100% Drawings yields the differences in height. There are 3 reasons this could vary: 1. excavation was deeper or shallower; 2. The volume of woody materials used were higher or lower than specified; 3. A combination of reasons 1 and 2.</td>
<td>Stability: Possibly more stable with reduced forces impinging on the structure that could destabilize it or less stable with increased forces. Habitat Function: Potentially less hydraulic influence on geomorphic response until bed adjusts resulting in reduced/slower habitat formation.</td>
</tr>
</tbody>
</table>
B. Photo Documentation

Photo points were established during and post construction (Appendix C). Photo points will allow the Nooksack Tribe to monitor the structural integrity and effectiveness of the ELJ structures and also the survival of the trees and shrubs planted post-construction. Photo points have been labeled using the MAPLE_PP00 format. Each photo point has been GPS’d in the field. Photos will be taken at each photo point every year for the first five years and thereafter, as site conditions, access, time, and resources permit. Appendix C includes an aerial map showing the photo point locations, a detailed photo point spreadsheet, and photos from each photo point established.

I. Lessons Learned

The Maple Creek Reach is a challenging reach in which to design and plan restoration projects, given the channel’s ability to shift during design. Much like past North Fork projects in unconfined and braided reaches, we have had to adapt our approach to the design process by waiting until after the winter flood season to finalize the design and plan access routes and crossings. This delay puts the project in a time crunch to get the project permitted and out to bid for logs and construction in a short window.

Key lessons learned during the Phase 1 project implementation include:

- Vigilance to bait-and-switch tactics by contractors and subcontractors in regard to division of labor and equipment, and assigned Project Manager specified in bids. Violation of contract terms/ WSDOT Standard Spec is difficult to enforce during construction.
- Due to supply chain issues, hardware was made the contractor’s responsibility and this helped alleviate some of the stress during the lead up to construction.
- Vetting ELJ locations with the biologist responsible for defishing in the field prior to finalizing design continues to be critical to ensure ELJ’s are constructible in the designed locations and to ensure water management is feasible.
- Ensuring logs are delivered on-site prior to construction continues to be a hurdle. For this project, the log contractor strongly advocated for log deliveries closer to where they were needed for ELJ construction. Ensuring there is ample space for log deliveries is critical.
- Clear division of roles and responsibilities by NNR staff working on the project need to be made before construction is underway, i.e. establishing individual leads for log inventory, isolation construction oversight, turbidity monitoring, water management but deferring to NNR PM for final say, etc. Communications to the contractor should go through the NNR PM unless clearly delegated.
- Having a contractor who is flexible and prioritizes communication with NNR staff is critical. NNR had never worked with Strider but had worked with their subcontractor Harkness Inc. Having rapport between the superintendent and the NNR PM and having a past working relationship with the contractor is invaluable during construction, since there are so many moving variables and thus a need to be open to adaptation and collaborative problem-solving.
V. Appendices

A. Appendix A: 100% Design Plans
B. Appendix B: Redline Drawings
C. Appendix C: As-built Photopoints
VI. ENGINEER CERTIFICATION
I certify that I have read and do hereby approve that Section IV of this report is accurate of as-built conditions.

Nic Truscott, P.E., Natural Systems Design
Date
VII. REFERENCES


1. All logs, racking material and slash material has been provided by the contracting agency and is staged at the project site.
2. Carefully handle, transport, and stage provided woody material for ELJ construction. Any woody material damaged as a direct result of contractor actions shall be replaced in-kind at no additional cost to the contracting agency.
3. The contractor shall place logs as illustrated on this sheet unless directed otherwise by the contracting officer.
4. Retention logs to be placed to pin racking material in place at the discretion of the contracting officer.
5. Connect logs by chain lashing where indicated on the drawings. See details.
6. Excavate as necessary to construct the scour pool to the depth shown on this sheet. Clearly stake or otherwise mark the limits of the scour pool for review prior to any excavation for ELJ construction. Excavation allowed to be placed behind the structure as directed by the contracting officer.
7. Construct at least one full racking bundle using contracting agency supplied racking material for use in structure. See section 6-20.21 of the special provisions for more information.
8. Existing woody material at the structure construction site shall be moved or protected from construction activities and then incorporated into the structure as directed by the contracting officer.

### TYPE 1 ELJ STRUCTURE SCHEDULE

<table>
<thead>
<tr>
<th>ELJ</th>
<th>1-1</th>
<th>1-2</th>
<th>1-3</th>
<th>1-5</th>
<th>1-7</th>
<th>1-9</th>
<th>1-18</th>
<th>1-21</th>
<th>1-25</th>
<th>1-26</th>
<th>1-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCE ELEVATION</td>
<td>507.5</td>
<td>505.0</td>
<td>502.0</td>
<td>510.0</td>
<td>513.9</td>
<td>513.9</td>
<td>515.5</td>
<td>515.5</td>
<td>517.0</td>
<td>517.0</td>
<td>517.0</td>
</tr>
<tr>
<td>ELECTRIC ELEVATION</td>
<td>509.9</td>
<td>514.3</td>
<td>516.0</td>
<td>513.8</td>
<td>517.6</td>
<td>517.6</td>
<td>520.3</td>
<td>535.8</td>
<td>535.0</td>
<td>537.7</td>
<td>517.6</td>
</tr>
<tr>
<td>DEPTH TO POST EMBEDMENT (FT)</td>
<td>16.4</td>
<td>21.3</td>
<td>21.0</td>
<td>17.8</td>
<td>16.7</td>
<td>16.1</td>
<td>19.7</td>
<td>22.3</td>
<td>21.0</td>
<td>20.7</td>
<td>16.3</td>
</tr>
</tbody>
</table>

* Existing elevations determined by grading composite surface generated in 2018. Actual existing elevations to be verified in the field by engineer (expected to be 4-16 ft. of reported values in plans)

### TYPE 1 ELJ MATERIALS SCHEDULE

<table>
<thead>
<tr>
<th>LOG ID</th>
<th>SHA</th>
<th>LENGTH (INCHES)</th>
<th>FOOTING (Y/N)</th>
<th>QUANTITY PER STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-2</td>
<td>28-22</td>
<td>30</td>
<td>Y</td>
<td>12</td>
</tr>
<tr>
<td>M-4</td>
<td>28-22</td>
<td>40</td>
<td>Y</td>
<td>4</td>
</tr>
<tr>
<td>C-6</td>
<td>18-22</td>
<td>40</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>C-4</td>
<td>18-22</td>
<td>40</td>
<td>N</td>
<td>8</td>
</tr>
<tr>
<td>M-2</td>
<td>18-22</td>
<td>40</td>
<td>N</td>
<td>9</td>
</tr>
<tr>
<td>M-4</td>
<td>18-22</td>
<td>40</td>
<td>N</td>
<td>9</td>
</tr>
<tr>
<td>CHAIN</td>
<td>M-4</td>
<td>18-22</td>
<td>40</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACKING</td>
<td>48 x 73</td>
</tr>
<tr>
<td>SPLICE</td>
<td>6 x 12</td>
</tr>
<tr>
<td>SASH</td>
<td>&lt;8</td>
</tr>
</tbody>
</table>

NOTES:

- All logs, racking material, and slash material has been provided by the contracting agency and is staged at the project site.
- Carefully handle, transport, and stage provided woody material for ELJ construction. Any woody material damaged as a direct result of contractor actions shall be replaced in-kind at no additional cost to the contracting agency.
- The contractor shall place logs as illustrated on this sheet unless directed otherwise by the contracting officer.
- Retention logs to be placed to pin racking material in place at the discretion of the contracting officer.
- Connect logs by chain lashing where indicated on the drawings. See details.
- Excavate as necessary to construct the scour pool to the depth shown on this sheet. Clearly stake or otherwise mark the limits of the scour pool for review prior to any excavation for ELJ construction. Excavation allowed to be placed behind the structure as directed by the contracting officer.
- Construct at least one full racking bundle using contracting agency supplied racking material for use in structure. See section 6-20.21 of the special provisions for more information.
- Existing woody material at the structure construction site shall be moved or protected from construction activities and then incorporated into the structure as directed by the contracting officer.

**NOTE:** Only half of backfill shown for clarity.
1. Excavate scour pool, stockpile excavated material to be used as backfill on downstream side of structure.
2. Excavate 1 vertical post excavation and install posts. Backfill posts to elevation as bottom of scour pool.
3. Excavate trenches for 3 racing bundles.
4. Backfill posts to top of racing bundle.

1. Place random racing in scour pool in front of racing bundles.
2. Trench and place 2 0-3 logs. Tops of logs shall be equal with tops of racing bundles. Install 1 chain lashing per log as shown.
3. Excavate and place 4 3-6 logs and 2 8-10 restraints extending over the racing bundles and racing.

1. Place random racing in scour pool in front of racing bundles.
2. Place 2 0-3 logs.
3. Place 1 3-6 and 1 5-8 log on top of previous logs.
4. Chain lash at 2 locations.
5. Backfill area downstream of scour pool, so it is at reference elevation.
1. Place random racking in front of structure.
2. Place 2 0-3 logs.
3. Place 2 2D-3 logs, excavate as necessary to embed tips.
4. Place 2 2D-4 logs and 2 2D-5 footbridges.
5. Chain lash at 4 locations.

1. Reduce and place 2 2D-5 footbridges as upstream retention logs. Place 2 in random racking. Barkfill after installation.
2. Barkfill excess material on top of structure on downstream side.
3. Sawcut post tops.

MAPLE CREEK REACH HABITAT RESTORATION PROJECT
TYPE 1 ELJ POST DIMENSIONING PLAN
1. Excavate scour pool. Stockpile excavated material to be used as backfill on downstream side of structure.
2. Excavate 3 vertical post locations and install posts.
3. Backfill posts to the same elevation as bottom of scour pool.
4. Excavate trenches for 3 racking bundles. Place racking bundles.
5. Backfill posts to top of racking bundles.

1. Trench and place 1 D=3 log. Top of log shall be equal with tops of racking bundles. Backfill to top of log.
2. Place 2 D=1 logs, nesting on top of racking bundles.
3. Place random racking in scour pool.

1. Place 4 D=3 logs.
2. Place random racking.
3. Place 2 D=5 footpool logs.
NOTES
1. ALL LOGS, RACKING MATERIAL, AND SLASHER MATERIAL HAS BEEN PROVIDED BY THE CONTRACTING AGENCY AND IS STAGED AT THE PROJECT SITE.
2. CARRIERS MUSE TRANSPORT AND STAGE PROVIDED WOOD MATERIAL FOR ELJ CONSTRUCTION. ANY WOOD MATERIAL Dangerous AS A RESULT OF CONTRACTOR ACTIONS SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO THE CONTRACTING AGENCY.
3. THE CONTRACTOR SHALL PLACE LOGS AS ILLUSTRATED ON THIS SHEET UNLESS DIRECTED OTHERWISE BY THE CONTRACTING OFFICER.
4. RETENTION LOGS TO BE PLACED TO PIN RACKING MATERIAL IN PLACE AT THE DIRECTION OF THE CONTRACTING OFFICER.
5. CONNECT LOGS BY CHAIN LASHING WHERE INDICATED ON THE DRAWINGS SEE DETAILS.
6. EXCAVATE AS NECESSARY TO CONSTRUCT THE PIT FOR RACKING MATERIAL TO THE DEPTH SHOWN ON THIS SHEET. EXCAVATED ALLUVIUM TO BE PLACED BEHIND THE STRUCTURE AS DIRECTED BY THE CONTRACTING OFFICER.
7. EXISTING WOOD MATERIAL AT THE STRUCTURE CONSTRUCTION SITE SHALL BE MOVED OR PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AS DIRECTED BY THE CONTRACTING OFFICER.

TYPE 3 ELJ MATERIALS SCHEDULE

<table>
<thead>
<tr>
<th>LOG ID</th>
<th>DIA (INCHES)</th>
<th>LENGTH (FEET)</th>
<th>ROOTWAD (Y/N)</th>
<th>QUANTITY PER STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-6</td>
<td>18-22</td>
<td>60</td>
<td>Y</td>
<td>6</td>
</tr>
<tr>
<td>10-5</td>
<td>18-22</td>
<td>30</td>
<td>Y</td>
<td>2</td>
</tr>
<tr>
<td>RACKING</td>
<td>6-12</td>
<td>30-60</td>
<td>Y/N</td>
<td>100 EA</td>
</tr>
<tr>
<td>SLASH</td>
<td>.6</td>
<td>&lt;30</td>
<td>N</td>
<td>30.02</td>
</tr>
<tr>
<td>ROCK COLLAR</td>
<td>35</td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

TYPE 3 ELJ STRUCTURE SCHEDULE

<table>
<thead>
<tr>
<th>ELJ</th>
<th>3-11</th>
<th>3-12</th>
<th>3-13</th>
<th>3-14</th>
<th>3-15</th>
<th>3-16</th>
<th>3-17</th>
<th>3-20</th>
<th>3-22</th>
<th>3-23</th>
<th>3-24</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEV</td>
<td>514.0</td>
<td>513.5</td>
<td>513.5</td>
<td>514.0</td>
<td>514.5</td>
<td>514.0</td>
<td>514.5</td>
<td>514.5</td>
<td>514.5</td>
<td>514.5</td>
<td>514.5</td>
</tr>
</tbody>
</table>

ELEVATION ELEVATION: 517.7, 516.0, 515.5, 514.5, 514.0, 522.6, 523.8, 523.6, 523.6

EXISTING STRUCTURES IDENTIFIED BY QUANTIFYING CORRESPONDING SURFACE DEPOSITS. ACTUAL EXISTING ELEVATIONS TO BE VERIFIED IN THE FIELD BY ENGINEER (EXPECTED TO BE 4'-10" FT OF REPORTED VALUES IN TABLE)

TYPE 3 ELJ DETAILS
LAYER 0
1. PLACE 6 RB-3 VERTICAL POSTS.
2. EXCAVATE PIT. USE EXCESS MATERIAL AS BACKFILL ON TOP OF STRUCTURE.

LAYER 1
1. PLACE 1 RE-3 FOOTING.
2. PLACE RACKING AND SLASH, PLACE RACKING AND SLASH AT EACH SUBSEQUENT LAYER.

LAYER 2
1. PLACE RACKING AND SLASH.
2. PLACE 1 RE-3 FOOTING.

LAYER 3
1. PLACE 1 RE-3 FOOTING.
2. PLACE 6 RIDE COLLARS.
3. PLACE RACKING AND SLASH.

LAYER 4
1. EXCAVATE AND PLACE 2 RB-4 FOOTINGS AS UPSTREAM RETENTION.
2. PLACE TO FIN RACKING, BACKFILL AFTER INSTALLATION.
3. BACKFILL EXCESS MATERIAL ON TOP OF STRUCTURE.
4. SAWCUT POST TOPS.

POST DIMENSIONING PLAN
SCALE: 1" = 10'
NOTES FOR TEMPOARY BAR ACCESS
1. BAR ACCESS TO BE ROUTED TO MINIMIZE VEGETATION DISTURBANCE.
2. CONTRACTOR SHALL PROVIDE SUBMITTAL OF PROPOSED BAR ACCESS FOR APPROVAL BY ENGINEER.
3. EQUIPMENT SHALL OPERATE ONLY WITHIN SHARED BAR ACCESS AREA OR OTHER DEFINED PROJECT AREAS.
4. AVOID SNOWS AND DIAPHRAGMS WHENEVER POSSIBLE; NEVER CUT SNOW OR DIAPHRAGMS.
5. BAR ACCESS SHALL BE DECOMPACTED TO 10 INCH DEPTH AT TERMINATION OF WORK.

TEMPORARY BAR ACCESS
SCALE 1:50

NOTES FOR TEMPORARY CLEARED ACCESS
1. CLEARED ACCESS TO BE ROUTED TO MINIMIZE VEGETATION DISTURBANCE AND FOREST CLEARING.
2. OWNER SHALL MARK CLEARING LIMITS WITH PLOWING. CLEARING LIMITS TO BE APPROVED BY OWNER PRIOR TO ANY CLEARING ACTIVITIES.
3. REMOVAL OF VEGETATION AND ORGANIC SOIL SHALL BE CROSSED, STOCKPILED, AND DISPOSED OF ON ROAD AVERAGE FOLLOWING TERMINATION OF WORK.
4. ACCESS SHALL BE MAINTAINED BY MINOR GRADING AND IMPORTATION OF WOOD CHIPS OR SOIL.
5. CLEARED ACCESS SHALL BE SCRAPPED AND DECONSTRUCTED TO PREVENT FUTURE ACCESS AT THE TERMINATION OF WORK.

TEMPORARY CLEARED ACCESS
SCALE 1:50

COFFERDAM
SCALE 1:50

NOTES FOR COFFERDAM
1. WRAP SACKS WITH IMPERMEABLE PLASTIC TO PREVENT SEEPAGE.
2. BACIFILM THE INTERIOR WITH COFFER DAM WITH NAVY, ADJACENT VITAMIN.
3. USE SACKS AS BREATHERS AS REQUIRED.
MAPLE CREEK REACH
HABITAT RESTORATION PROJECT
NOOKSACK INDIAN TRIBE

STATE OF WASHINGTON
SCALE 1: 50 MILES

RECORD DRAWINGS
THE MAPS/PLOTS INCLUDED IN THIS SET OF RECORD DRAWINGS ARE INTENDED TO CAPTURE THE GENERAL NATURE OF FIELD OBSERVATIONS AND MODIFICATIONS MADE DURING CONSTRUCTION DUE TO SITE CONDITIONS OR ISSUES WITH CONSTRUCTION. CHANGES MADE TO THE DESIGN ARE INCLUDED HEREIN AS SHOWN TO THE FINAL DESIGN PLAN SHEETS. ONLY THOSE ELEMENTS WHICH ARE NEEDED TO PERMIT KNOWLEDGE OF CONTRACTED CHANGES HAVE BEEN INCLUDED.
GENERAL NOTES

1. THESE PLANS HAVE BEEN PREPARED FOR THE EXCLUSIVE USE OF THE NOCKEEN RESERVOIR IMPLEMENTATION TEAM AS ORDERED AND AUTHORIZED by the Owner. All original plans shall be returned to the Contractor upon completion of the work. The Contractor shall not reproduce or copy the plans without express written permission of the Owner. The Contract Office shall be on-site during construction and shall be responsible for the accuracy of the construction of the Contract documents. The Owner and the Contractor.

2. NATURAL SYSTEMS DESIGN (hereafter referred to as "DESIGN ENGINEER") is responsible for preparing all applicable natural systems design documents, and all work, including but not limited to, natural systems design work, shall be performed by DESIGN ENGINEER. Any other unauthorized use of this document is prohibited.

3. WORK MODIFICATIONS ARE EXPECTED TO BE SUBMITTED AS ADDENDUMS TO THE EXISTING DOCUMENTS. SUCH MODIFICATIONS ARE TO BE SUBMITTED TO THE CONTRACTING OFFICE, WHEREVER POSSIBLE, AND ONLY IN THAT ORDER. THE MODIFICATIONS MUST BE AGREED TO IN WRITING AND NOTIFIED IMMEDIATELY.

4. THE LOCATION OF ALL UTILITIES SHOWN IS APPROXIMATE.

5. THE CONTRACTOR IS TO ASSUME PRIMARY RESPONSIBILITY FOR SUBMITTING COMPLETE INFORMATION TO THE CITY OF AUBURN-ALOPA FOR ALL THE PLANNED, CONSTRUCTION ACTIVITIES, AND TO CONFORM WITH ALL CITY REQUIREMENTS, STANDARDS, AND REGULATIONS. THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR ANY ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

6. ALL MODIFICATIONS TO THE CONTRACT OR SPECIFICATIONS SHALL BE LOCATED ON THIS DOCUMENT. THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR ALL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

7. THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR ALL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

8. THE CONTRACTOR IS RESPONSIBLE FOR REPRODUCING THE CONTRACT DOCUMENTS AND FOR ALLОРMENTS TO THE CONTRACT DOCUMENTS.

9. PROPOSED MODIFICATIONS AND CHANGES TO THE CONTRACT DOCUMENTS ARE TO BE SUBMITTED TO THE CONTRACTING OFFICE, WHEREVER POSSIBLE, AND ONLY IN THAT ORDER. THE MODIFICATIONS MUST BE AGREED TO IN WRITING AND NOTIFIED IMMEDIATELY.

10. THE CONTRACTOR IS TO SUBMIT A COMPLIANCE CERTIFICATE TO THE CONTRACTING OFFICE, WHEREVER POSSIBLE, AND ONLY IN THAT ORDER. THE MODIFICATIONS MUST BE AGREED TO IN WRITING AND NOTIFIED IMMEDIATELY.

11. THE CONTRACTOR IS TO SUBMIT A COMPLIANCE CERTIFICATE TO THE CONTRACTING OFFICE, WHEREVER POSSIBLE, AND ONLY IN THAT ORDER. THE MODIFICATIONS MUST BE AGREED TO IN WRITING AND NOTIFIED IMMEDIATELY.

CONSTRUCTION NOTES

1. CONTRACT DOCUMENTS REFER TO ALL DOCUMENTS INCLUDED IN THIS PACKAGE, INCLUDING THESE PLANS.

2. CONTRACTOR MUST INCLUDE ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY TO COMPLETE ALL WORK AS INDICATED ON THE CONTRACT DOCUMENTS.

3. ESTIMATED TOTAL COST SHALL BE NECESSARY BETWEEN 2:00 AND 2:00 AM UNLESS PRIOR AGREEMENT IS REACHED WITH THE OWNER.

4. ANY MODIFICATIONS ARE TO BE SUBMITTED TO THE ESTATE OF THE LAND PRIOR TO COMMENCEMENT OF WORK.

5. THE CONTRACTOR MUST INSTALL ALL MATERIALS AND EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND SPECIFICATIONS.

6. ALL WORK PERFORMED AND MATERIALS INSTALLED SHALL BE IN STRICT ACCORDANCE WITH ALL APPROPRIATE CODES, REGULATIONS, AND ORDINANCES.

7. THE CONTRACTOR SHALL SUPPLEMENT AND EXPEND THE WORK USING THE BEST SKILLS AND ATTENTION. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ALL CONSTRUCTION WORK, WORKSHOPS, AND PROFESSIONAL SERVICES AND FOR COORDINATING ALL ASPECTS OF THE WORK UNDER THIS CONTRACT.

8. THE CONTRACTOR SHALL MAKE ALL NECESSARY PROVIDERS TO SUBMIT EXTRAVAGANT, UNNECESSARY, UNNECESSARY, AND UNREASONABLE, SUCH ITEMS TO BE DETERMINED TO BE NECESSARY FOR THE CONSTRUCTION WORK.

9. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

10. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

11. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

12. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

13. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

14. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

15. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

16. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.

17. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY PROFESSIONAL OR TECHNICAL ERRORS, OMISSIONS, OR MISREPRESENTATIONS.
1. Excavate scour pool. Stockpile excavated material to be used as backfill on downstream side of structure.
2. Excavate 1 vertical post footing and install posts. Backfill posts to elevation as bottom of scour pool.
3. Excavate trenches for 3 racking bundles.
4. Backfill posts to top of racking bundle.

1. Place random racking in scour pool in front of racking bundles.
2. Trench and place 2 0'-3' Los. Tops of los shall be equal with tops of racking bundles. Install 1 chain element per los as shown.
3. Excavate and place 4 0'-4' los and 2 10'-4' restrains extending over the racking bundles and racking.

1. Place random racking in scour pool in front of racking bundles.
2. Place 2 0'-3' los.
3. Place 1 0'-4' and 1 10'-4' los on top of previous los.
4. Chain lash at 2 locations.
5. Backfill area downstream of scour pool so it is at reference elevation.
1. Place random racking in front of structure.
2. Place 2 R-5 logs.
3. Place 1 R-5 log and 1 R-6 log as shown.
4. Chain each at 4 locations.

Layer 4:
1. Place random racking in scup pool in front of structure.
2. Place 1 R-5 log and 1 R-6 log as shown.
3. Chain each at 4 locations.

Layer 5:
1. Excavate and place 2 R-5-6 rackets as upstream retention logs. Place to pin random racking backfill after installation.
2. Backfill excess material on top of structure on downstream side.
3. Sawcut post tops.
1. Excavate scour pool. Stockpile excavated material to be used as backfill on downstream side of structure.
2. Excavate to vertical post location and install posts. Backfill posts to the same elevation as bottom of scour pool.
3. Excavate trenches for 3 racking bundles. Place racking bundles.
4. Backfill posts to top of racking bundles.

Layer 0:
- Trench and place 1 2x4 log. Top of log shall be equal with tops of racking bundles. Backfill to top of log.
- Place 2 2x4 logs, resting on top of racking bundles.
- Place random racking in scour pool.

Layer 1:
- Place 1 2x3 log.
- Place random racking.
- Place 2 2x3 racking logs.

Layer 2:
- Place 4 2x3 logs.

Layer 3:
- Place random racking.
1. Place 6 RB-3 vertical posts.
2. Excavate fit. Use excess material as backfill on top of structure.

Layer 0

Layer 1
1. Place 1 RE-3 rootball.
2. Place racking and slash. Place racking and slash at each subsequent layer.

Layer 2
1. Place racking and slash.
2. Place 1 RE-3 rootball.

Layer 3
1. Place 1 RE-3 rootball.
2. Place 6 rock collars.
3. Place racking and slash.

Layer 4
1. Excavate and place 2 RB-4 rockwalls as upstream retention. Loss. Place to fit rainbow racking. Backfill after installation.
2. Backfill excess material on top of structure.
3. Sawcut post tops.

Post dimensioning plan 1
Scale 1" = 10'
HIGH FLOODPLAIN FLOOD FENCE PLAN PER 48' LENGTH

LOW FLOODPLAIN FLOOD FENCE PLAN PER 48' LENGTH

NOTES:
1. ALL LOGS, RACKING MATERIAL AND SEAL MATERIAL HAS BEEN PROVIDED BY THE CONTRACTING AGENCY AND IS STATED AT THE PROJECT SITE.
2. CAREFULLY HANDLE TRANSPLANTED STANDS. PROVIDE WOODY MATERIAL AS PROVIDED. WOODY MATERIAL DAMAGED AS A RESULT OF CONTRACT ACTIONS SHALL BE REPLACED AND AT NO ADDITIONAL COST TO THE CONTRACTING AGENCY.
3. THE CONTRACTOR SHALL MEET LOG AS ILLUSTRATED ON THE SHEET SHALL BE DETERMINED BY THE CONTRACTING AGENCY.
4. WOODY MATERIAL AT THE STRUCTURE CONSTRUCTION SITE SHALL BE PROTECTED FROM CONSTRUCTION ACTIVITIES AND THEN INCORPORATED INTO THE STRUCTURE AS DETERMINED BY THE CONTRACTING AGENCY.
5. WOODY STAKES WILL BE INSTALLED BY OTHERS FOLLOWING CONSTRUCTION. ALL OTHER MATERIAL SHALL BE PLACED AS SHOWN ON THIS SHEET.

FLOODPLAIN FENCE DETAILS

FLOODPLAIN FENCE MATERIALS SCHEDULE PER 48 FT OF LENGTH

LOG ID | O.D. (INCHES) | LENGTH (FEET) | ROOTWAD (Y/N) | QUANTITY PER STRUCTURE
--- | --- | --- | --- | ---
RACKING | 6-12 | 30 | Y/N | 14

FLOODPLAIN FENCE POST PROFILE

FLOODPLAIN FENCE STRUCTURE SCHEDULE

LOG ID | O.D. (INCHES) | LENGTH (FEET) | ROOTWAD (Y/N) | QUANTITY PER STRUCTURE
--- | --- | --- | --- | ---
RACKING | 6-12 | 30 | Y/N | 14

LOW FLOODPLAIN FLOOD FENCE PLAN PER 48' LENGTH

LOW FLOODPLAIN FLOOD FENCE PERSPECTIVE

LOW FLOODPLAIN FLOOD FENCE PERSPECTIVE
Appendix A

NF Maple Reach Phase 1 Photo Point Documentation

2021
Figure 1: Maple Reach Phase 1 Photo Point Locations and Numbers
<table>
<thead>
<tr>
<th>Photo Point</th>
<th>Project Phase</th>
<th>Structure(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maple-PP01</td>
<td>1</td>
<td>ELJ 18, FF 17-18</td>
<td>Look DS at ELJ 18 and FF-18</td>
</tr>
<tr>
<td>Maple-PP02 view 1</td>
<td>ELJ 18</td>
<td>Look east at ELJ 18</td>
<td></td>
</tr>
<tr>
<td>Maple-PP02 view 2</td>
<td>ELJ 19</td>
<td>Look DS at ELJ 19</td>
<td></td>
</tr>
<tr>
<td>Maple-PP03</td>
<td>ELJ 17, FF-18</td>
<td>Look DS at ELJ 17 and FF 17-18</td>
<td></td>
</tr>
<tr>
<td>Maple-PP04</td>
<td>ELJ 17</td>
<td>Look DS at ELJ 17</td>
<td></td>
</tr>
<tr>
<td>Maple-PP05</td>
<td>ELJ 16</td>
<td>Look DS at ELJ 16</td>
<td></td>
</tr>
<tr>
<td>Maple-PP06</td>
<td>ELJ 16</td>
<td>Look northwest at ELJ 16</td>
<td></td>
</tr>
<tr>
<td>Maple-PP07 view 1</td>
<td>ELJ 18, ELJ 19</td>
<td>Look US at ELJ 18 from top of ELJ 19</td>
<td></td>
</tr>
<tr>
<td>Maple-PP07 view 2</td>
<td>ELJ 8, ELJ 9, ELJ 1, ELJ 2, FF 1-2</td>
<td>Look DS from back of ELJ 19 project view</td>
<td></td>
</tr>
<tr>
<td>Maple-PP08</td>
<td>ELJ 15</td>
<td>Look DS at ELJ 15</td>
<td></td>
</tr>
<tr>
<td>Maple-PP09</td>
<td>ELJ 15</td>
<td>Look DS at ELJ 15</td>
<td></td>
</tr>
<tr>
<td>Maple-PP10</td>
<td>ELJ 14</td>
<td>Look DS at ELJ 14</td>
<td></td>
</tr>
<tr>
<td>Maple-PP11</td>
<td>ELJ 9, ELJ 8</td>
<td>Look DS at ELJ 9</td>
<td></td>
</tr>
<tr>
<td>Maple-PP12</td>
<td>ELJ 8, ELJ 9</td>
<td>Look DS at ELJ 8</td>
<td></td>
</tr>
<tr>
<td>Maple-PP13</td>
<td>ELJ 8</td>
<td>Look northwest at ELJ 8</td>
<td></td>
</tr>
<tr>
<td>Maple-PP14</td>
<td>ELJ 10</td>
<td>Look west at ELJ 10</td>
<td></td>
</tr>
<tr>
<td>Maple-PP15</td>
<td>ELJ 11, ELJ 12, ELJ 13</td>
<td>Look south at ELJ 11</td>
<td></td>
</tr>
<tr>
<td>Maple-PP16</td>
<td>ELJ 11, ELJ 12, ELJ 13</td>
<td>Look south at ELJ 11</td>
<td></td>
</tr>
<tr>
<td>Maple-PP17</td>
<td>ELJ 12, ELJ 13</td>
<td>Look south at ELJ 12</td>
<td></td>
</tr>
<tr>
<td>Maple-PP18</td>
<td>ELJ 13</td>
<td>Look south at ELJ 13</td>
<td></td>
</tr>
<tr>
<td>Maple-PP19</td>
<td>ELJ 1</td>
<td>Look east at ELJ 1</td>
<td></td>
</tr>
<tr>
<td>Maple-PP20 view 1</td>
<td>ELJ 2, ELJ 3</td>
<td>Look North at ELJ 2, ELJ 3</td>
<td></td>
</tr>
<tr>
<td>Maple-PP20 view 2</td>
<td>Site view</td>
<td>Look Northeast upriver</td>
<td></td>
</tr>
<tr>
<td>Maple-PP21</td>
<td>ELJ 2</td>
<td>Look west at ELJ 2</td>
<td></td>
</tr>
<tr>
<td>Maple-PP22</td>
<td>ELJ 3</td>
<td>Look Northwest at ELJ 3</td>
<td></td>
</tr>
<tr>
<td>Maple-PP23</td>
<td>ELJ 2, ELJ 3</td>
<td>Look southwest at ELJ 2, ELJ 3</td>
<td></td>
</tr>
<tr>
<td>Maple-PP25</td>
<td>ELJ 5, ELJ 6, ELJ 7, FF-5, FF-7</td>
<td>Look North at ELJ 5</td>
<td></td>
</tr>
<tr>
<td>Maple-PP26</td>
<td>ELJ 4</td>
<td>Look West at ELJ 5</td>
<td></td>
</tr>
<tr>
<td>Maple-PP27</td>
<td>ELJ 5, FF-5</td>
<td>Look West at ELJ 7</td>
<td></td>
</tr>
<tr>
<td>Maple-PP28</td>
<td>ELJ 6</td>
<td>Look Southwest at ELJ 6</td>
<td></td>
</tr>
<tr>
<td>Maple-PP29</td>
<td>ELJ 7</td>
<td>Look West at ELJ 7</td>
<td></td>
</tr>
<tr>
<td>Maple-PP30</td>
<td>ELJ 7</td>
<td>Look West at ELJ 7</td>
<td></td>
</tr>
<tr>
<td>Maple-PP31</td>
<td>ELJ 22</td>
<td>Look west at ELJ 22</td>
<td></td>
</tr>
<tr>
<td>Maple-PP32</td>
<td>ELJ 21</td>
<td>Look west at ELJ 21</td>
<td></td>
</tr>
<tr>
<td>Maple-PP33</td>
<td>ELJ 20</td>
<td>Look west at ELJ 20</td>
<td></td>
</tr>
<tr>
<td>Maple-PP34</td>
<td>Site view</td>
<td>Look west downriver</td>
<td></td>
</tr>
</tbody>
</table>
Maple Phase 1 Photo Point 1

8-19-2021
Maple Phase 1 Photo Point 2 view 2

8-19-2021
Maple Phase 1 Photo Point 3

8-19-2021
Maple Phase 1 Photo Point 4

8-19-2021
Maple Phase 1 Photo Point 5

8-19-2021
Maple Phase 1 Photo Point 6

8-19-2021
Maple Phase 1 Photo Point 7 view 1

8-19-2021
Maple Phase 1 Photo Point 7 view 2

8-19-2021
Maple Phase 1 Photo Point 9

8-19-2021
Maple Phase 1 Photo Point 12

8-19-2021
Maple Phase 1 Photo Point 13

8-19-2021
Maple Phase 1 Photo Point 14

8-19-2021
Maple Phase 1 Photo Point 15

8-19-2021
Maple Phase 1 Photo Point 17

8-19-2021
Maple Phase 1 Photo Point 20 view2

9-15-2021
Maple Phase 1 Photo Point 21

9-15-2021
Maple Phase 1 Photo Point 22

9-15-2021
Maple Phase 1 Photo Point 23

9-15-2021
Maple Phase 1 Photo Point 25

9-15-2021
Maple Phase 1 Photo Point 26

9-15-2021
Maple Phase 1 Photo Point 27

9-15-2021
Maple Phase 1 Photo Point 28

9-15-2021
Maple Phase 1 Photo Point 29

9-15-2021
Maple Phase 1 Photo Point 30

9-15-2021
Maple Phase 1 Photo Point 31

9-15-2021
Maple Phase 1 Photo Point 32

9-15-2021
Maple Phase 1 Photo Point 33

9-15-2021
Maple Phase 1 Photo Point 34

9-15-2021