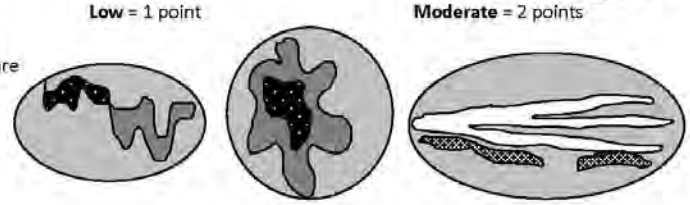
Wetland name or number F

These questions apply to wetlands of all HGM classes. **HABITAT FUNCTIONS** - Indicators that site functions to provide important habitat	(only 1 score per box)
H 1.0. Does the wetland have the potential to provide habitat for many species?	
H 1.1. Structure of the plant community: *Check the Cowardin vegetation classes present and categories of emergent plants. Size threshold for each category is >= ¼ ac or >= 10% of the wetland if wetland is < 2.5 ac.* ____Aquatic bed ____Emergent plants 0-12 in (0-30 cm) high are the highest layer and have > 30% cover ____Emergent plants >12-40 in (>30-100 cm) high are the highest layer with >30% cover ____Emergent plants > 40 in (> 100 cm) high are the highest layer with >30% cover ____Scrub-shrub (areas where shrubs have >30% cover) 4 or more checks: points = 3 ____Forested (areas where trees have >30% cover) 3 checks: points = 2 2 checks: points = 1 1 check: points = 0	0
H 1.2. Is one of the vegetation types Aquatic Bed? Yes = 1 No = 0	0
H 1.3. Surface water H 1.3.1. Does the wetland have areas of open water (without emergent or shrub plants) over at least ¼ ac **OR** 10% of its area during the March to early June **OR** in August to the end of September? ***Answer YES for Lake Fringe wetlands.*** Yes = 3 points & go to H 1.4 No = go to H 1.3.2 H 1.3.2. Does the wetland have an intermittent or permanent, and unvegetated stream within its boundaries, or along one side, over at least ¼ ac or 10% of its area? *Answer yes only if H 1.3.1 is No.* Yes = 3 No = 0	3
H 1.4. Richness of plant species Count the number of plant species in the wetland that cover at least 10 ft^2. *Different patches of the same species can be combined to meet the size threshold. You do not have to name the species.* *Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Russian olive, Phragmites, Canadian thistle, yellow-flag iris, and saltcedar (Tamarisk)* # of species 0 Scoring: > 9 species: points = 2 4-9 species: points = 1 < 4 species: points = 0	0
H 1.5. Interspersion of habitats Decide from the diagrams below whether interspersion among types of plant structures (described in H 1.1), and unvegetated areas (open water or mudflats) is high, moderate, low, or none. *Use map of Cowardin and emergent plant classes prepared for questions H 1.1 and map of open water from H 1.3. If you have four or more plant classes or three classes and open water, the rating is always high.*  **None** = 0 points **Low** = 1 point **Moderate** = 2 points All three diagrams in this row are **High** = 3 points  Riparian braided channels with 2 classes	Figure 1

Wetland name or number F

H 1.6. Special habitat features *Check the habitat features that are present in the wetland. The number of checks is the number of points.* ____Loose rocks larger than 4 in OR large, downed, woody debris (> 4 in diameter) within the area of surface ponding or in stream. ____Cattails or bulrushes are present within the wetland. ____Standing snags (diameter at the bottom > 4 in) in the wetland or within 30 m (100 ft) of the edge. ____Emergent or shrub vegetation in areas that are permanently inundated/ponded. ____Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 45 degree slope) OR signs of recent beaver activity __X__ Invasive species cover less than 20% in each stratum of vegetation *(canopy, sub-canopy, shrubs, herbaceous, moss/ground cover)*	1
Total for H 1 — Add the points in the boxes above	5

Rating of Site Potential If score is: ___**15-18 = H** ___**7-14 = M** _X_**0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support habitat functions of the site?	
H 2.1. Accessible habitat (only area of habitat abutting wetland). If total accessible habitat is: *Calculate:* % undisturbed habitat _____ + [(% moderate and low intensity land uses)/2] _____ =_____% > 1/3 (33.3%) of 1 km Polygon — points = 3 20-33% of 1km Polygon — points = 2 10-19% of 1km Polygon — points = 1 <10% of 1km Polygon — points = 0	3
H 2.2. Undisturbed habitat in 1 km Polygon around wetland. *Calculate:* % undisturbed habitat _____ + [(% moderate and low intensity land uses)/2] _____ =_____% Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10 - 50% and in 1-3 patches — points = 2 Undisturbed habitat 10 - 50% and > 3 patches — points = 1 Undisturbed habitat < 10% of Polygon — points = 0	3
H 2.3. Land use intensity in 1 km Polygon: > 50% of Polygon is high intensity land use — points = (- 2) Does not meet criterion above — points = 0	0
H 2.4. The wetland is in an area where annual rainfall is less than 12 in, and its water regime is not influenced by irrigation practices, dams, or water control structures. *Generally, this means outside boundaries of reclamation areas, irrigation districts, or reservoirs* — Yes = 3 No = 0	0
Total for H 2 — Add the points in the boxes above	6

Rating of Landscape Potential If score is: _X_**4-9 = H** ___**1-3 = M** ___**< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?	
H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose the highest score that applies to the wetland being rated* Site meets ANY of the following criteria: — points = 2 _X_ It has 3 or more priority habitats within 100 m (see Appendix B) — It provides habitat for Threatened or Endangered species (any plant or animal on state or federal lists) — It is mapped as a location for an individual WDFW species — It is a Wetland of High Conservation Value as determined by the Department of Natural Resources — It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats within 100 m (see Appendix B) — points = 1 Site does not meet any of the criteria above — points = 0	2

Rating of Value If score is: _X_**2 = H** ___**1 = M** ___**0 = L** *Record the rating on the first page*

Wetland name or number F

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Please determine if the wetland meets the attributes described below and circle the appropriate category. NOTE: A wetland may meet the criteria for more than one set of special characteristics. Record all those that apply. NOTE: All wetlands should also be characterized based on their functions.

Wetland Type *Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.*	**Category**
SC 1.0. Vernal pools Is the wetland **less than 4000 ft²**, and does it meet at least **two** of the following criteria? — Its only source of water is rainfall or snowmelt from a small contributing basin and has no groundwater input. — Wetland plants are typically present only in the spring; the summer vegetation is typically upland annuals. *If you find perennial, obligate, wetland plants, the wetland is probably NOT a vernal pool.* — The soil in the wetland is shallow [< 1 ft (30 cm)deep] and is underlain by an impermeable layer such as basalt or clay. — Surface water is present for less than 120 days during the wet season. Yes – Go to **SC 1.1** No = **Not a vernal pool** SC 1.1. Is the vernal pool relatively undisturbed in February and March? Yes – Go to **SC 1.2** No = **Not a vernal pool with special characteristics**	
SC 1.2. Is the vernal pool in an area where there are at least 3 separate aquatic resources within 0.5 mi (other wetlands, rivers, lakes etc.)? Yes = **Category II** No = **Category III**	**Cat. II** **Cat. III**
SC 2.0. Alkali wetlands Does the wetland meet **one** of the following criteria? — The wetland has a conductivity > 3.0 mS/cm. — The wetland has a conductivity between 2.0 and 3.0 mS, and more than 50% of the plant cover in the wetland can be classified as "alkali" species (see Table 4 for list of plants found in alkali systems). — If the wetland is dry at the time of your field visit, the central part of the area is covered with a layer of salt. **OR** does the wetland unit meet two of the following three sub-criteria? — Salt encrustations around more than 75% of the edge of the wetland — More than ¾ of the plant cover consists of species listed on Table 4 — A pH above 9.0. All alkali wetlands have a high pH, but please note that some freshwater wetlands may also have a high pH. Thus, pH alone is not a good indicator of alkali wetlands. Yes = **Category I** No = **Not an alkali wetland**	**Cat. I**
SC 3.0. Wetlands of High Conservation Value (WHCV) SC 3.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? Yes – Go to **SC 3.2** No – Go to **SC 3.3** SC 3.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? Yes = **Category I** No = **Not a WHCV** SC 3.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf Yes – **Contact WNHP/WDNR and go to SC 3.4** No = **Not a WHCV** SC 3.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and it is listed on their website? Yes = **Category I** No = **Not a WHCV**	**Cat. I**

Wetland name or number F

SC 4.0 Bogs and Calcareous Fens Does the wetland (or any part of the wetland unit) meet both the criteria for soils and vegetation in bogs or calcareous fens? *Use the key below to identify if the wetland is a bog or calcareous fen.* ***If you answer yes you will still need to rate the wetland based on its functions.*** SC 4.1. Does an area within the wetland have organic soil horizons (i.e., layers of organic soil), either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? *See Appendix C for a field key to identify organic soils.* Yes – Go to **SC 4.3** No – Go to **SC 4.2** SC 4.2. Does an area within the wetland have organic soils, either peats or mucks, that are less than 16 in deep over bedrock or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? Yes – Go to **SC 4.3** No = **Is not a bog for rating** SC 4.3. Does an area within the wetland have more than 70% cover of mosses at ground level AND at least 30% of the total plant cover consists of species in Table 5? Yes = **Category I bog** No – Go to **SC 4.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 5 are present, the wetland is a bog. SC 4.4. Is an area with peats or mucks forested (> 30% cover) with subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 5 provide more than 30% of the cover under the canopy? Yes = **Category I bog** No – Go to **SC 4.5** SC 4.5. Do the species listed in Table 6 comprise at least 20% of the total plant cover within an area of peats and mucks? Yes = **Is a Calcareous Fen for purpose of rating** No – Go to **SC 4.6** SC 4.6. Do the species listed in Table 6 comprise at least 10% of the total plant cover in an area of peats and mucks, AND one of the two following conditions is met: — Marl deposits [calcium carbonate ($CaCO_3$) precipitate] occur on the soil surface or plant stems — The pH of free water is ≥ 6.8 AND electrical conductivity is ≥ 200 uS/cm at multiple locations within the wetland Yes = **Is a Category I calcareous fen** No = **Is not a calcareous fen**	**Cat. I** **Cat. I**

SC 5.0. Forested Wetlands Does the wetland have an area of forest rooted within its boundary that meets **at least one** of the following three criteria? (*Continue only if you have identified that a forested class is present in question H 1.1*) — The wetland is within the 100 year floodplain of a river or stream — Aspen (*Populus tremuloides*) represents at least 20% of the total cover of woody species — There is at least ¼ ac of trees (even in wetlands smaller than 2.5 ac) that are "mature" or "old-growth" according to the definitions for these priority habitats developed by WDFW *(see definitions in question H3.1)* Yes – Go to **SC 5.1** No = **Not a forested wetland with special characteristics**	
SC 5.1. Does the wetland have a forest canopy where more than 50% of the tree species (by cover) are slow growing native trees (*see Table 7*)? Yes = **Category I** No – Go to **SC 5.2**	**Cat. I**
SC 5.2. Does the wetland have areas where aspen (*Populus tremuloides*) represents at least 20% of the total cover of woody species? Yes = **Category I** No – Go to **SC 5.3**	**Cat. I**
SC 5.3. Does the wetland have at least ¼ acre with a forest canopy where more than 50% of the tree species (by cover) are fast growing species (*see Table 7*)? Yes = **Category II** No – Go to **SC 5.4**	**Cat. II**
SC 5.4. Is the forested component of the wetland within the 100 year floodplain of a river or stream? Yes = **Category II** No = **Not a forested wetland with special characteristics**	**Cat. II**
Category of wetland based on Special Characteristics *Choose the highest rating if wetland falls into several categories* If you answered No for all types, enter "Not Applicable" on Summary Form	Not Applicable

For Wetland F

Appendix B: WDFW Priority Habitats in Eastern Washington

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland: ***NOTE:*** *This question is independent of the land use between the wetland and the priority habitat.*

— **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

X — **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

— **Old-growth/Mature forests:** Old-growth east of Cascade crest – Stands are highly variable in tree species composition and structural characteristics due to the influence of fire, climate, and soils. In general, stands will be >150 years of age, with 10 trees/ac (25 trees/ha) that are > 21 in (53 cm) dbh, and 1-3 snags/ac (2.5-7.5 snags/ha) that are > 12-14 in (30-35 cm) diameter. Downed logs may vary from abundant to absent. Canopies may be single or multi-layered. Evidence of human-caused alterations to the stand will be absent or so slight as to not affect the ecosystem's essential structures and functions. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west and 80-160 years old east of the Cascade crest.

— **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

X **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

— **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

— **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

— **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

— **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

— **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 12 in (30 cm)in eastern Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

— **Shrub-steppe:** A nonforested vegetation type consisting of one or more layers of perennial bunchgrasses and a conspicuous but discontinuous layer of shrubs (see Eastside Steppe for sites with little or no shrub cover).

— **Eastside Steppe:** Nonforested vegetation type dominated by broadleaf herbaceous flora (i.e., forbs), perennial bunchgrasses, or a combination of both. Bluebunch wheatgrass (*Pseudoroegneria spicata*) is often the prevailing cover component along with Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), rough fescue (*F. campestris*), or needlegrasses (*Achnatherum* spp.).

— **Juniper Savannah:** All juniper woodlands.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Appendix B| Large Wood Risk Assessment Memorandum

TECHNICAL MEMORANDUM

To: Stephen Kolk, U.S. Bureau of Reclamation; Scott Bailey, Chelan County Natural Resources

From: Inter-Fluve, Inc.

Date: August 2025

Project: Lower Chiwawa Area D 60% Design

Re: Large Wood Structure Risk and Stability Analysis

1. INTRODUCTION

Inter-Fluve has designed several configurations of large wood structures (LWS) for the Lower Chiwawa Area D Habitat Enhancement Project. This memorandum provides documentation on the LWS design criteria, considerations, and key assumptions, as well as an overview of the design methodology that will be used in the stability analyses in future design phases. The project plans show the LWS configurations and specify the type of ballast (e.g., soil backfill, timber piles/vertical snags) that will be needed to achieve the target stability factors of safety.

2. DESIGN CRITERIA

The proposed LWS for this project are designed to balance the geomorphic and habitat objectives with the management of risks to public safety and property damage. This is especially critical during the first 1 to 3 years following construction, before planted riparian vegetation will have a chance to mature and thereby provide hydraulic roughness and contribute to LWS stability.

2.1. RISK AND STABILITY ANALYSIS

Using the risk matrices provided in the USBR's Large Wood Material Risk Based Design Guidelines (Knutson et. al., 2014), risk categories for public safety and property damage are assessed in the following subsections. Given the subjective methods for assessing the level of risk associated with each sub-category in the matrices, a representative range of potential risk was assigned for the various characteristics defined on each axis of the matrices.

2.1.1. Public Safety Risk

Public safety risks pertain to the hazards caused by LWS or LWM within the wetted perimeter of stream that can cause harm to people in and around the stream, particularly recreational users and children (Knutson et al., 2014). The public risk evaluation matrix weighs the characteristics of a LWS (generalized for all LWS types proposed in the project area in this analysis) versus the general characteristics of public users of the river in the project area to place bounds on the overall risk of proposed LWS to public safety. Figure 1 shows the results of the public safety risk analysis performed for LWS proposed in the project area. Table 1 and 2 document the rationale used to inform scoring of the public safety risk matrix.

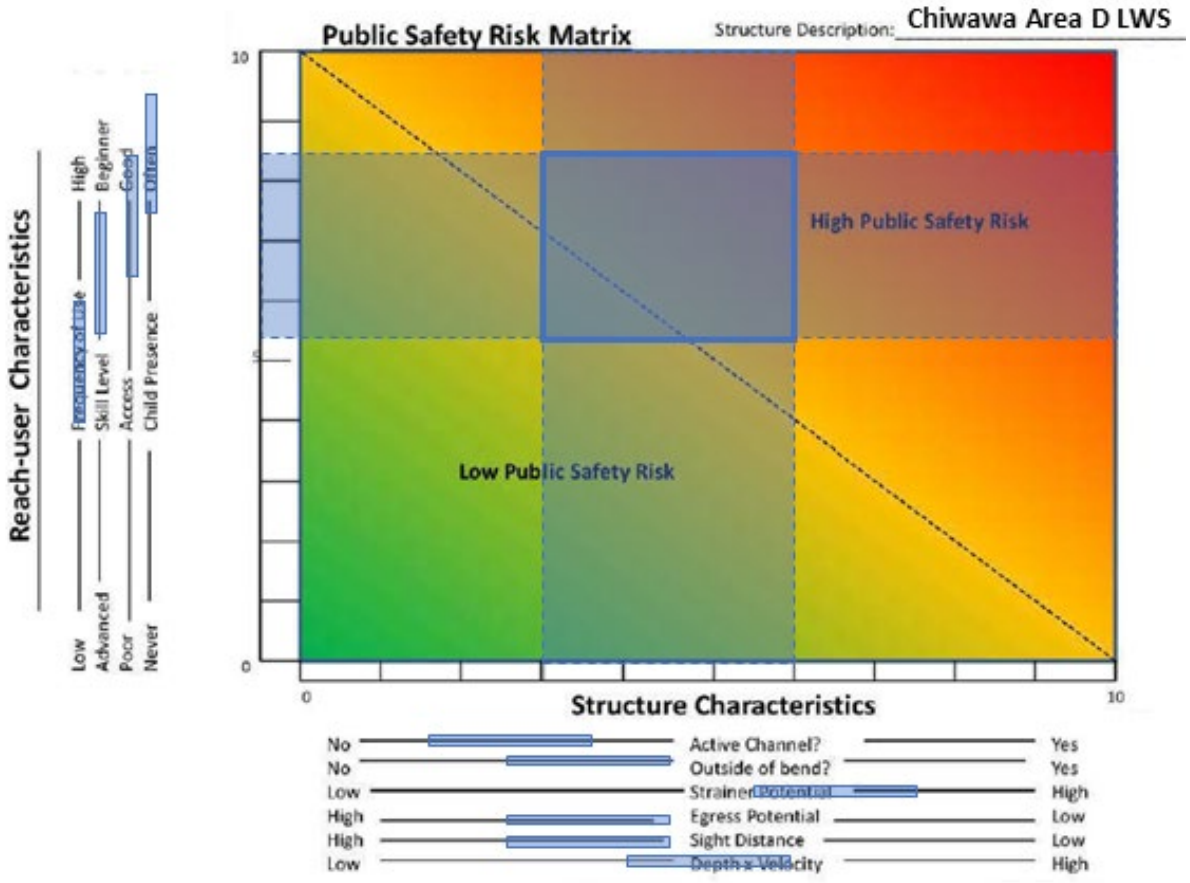


Figure 1: Public safety risk matrix annotated with project-specific scoring for LWS proposed in Chiwawa Area D.

The assessment of structure characteristics (x-axis) rates proposed LWS placements within this reach as a moderate risk for public safety. In most cases, structures are in locations where they are of lower risk to recreational users floating the river (e.g., inside of bends, easy to avoid, adequate sight distance), yet some structures have the potential to act as strainers under some flow condition, or if additional wood racks against the structures. Table 1 provides details about assessed structure risk rating and the justification for each rating factor. The assessment of reach-user characteristics (y-axis) yields a "high" risk rating. Easy access to the river for those with limited experience recreating and swimming in rivers, and high potential for children in the river in the project area drive this rating. Table 2 provides details about assessed reach-user risk rating and the justification for each rating factor.

Table 1: Overview of LWS structure characteristics for evaluating public safety risk.

Structure Characteristics Factor	**Risk**	**Justification**
Active Channel	**Low**	Channel migration and channel geomorphic complexity in the project area is low. Bedrock and coarse-grained terraces bound the channel through much of the project area.
Outside of Bend	**Low - Moderate**	No LWS are proposed on the river right bank on the outside of the river bend to reduce potential impacts to recreationists.
Strainer Potential	**Moderate – High**	Several LWS are positioned at the apex of mid-channel bars and are likely to trap additional mobile LWM following their construction. Therefore, these structures have high potential to develop into strainers. Other LWS styles have lesser projection into the channel and are less likely to trap as much mobile wood.
Egress Potential	**Low – Moderate**	At flow conditions where most bank-accessed recreation occurs, most structures are located in areas where water is easily wadable or swimmable, and in many cases the banks are easily scalable. At the downstream side of the project area banks are higher and steeper, but less recreational use is anticipated in this area.
Sight Distance	**Low – Moderate**	Proposed LWS are generally not located in areas with limited sight distance, and in the few cases where LWS are located behind bends, the LWS are generally located in areas of lower velocity allowing boaters time to react.
Depth & Velocity	**Moderate**	Flow is generally wadable in the vicinity of most proposed LWS under the flow conditions where most bank-accessed recreation occurs. LWS that have higher-risk hydraulics are commonly harder to access for most recreational users.

Table 2: Overview of reach-user characteristics for evaluating public safety risk.

Reach-User Characteristics Factor	**Risk**	**Justification**
Frequency of Use	**Moderate**	The project area is used for a variety of recreational uses, but overall boating use on the Lower Chiwawa is not as common as some other rivers in the Upper Wenatchee basin. Use is anticipated to be primarily related to people camping and staying in cabins in the project area. Campers are more likely to use the river during warmer, lower flow months, although there are likely hunters camping in the area during deer and elk hunting seasons. A current study focusing on the recreation in the Chiwawa River for Chelan County is ongoing. The results of the study will be incorporated into future design phases.
Skill Level	**Moderate – High**	The ease of access to the project site from campgrounds and cabins make it more likely that those with little river experience will be in the river in the project area.
Access	**High**	Chiwawa River Road crosses the river in the project area, and numerous secondary roads provide access and parking areas to access the Chiwawa. The project area is a common access point for boating and site for other recreational river access.
Child Presence	**High**	Established and dispersed campgrounds, and several cabins located on leased USFS lands border the Chiwawa River for much of the project area. Families with children are anticipated to be present in much of the project area during the warmer months, and some LWS are sited in areas that could be accessed via campgrounds and cabins.

2.1.2. Property Damage Risk

Property damage risks pertain to the risks to in-stream and floodplain structures and property due to changes in channel behavior caused by the installation of LWS or LWM within a project area (Knutson et al., 2014). The property damage risk evaluation matrix weighs the characteristics of the channel and its dynamism (generalized for the entire project area in this analysis) versus the land use and development characteristics of the active valley bottom through which the channel flow to place bounds on the overall risk of proposed LWS to built and unbuilt property in the project area. Figure 2 shows the results of the property damage risk analysis performed for LWS proposed in the project area. Table 3 and Table 4 document the rationale used to inform scoring of the property damage risk matrix.

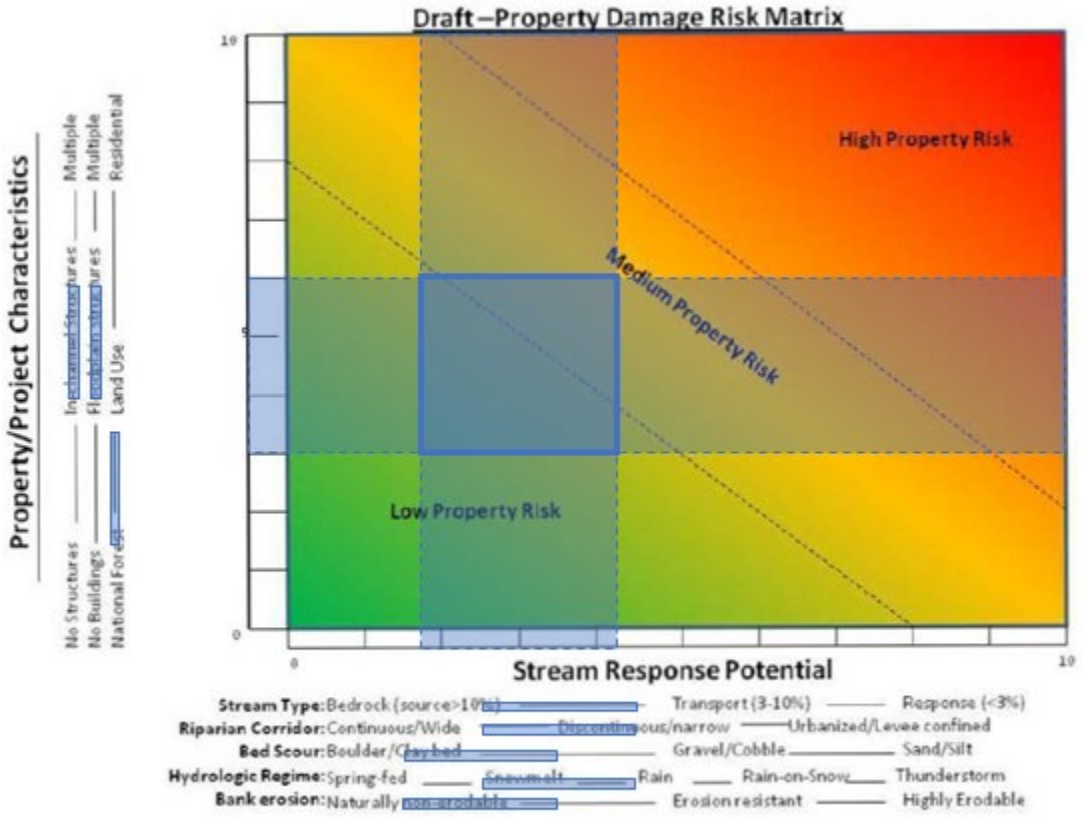


Figure 2: Property damage risk matrix annotated with project-specific scoring for LWS proposed in Chiwawa Area D.

The assessment of stream response potential risk (x-axis) rates the project area low for risk to property. The channel is not particularly dynamic, with non-deformable boundaries in many locations, and is unlikely to erode substantial volumes from the bed or banks. Table 3 provides details about assessed stream response potential risk rating and the justification for each rating factor. The assessment of property/project characteristics (y-axis) yields a low-risk rating. All land within and adjacent to the project reach is USFS property, with relatively little in-channel infrastructure (Chiwawa River Rd. bridge is upstream of most LWS and has no piers in the active channel) or high-value structures in the active valley bottom. Table 4 provides details about assessed property risk rating and the justification for each rating factor.

Table 3: Overview of stream response potential for evaluating property damage risk.

Stream Response Potential Factors	**Risk**	**Justification**
Stream Type	**Low - Moderate**	The channel is a transport channel, but it bounded by bedrock and/or glacial landforms which are resistant to erosion. The channel morphology reduces the streams' ability to respond.
Riparian Corridor	**Low - Moderate**	The active valley bottom in the project area is relatively narrow, yet channel migration is unlikely in most locations due to the morphology of the valley, and in places where this could occur, channel migration is not anticipated to cause serious harm.
Bed Scour Potential	**Low**	The bed in the project area primarily flows over bedrock or coarse glacial deposits, which are likely immobile at all but the most extreme peak flows.
Bank Erosion Potential	**Low**	Banks in the project area primarily consist of bedrock, coarse glacial sediments, or coarse glaciofluvial deposits. Banks generally are supported by dense root networks and erode slowly.
Dominant Hydrologic Regime	**Low – Moderate**	The hydrology of the Chiwawa River is snowmelt-driven, but occasional large floods have been associated with late-fall rainfall or rain-on-snow events.

Table 4: Overview of property/project characteristics for evaluating property damage risk.

Property / Project Characteristics Factor	**Risk**	**Justification**
In-Channel Structures	**Moderate**	The Chiwawa River Road bridge is located at the upstream side of the project area, but almost all LWS are located downstream of the bridge. No in-channel structures are present in the active channel for several river miles downstream of the project area.
Floodplain Structures	**Moderate**	Leased cabins and minor campground infrastructure are the only floodplain structures in the project area. A few of the leased cabins are situated within or adjacent to the modeled 100-year floodplain under existing conditions. More detailed information and an evaluation of the project on flooding in this area can be found in the Basis of Design Report.
Land Use	**Low**	The project area is entirely located on USFS land.

2.2. EVALUATION OF WOOD STRUCTURE RISK AND STABILITY

Based on the above analysis, the project has a high public safety risk and a moderate property damage risk, based on the bulk of each risk envelope falling within these categories. Therefore, the LWS in the project area are recommended to be designed for stability up to a 50-year flood (Knutson et al., 2014). However, the 100-year return period peak flow was chosen as a conservative design criterion for LWS stability based on direction from the project development team due to concerns about the propensity of the bridge downstream of the project (Chiwawa Loop Road bridge; approx. 5 miles downstream) to rack mobile woody material. Additionally, the choice of the 100-Year Flood provides additional an additional factor of safety against any changes to the hydrologic regime due to climate change. Table 5 provides a summary of risk assessment findings, recommended stability criteria, and minimum target FOS values for wood mobility based on risk assessment findings.

Table 5: Chiwawa Area D large wood structure risk assessment results and recommended stability characteristics.

Public Safety Risk	Property Damage Risk	Stability Design Flow Criteria	Net Horizontal (FOS $_{sliding}$)	Net Vertical (FOS $_{buoyancy}$)
High	Moderate	100-year	1.5	1.75

Note: Values are from Table 4 p. 47 (Knutson et. al. 2014). FOS rotation and FOS overturning are not reported as they are not critical to the project LWS types.

3. DESIGN APPROACH

3.1. GEOMORPHIC AND HABITAT FUNCTIONS

The locations of LWS, as well as individual pieces of large wood material within the structures, have been chosen to provide particular geomorphic and habitat functions. LWS placed along the channel margins are intended to induce pool scour, provide cover, and add roughness; these effects are anticipated to enhance holding and rearing habitats. LWS placed at the apex of bars function to split or deflect flows, sort and store sediment, and trap mobile wood; these effects are intended to boost the geomorphic processes which drive habitat creation in the channel rather than to provide point habitat, though they may evolve to do so over time. Whole trees incorporated within structures or located separately are designed to mimic the redirection of flow and hydraulic complexity that typically occurs when a large fallen tree is present along the channel margins or on the floodplain.

3.2. STABILIZATION METHODS

Stabilization for LWS will be provided by a combination of:

- Native backfill, where the LWM are partially buried and the weight of the overlying soil provides vertical resistance to buoyant forces and passive soil forces to resist sliding.
- Timber Piles (vertical snags), where the horizontal LWM are mechanically connected to the timber piles transferring vertical and horizontal forces.

Additionally, project construction documents require timber pile installation pull-out resistance tests to be performed during construction. These tests will help validate design timber pile capacity assumptions and provide information needed for field engineering, should it be needed. These services will help ensure that the minimum design factors of safety are met for all the LWS as they are constructed.

3.3. CALCULATIONS

Calculations followed the procedures and formulas provided in the USBR's Large Wood Material Risk Based Design Guidelines (Knutson et al., 2014). Applicable sections included; 6.4.2 Resistance to Floatation and 6.4.3 Resistance to Sliding. Given the configuration of the LWS in the project, resistance to rotation (Section 6.4.4) and resistance to overturning (Section 6.4.5) will not be evaluated. The calculations were based on the results of the proposed 2D hydraulic modeling, as well as the size and the configurations of each type of LWS. The calculations are included as an attachment to this Appendix. These calculations utilize typical LWS configurations for the Apex LWS, Apex – Narrow LWS, Bank-Buried LWS, and Side Channel Confluence LWS with piles. Typical configurations were analyzed to account for potential uncertainties encountered during construction, and because the configuration and hydraulics at each LWS location are relatively similar. Given that these are typical configurations, calculation parameters assume the most conservative values with respect to hydraulic forces and burial depths. A summary of the calculated factors of safety is provided in Table 6.

Table 6. Summary of calculated Factors of Safety for typical LW configurations.

LW Structure	Stability Method	Target $FOS_{buoyancy}$	Calculated $FOS_{buoyancy}$	Target $FOS_{sliding}$	Calculated $FOS_{sliding}$
Apex: Typical	Backfill/Piles	1.75	**2.2**	1.5	**6.9**
Apex - Narrow: Typical	Backfill/Piles	1.75	**2.2**	1.5	**3.8**
Bank-buried: Typical	Backfill/Piles	1.75	**1.9**	1.5	**6.1**
Side Channel Confluence: Typical	Backfill/Piles	1.75	**2.0**	1.5	**26.2**

4. REFERENCES

Knutson, M. and Fealko, J. 2014. Large Woody Material - Risk Based Design Guidelines. U.S. Department of the Interior Bureau of Reclamation Pacific Northwest Region & Technical Services. Boise, Idaho. September 2014. http://www.usbr.gov/pn//fcrps/documents/lwm.pdf

Lower Chiwawa River Project Area D - Large Woody Structure Stability Evaluation

Structural Stability | *6.4*

Structural stability of large woody material placements is evaluated herein using the procedures, formulas, and recommendations provided in the Reclamation's *Large Woody Material - Risk Based Design Guidelines* (Knutson et. al. 2014) along with insight gained from professional experience and general engineering judgment.

Factors of Safety | *6.4.1*

Safety factors for structural stability were selected from Table 4.

Minimum recommended factors of safety given the site specific public safety and property damage risk levels are as follows:

Public Safety Risk	High	**$FOS_{sliding}$**	1.5
Property Damage Risk	Moderate	**$FOS_{buoyancy}$**	1.75
Stability Design Flow Criteria	100-year modeled flow approach velocity	**$FOS_{rotation}$**	N/A

Resistance to Flotation | *6.4.2*

Flotation is typically caused by the buoyant force and the lift force acting on the wood material from water passing over its surface.

Large Wood Material Force

Accounts for the vertical buoyant force of submerged large wood and the vertical weight force of unsubmerged large wood.

$$F_{LWMs} = V_{LWMs} \times (\gamma_{wood} - \gamma_w)$$

$$V_{LWMs} = total\ volume\ of\ submerged\ large\ wood\ material$$

$$V_{LWMs} = \sum N_{LWMi} \times V_{LWMi}$$

Variable	Design Value	Units	
$\gamma_{wood} = unit\ weight\ of\ wood$	33	lb/ft^3	*Typical of Douglas fir density*
$\gamma_{wood} = unit\ weight\ of\ wood$	28	lb/ft^3	*Typical of Cedar density*
$\gamma_w = unit\ weight\ of\ water$	62.4	lb/ft^3	
V_{LWMs} (Douglas Fir)	6052	ft^3	
V_{LWMs} (Cedar)	0	ft^3	

F_{LWMs} (lb)	**177,928**	*Positive values are upward forces.*

Lift Force

Accounts for the lift force of large wood in flowing water. Not applicable to LWS where the bed will deform around the leading edges.

$$F_L = \frac{C_L \times A_{LWM} \times \gamma_w \times U_o^2}{2 \times g}$$

	Design Value	Units / Notes
$C_L = lift\ coefficient$	0.2	typ. LWM value
$A_{LWM} = area\ of\ large\ woody\ material\ perpendicular\ to\ flow$	$A_{LWM} = See\ Design\ Plan$	
	A_{LWM} (ft²) 540	
$U_u = upstream\ channel\ velocity\ at\ design\ event$	9	ft/s
$g = acceleration\ due\ to\ gravity$	32.2	ft/s²

F_L (lb)	N/A

Boulder Ballast Force

Accounts for the ballasting force of large boulders directly attached to or placed over LWM.

$$_{bouldersub} = N_{bouldersub} \times {}^{\pi}/_{6} \times d^3_{bouldersub} \times (\gamma_{boulder} - \gamma_w)$$

	Design Value	Units / Notes
$_{bouldersub} = number\ of\ submerged\ boulders$	0	number
$_{bouldersub} = effective\ diameter\ of\ submerged\ boulders$	3	ft
$= unit\ weight\ of\ boulders$	156	lb/ft³

$F_{bouldersub}$ (lb)	0

Backfill Ballast Force

Accounts for the ballasting force of backfill placed directly over LWM members. Volume is based on the fill area over the log(s) and a the effective cover depth shown on the Drawings.

$$_{backfillsub} = V_{backfillsub} \times (\gamma_s - \gamma_w)$$

	Design Value	Units / Notes
$_{backfillsub} = volume\ of\ backfill\ over\ LWM\ members$	3,240	ft³
$weight\ of\ backfill\ material$	*See design plans* 132	lb/ft³

$F_{backfillsub}$ (lb)	-225,504

Pile Skin Friction

Accounts for the vertical resistance provided by piles within the LWM structure. USBR document equation modified by Inter-Fluve to match industry pile design standard formulations.

$$F_{piles} = N_{piles} \times \pi \times d_{piles} \times L_{piles} \times \left(k_s \times \tan\tfrac{2}{3}\theta \times \sigma'\right)$$

Assumes piles are connected to logs.

	Design Values	Units
$N_{piles} = number\ of\ piles$	18	number
$L_{piles} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$	10.7	ft
$d_{piles} = nominal\ diameter\ of\ the\ piles$	1.3	ft
$\sigma' = \left(L_{piles} \times (\gamma_{sat} - \gamma_w)\right)$	742.4	lb/ft^2
$K_s = coefficient\ of\ lateral\ earth\ pressure\ (0.5\ to\ 1.0)$	0.6	unit less
$\theta = internal\ friction\ angle\ of\ soils$	38	deg.

Value based on extensive pile proof load testing on other similar projects.

F piles-v (lb)	**-170,259**	*Negative values resist upward displacement.*

Piles Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bPiles} = \frac{F_{piles-v}}{F_{LWMs}+F_L}$$

FOS b	1.0

Note this value does not include the backfill assuming it's all lost but the piles are holding.

Backfill and Ballast Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bBackfill} = \frac{F_{backfillsub}}{F_{LWMs}+F_L}$$

FOS b	1.3

Note this value does not include the piles.

Net Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bNet} = \frac{F_{backfillsub}+F_{piles-v}}{F_{LWMs}+F_L}$$

FOS b	**2.2**

Note this value includes the piles and backfill.

Resistance to Sliding | *6.4.3*

LWM structures are also susceptible to failure through sliding.

Drag Force

LWM structures are pushed downstream by the fluid drag forces acting upon the wood by the flowing water.

$$F_d = \frac{C_D \times A_{LWM} \times \gamma_w \times U_c^2}{2 \times g}$$

	Design Value	Units / Notes
$C_D = drag\ coefficient$	1	Per Equations 23 and 24
$A_{LWM} = area\ of\ wetted\ wood\ normal\ to\ the\ flow\ direction$	$A_{LWM} = See\ Design\ Plan$	**A_{LWM} (ft^2) 540**
$U_c = velocity\ adjacent\ to\ the\ LWM\ structure$	9	ft/s — *Velocity value is conservative for all LWS locations. Value from max. 2D model results for LWS lactations.*
$g = acceleration\ due\ to\ gravity$	32.2	ft/s^2

F_d (lb) 42,382

Hydrostatic Force

Hydrostatic forces act on the upstream and downstream faces of a LWM structure. They account for differences in the upstream and downstream water depths against the structure.

$$F_{hu} = \tfrac{1}{2} \times \gamma_w \times Y_u \times A_u \qquad F_{hd} = \tfrac{1}{2} \times \gamma_w \times Y_d \times A_d$$

F_{hu} , $F_{hd} = hydrostatic\ force\ on\ upstream\ and\ downstream\ side\ of\ the\ wood\ structure$

Y_u , $Y_d = water\ depth\ upstream\ and\ downstream\ of\ the\ structue$

A_u , $A_d = area\ projected\ to\ flow\ direction\ on\ the\ upstream\ and\ downstream\ of\ the\ structure$

Variable	Design Value
Y_u (ft)	8
A_u (ft^2)	540
Post racking area	
Y_d (ft)	8
A_d (ft^2)	540
Plan downstream area	

$F_{hu} + F_{hd} = F_h$ (lb) 0

Impact Force

The impact force associated with debris impacting a large wood structure can be estimated by the impact force equation.

$$F_i = \frac{w_{debris}}{g} \times \frac{V_{channel}\text{^}2}{2 \times \Delta x} \times C_i \times C_o \times C_d \times C_b \times R_{max}$$

$w_{debris} = weight\ of\ debris$

$V_{channel} = channel\ approach\ velocity$

$\Delta x = deceleration\ distance$

Coefficients *(see Table 8 and Figures 11, 12 for values)*
$C_i = importance$, $C_o = orientation = 0.8$, $C_d = depth$, $C_b = blockage$, $R_{max} = impluse\ response\ ratio$

Variable	Design Value
W_{debris} (lb)	6,560
$V_{channel}$ (ft/s)	9
Δx (ft)	1
C_i	0.6
C_o	0.8
C_d	1.0
C_b	1.0
R_{max}	0.8

F_i (lb)	3,168

Friction Force

Accounts for the friction force between the LWM and the channel bed. Restraint force from piles is not included as it does not exert a pressure on the LWS / bed interface.

$$F_f = -\mu_{bed} \times \left(F_{LWMs} + F_L + F_{bouldersub} + F_{backfillsub}\right)$$

	Design Value	Units / Source
$\mu_{bed} = coefficient\ of\ bed\ friction = tan(\theta)$	0.78	unit less
$\theta = internal\ friction\ angle\ (degrees)$	38	*Value based on extensive snag proof load testing on other similar projects.*

F_f (lb)	-37,171

Negative values resist downstream displacement.

Lateral Resistance From Piles

Accounts for the lateral resistance provided by piles within the LWM structure. Assumes soil resistance is limiting, i.e. the pile pushes over before it breaks.

$$F_{piles-h} = N_{piles} \times \frac{L_{pile}^3 \times \frac{1}{2} \times (\gamma_s - \gamma_w) \times d_{pile} \times K_p}{h_{load} + L_{pile}}$$

		Design Values	Units
$N_{pile} = number\ of\ piles$	Number of effective piles varies based on best engineering judgment.	18	number
$L_{pile} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$		10.7	ft
$d_{pile} = diameter\ of\ the\ pile$		1.3	ft
$h_{load} = applied\ load\ height\ above\ the\ potential\ scour\ depth$		4.8	ft
$K_p = \frac{1 + \sin\theta}{1 - \sin\theta}$		4.2	unit less

$F_{piles-h}$ (lb)	-278,008

Negative values resist downstream displacement.

Sliding Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{sliding} = \frac{F_f + F_{piles-h}}{F_d + F_{hu} + F_{hd} + F_i}$$

FOS sliding **6.92**

Pile Strength Factor of Safety

The factor of safety for the timber bending stress capacity of the pile. This evaluates the potential for the pile(s) to break under load prior to the pile pushing over in the ground.

		Design Values	Units
$F_b = Timber\ Bending\ Stress\ Capacity$ per Timber Pile Manual Table 3-1 or AWC NDS Supplement Table 4D		1,200	psi
		172,800	psf
$d_{pile} = diameter\ of\ the\ pile$		1.33	ft
$I = circular\ cross-sectional\ moment\ of\ inertia$	$I = \frac{\pi\, d_{pile}^{\,4}}{64}$	0.16	ft^4
$S = circular\ section\ modulus$	$S = \frac{\pi\, d_{pile}^{\,3}}{32}$	0.233	ft^3
$C_F = strength\ reduction\ size\ factor$ for diameters greater than 12"	$C_F = \frac{1}{d_{pile}}^{(1/9)}$	0.969	--
$M_p = applied\ moment\ per\ pile$	$M_p = \frac{(F_d + F_i + F_h) \times h_{load}}{N_{piles}}$	12,231	ft-lb
$f_b = applied\ pile\ bending\ stress$	$f_b = \frac{M_p}{S}$	52,559	psf
$F_{bx} = Pile\ bending\ stress\ capacity$	$F_{bx} = F_b \times C_F$	1,162	psi
		167,364	psf

$$FOS_{pile\ stength} = \frac{F_{bx}}{f_b}$$

FOS pile strength **3.2**

References

Large Woody Material - Risk Based Design Guidelines
M. Knutson, J. Fealko. 2014. *Large Woody Material - Risk Based Design Guidelines.* U.S. Department of the Interior Bureau of Reclamation Pacific Northwest Region & Technical Services. Boise, Idaho. September 2014. Online at: http://www.usbr.gov/pn//fcrps/documents/lwm.pdf

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American Wood Council (2018) National Design Specifications for Wood Construction, Design Supplement.

Lower Chiwawa River Project Area D - Large Woody Structure Stability Evaluation

Structural Stability | *6.4*

Structural stability of large woody material placements is evaluated herein using the procedures, formulas, and recommendations provided in the Reclamation's *Large Woody Material - Risk Based Design Guidelines* (Knutson et. al. 2014) along with insight gained from professional experience and general engineering judgment.

Factors of Safety | *6.4.1*

Safety factors for structural stability were selected from Table 4.
Minimum recommended factors of safety given the site specific public safety and property damage risk levels are as follows:

Public Safety Risk	High	**$FOS_{sliding}$**	1.5
Property Damage Risk	Moderate	**$FOS_{buoyancy}$**	1.75
Stability Design Flow Criteria	100-year modeled flow approach velocity	**$FOS_{rotation}$**	N/A

Resistance to Flotation | *6.4.2*

Flotation is typically caused by the buoyant force and the lift force acting on the wood material from water passing over its surface.

Large Wood Material Force

Accounts for the vertical buoyant force of submerged large wood and the vertical weight force of unsubmerged large wood.

$$F_{LWMs} = V_{LWMs} \times (\gamma_{wood} - \gamma_w)$$

$$V_{LWMs} = total\ volume\ of\ submerged\ large\ wood\ material$$

$$V_{LWMs} = \sum N_{LWMi} \times V_{LWMi}$$

Variable	Design Value	Units	
$\gamma_{wood} = unit\ weight\ of\ wood$	33	lb/ft^3	*Typical of Douglas fir density*
$\gamma_{wood} = unit\ weight\ of\ wood$	28	lb/ft^3	*Typical of Cedar density*
$\gamma_w = unit\ weight\ of\ water$	62.4	lb/ft^3	
V_{LWMs} (Douglas Fir)	4766	ft^3	
V_{LWMs} (Cedar)	0	ft^3	

F_{LWMs} (lb)	**140,124**	*Positive values are upward forces.*

Lift Force

Accounts for the lift force of large wood in flowing water. Not applicable to LWS where the bed will deform around the leading edges.

$$F_L = \frac{C_L \times A_{LWM} \times \gamma_w \times U_o^2}{2 \times g}$$

	Design Value	Units / Notes
$C_L = lift\ coefficient$	0.2	typ. LWM value
$A_{LWM} = area\ of\ large\ woody\ material\ perpendicular\ to\ flow$	$A_{LWM} = See\ Design\ Plan$	
	A LWM (ft²) **432**	
$U_u = upstream\ channel\ velocity\ at\ design\ event$	12	ft/s
$g = acceleration\ due\ to\ gravity$	32.2	ft/s²

F L (lb)	**N/A**

Boulder Ballast Force

Accounts for the ballasting force of large boulders directly attached to or placed over LWM.

$$_{bouldersub} = N_{bouldersub} \times {}^{\pi}/_{6} \times d^3_{bouldersub} \times (\gamma_{boulder} - \gamma_w)$$

	Design Value	Units / Notes
$_{bouldersub} = number\ of\ submerged\ boulders$	0	number
$_{bouldersub} = effective\ diameter\ of\ submerged\ boulders$	3	ft
$= unit\ weight\ of\ boulders$	156	lb/ft³

F bouldersub (lb)	**0**

Backfill Ballast Force

Accounts for the ballasting force of backfill placed directly over LWM members. Volume is based on the fill area over the log(s) and a the effective cover depth shown on the Drawings.

$$_{backfillsub} = V_{backfillsub} \times (\gamma_s - \gamma_w)$$

	Design Value	Units / Notes
$_{backfillsub} = volume\ of\ backfill\ over\ LWM\ members$	2,430	ft³
$weight\ of\ backfill\ material$	*See design plans* 132	lb/ft³

F backfillsub (lb)	**-169,128**

Pile Skin Friction

Accounts for the vertical resistance provided by piles within the LWM structure. USBR document equation modified by Inter-Fluve to match industry pile design standard formulations.

$$F_{piles} = N_{piles} \times \pi \times d_{piles} \times L_{piles} \times \left(k_s \times \tan\tfrac{2}{3}\theta \times \sigma'\right)$$

Assumes piles are connected to logs.

	Design Values	Units
$N_{piles} = number\ of\ piles$	15	number
$L_{piles} = avg.\ length\ of\ pile\ embedded\ below\ potential\ scour\ depth$	10.6	ft
$d_{piles} = nominal\ diameter\ of\ the\ piles$	1.3	ft
$\sigma' = \left(L_{piles} \times (\gamma_{sat} - \gamma_w)\right)$	737.76	lb/ft^2
$K_s = coefficient\ of\ lateral\ earth\ pressure\ (0.5\ to\ 1.0)$	0.6	unit less
$\theta = internal\ friction\ angle\ of\ soils$	38	deg.

Value based on extensive pile proof load testing on other similar projects.

F piles-v (lb)	**-140,198**	*Negative values resist upward displacement.*

Piles Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bPiles} = \frac{F_{piles-v}}{F_{LWMs}+F_L}$$

FOS b	1.0

Note this value does not include the backfill assuming it's all lost but the piles are holding.

Backfill and Ballast Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bBackfill} = \frac{F_{backfillsub}}{F_{LWMs}+F_L}$$

FOS b	1.2

Note this value does not include the piles.

Net Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bNet} = \frac{F_{backfillsub}+F_{piles-v}}{F_{LWMs}+F_L}$$

FOS b	**2.2**

Note this value includes the piles and backfill.

Resistance to Sliding | *6.4.3*

LWM structures are also susceptible to failure through sliding.

Drag Force

LWM structures are pushed downstream by the fluid drag forces acting upon the wood by the flowing water.

$$F_d = \frac{C_D \times A_{LWM} \times \gamma_w \times U_c^2}{2 \times g}$$

	Design Value	Units / Notes
$C_D = drag\ coefficient$	1	Per Equations 23 and 24
$A_{LWM} = area\ of\ wetted\ wood\ normal\ to\ the\ flow\ direction$	$A_{LWM} = See\ Design\ Plan$	**A_{LWM} (ft^2) 432**
$U_c = velocity\ adjacent\ to\ the\ LWM\ structure$	12	ft/s — *Velocity value is conservative for all LWS locations. Value from max. 2D model results for LWS lactations.*
$g = acceleration\ due\ to\ gravity$	32.2	ft/s^2

F_d (lb) 60,276

Hydrostatic Force

Hydrostatic forces act on the upstream and downstream faces of a LWM structure. They account for differences in the upstream and downstream water depths against the structure.

$$F_{hu} = \tfrac{1}{2} \times \gamma_w \times Y_u \times A_u \qquad F_{hd} = \tfrac{1}{2} \times \gamma_w \times Y_d \times A_d$$

F_{hu} , $F_{hd} = hydrostatic\ force\ on\ upstream\ and\ downstream\ side\ of\ the\ wood\ structure$

Y_u , $Y_d = water\ depth\ upstream\ and\ downstream\ of\ the\ structue$

A_u , $A_d = area\ projected\ to\ flow\ direction\ on\ the\ upstream\ and\ downstream\ of\ the\ structure$

Variable	Design Value
Y_u (ft)	8
A_u (ft^2)	432
Post racking area	
Y_d (ft)	8
A_d (ft^2)	432
Plan downstream area	

$F_{hu} + F_{hd} = F_h$ (lb) 0

Impact Force

The impact force associated with debris impacting a large wood structure can be estimated by the impact force equation.

$$F_i = \frac{w_{debris}}{g} \times \frac{V_{channel}\text{^}2}{2 \times \Delta x} \times C_i \times C_o \times C_d \times C_b \times R_{max}$$

$w_{debris} = weight\ of\ debris$

$V_{channel} = channel\ approach\ velocity$

$\Delta x = deceleration\ distance$

Coefficients *(see Table 8 and Figures 11, 12 for values)*
$C_i = importance$, $C_o = orientation = 0.8$, $C_d = depth$, $C_b = blockage$, $R_{max} = impluse\ response\ ratio$

Variable	Design Value
W_{debris} (lb)	6,560
$V_{channel}$ (ft/s)	12
Δx (ft)	1
C_i	0.6
C_o	0.8
C_d	1.0
C_b	1.0
R_{max}	0.8

F_i (lb)	5,633

Friction Force

Accounts for the friction force between the LWM and the channel bed. Restraint force from piles is not included as it does not exert a pressure on the LWS / bed interface.

$$F_f = -\mu_{bed} \times \left(F_{LWMs} + F_L + F_{bouldersub} + F_{backfillsub}\right)$$

	Design Value	Units / Source
$\mu_{bed} = coefficient\ of\ bed\ friction = tan(\theta)$	0.78	unit less
$\theta = internal\ friction\ angle\ (degrees)$	38	*Value based on extensive snag proof load testing on other similar projects.*

F_f (lb)	-22,661

Negative values resist downstream displacement.

Lateral Resistance From Piles

Accounts for the lateral resistance provided by piles within the LWM structure. Assumes soil resistance is limiting, i.e. the pile pushes over before it breaks.

$$F_{piles-h} = N_{piles} \times \frac{L_{pile}^3 \times \frac{1}{2} \times (\gamma_s - \gamma_w) \times d_{pile} \times K_p}{h_{load} + L_{pile}}$$

		Design Values	Units
$N_{pile} = number\ of\ piles$	Number of effective piles varies based on best engineering judgment.	15	number
$L_{pile} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$		10.6	ft
$d_{pile} = diameter\ of\ the\ pile$		1.3	ft
$h_{load} = applied\ load\ height\ above\ the\ potential\ scour\ depth$		4.9	ft
$K_p = \frac{1 + \sin\theta}{1 - \sin\theta}$		4.2	unit less

$F_{piles-h}$ (lb)	-227,760

Negative values resist downstream displacement.

Sliding Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{sliding} = \frac{F_f + F_{piles-h}}{F_d + F_{hu} + F_{hd} + F_i}$$

FOS sliding **3.80**

Pile Strength Factor of Safety

The factor of safety for the timber bending stress capacity of the pile. This evaluates the potential for the pile(s) to break under load prior to the pile pushing over in the ground.

		Design Values	Units
$F_b = Timber\ Bending\ Stress\ Capacity$ per Timber Pile Manual Table 3-1 or AWC NDS Supplement Table 4D		1,200	psi
		172,800	psf
$d_{pile} = diameter\ of\ the\ pile$		1.33	ft
$I = circular\ cross-sectional\ moment\ of\ inertia$	$I = \frac{\pi\, d_{pile}^{\,4}}{64}$	0.16	ft^4
$S = circular\ section\ modulus$	$S = \frac{\pi\, d_{pile}^{\,3}}{32}$	0.233	ft^3
$C_F = strength\ reduction\ size\ factor$ for diameters greater than 12"	$C_F = \frac{1}{d_{pile}}^{(1/9)}$	0.969	--
$M_p = applied\ moment\ per\ pile$	$M_p = \frac{(F_d + F_i + F_h) \times h_{load}}{N_{piles}}$	21,530	ft-lb
$f_b = applied\ pile\ bending\ stress$	$f_b = \frac{M_p}{S}$	92,519	psf
$F_{bx} = Pile\ bending\ stress\ capacity$	$F_{bx} = F_b \times C_F$	1,162	psi
		167,364	psf

$$FOS_{pile\ stength} = \frac{F_{bx}}{f_b}$$

FOS pile strength **1.8**

References

Large Woody Material - Risk Based Design Guidelines
M. Knutson, J. Fealko. 2014. *Large Woody Material - Risk Based Design Guidelines.* U.S. Department of the Interior Bureau of Reclamation Pacific Northwest Region & Technical Services. Boise, Idaho. September 2014. Online at: http://www.usbr.gov/pn//fcrps/documents/lwm.pdf

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Lower Chiwawa River Project Area D - Large Woody Structure Stability Evaluation

Structural Stability | *6.4*

Structural stability of large woody material placements is evaluated herein using the procedures, formulas, and recommendations provided in the Reclamation's *Large Woody Material - Risk Based Design Guidelines* (Knutson et. al. 2014) along with insight gained from professional experience and general engineering judgment.

Factors of Safety | *6.4.1*

Safety factors for structural stability were selected from Table 4.
Minimum recommended factors of safety given the site specific public safety and property damage risk levels are as follows:

Public Safety Risk	High	**$FOS_{sliding}$**	1.5
Property Damage Risk	Moderate	**$FOS_{buoyancy}$**	1.75
Stability Design Flow Criteria	100-year modeled flow approach velocity	**$FOS_{rotation}$**	N/A

Resistance to Flotation | *6.4.2*

Flotation is typically caused by the buoyant force and the lift force acting on the wood material from water passing over its surface.

Large Wood Material Force

Accounts for the vertical buoyant force of submerged large wood and the vertical weight force of unsubmerged large wood.

$$F_{LWMs} = V_{LWMs} \times (\gamma_{wood} - \gamma_w)$$

$$V_{LWMs} = total\ volume\ of\ submerged\ large\ wood\ material$$

$$V_{LWMs} = \sum N_{LWMi} \times V_{LWMi}$$

Variable	Design Value	Units	
$\gamma_{wood} = unit\ weight\ of\ wood$	33	lb/ft^3	*Typical of Douglas fir density*
$\gamma_{wood} = unit\ weight\ of\ wood$	28	lb/ft^3	*Typical of Cedar density*
$\gamma_w = unit\ weight\ of\ water$	62.4	lb/ft^3	
V_{LWMs} (Douglas Fir)	2672	ft^3	
V_{LWMs} (Cedar)	0	ft^3	

F_{LWMs} (lb)	**78,546**	*Positive values are upward forces.*

Lift Force

Accounts for the lift force of large wood in flowing water. Not applicable to LWS where the bed will deform around the leading edges.

$$F_L = \frac{C_L \times A_{LWM} \times \gamma_w \times U_o^2}{2 \times g}$$

	Design Value	Units / Notes
$C_L = lift\ coefficient$	0.2	typ. LWM value
$A_{LWM} = area\ of\ large\ woody\ material\ perpendicular\ to\ flow$	$A_{LWM} = See\ Design\ Plan$	
	A LWM (ft²) **105**	
$U_u = upstream\ channel\ velocity\ at\ design\ event$	10	ft/s
$g = acceleration\ due\ to\ gravity$	32.2	ft/s²

F L (lb)	**N/A**

Boulder Ballast Force

Accounts for the ballasting force of large boulders directly attached to or placed over LWM.

$$_{bouldersub} = N_{bouldersub} \times {}^{\pi}/_{6} \times d^3_{bouldersub} \times (\gamma_{boulder} - \gamma_w)$$

	Design Value	Units / Notes
$_{bouldersub} = number\ of\ submerged\ boulders$	0	number
$_{bouldersub} = effective\ diameter\ of\ submerged\ boulders$	3	ft
$= unit\ weight\ of\ boulders$	156	lb/ft³

F bouldersub (lb)	**0**

Backfill Ballast Force

Accounts for the ballasting force of backfill placed directly over LWM members. Volume is based on the fill area over the log(s) and a the effective cover depth shown on the Drawings.

$$_{backfillsub} = V_{backfillsub} \times (\gamma_s - \gamma_w)$$

	Design Value	Units / Notes
$_{backfillsub} = volume\ of\ backfill\ over\ LWM\ members$	1,584	ft³
$weight\ of\ backfill\ material$	*See design plans* 132	lb/ft³

F backfillsub (lb)	**-110,246**

Pile Skin Friction

Accounts for the vertical resistance provided by piles within the LWM structure. USBR document equation modified by Inter-Fluve to match industry pile design standard formulations.

$$F_{piles-v} = N_{piles} \times \pi \times d_{piles} \times L_{piles} \times \left(k_s \times \tan\tfrac{2}{3}\theta \times \sigma'\right)$$

Assumes piles are connected to logs.

	Design Values	Units
$N_{piles} = number\ of\ piles$	8	number
$L_{piles} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$	7.5	ft
$d_{piles} = nominal\ diameter\ of\ the\ piles$	1.3	ft
$\sigma' = \left(L_{piles} \times (\gamma_{sat} - \gamma_w)\right)$	522	lb/ft^2
$K_s = coefficient\ of\ lateral\ earth\ pressure\ (0.5\ to\ 1.0)$	0.6	unit less
$\theta = internal\ friction\ angle\ of\ soils$	38	deg.

Value based on extensive pile proof load testing on other similar projects.

F piles-v (lb)	**-38,755**	*Negative values resist upward displacement.*

Piles Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bPiles} = \frac{F_{piles-v}}{F_{LWMs}+F_L}$$

FOS b 0.5

Note this value does not include the backfill assuming it's all lost but the piles are holding.

Backfill and Ballast Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bBackfill} = \frac{F_{backfillsub}}{F_{LWMs}+F_L}$$

FOS b 1.4

Note this value does not include the piles.

Net Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bNet} = \frac{F_{backfillsub}+F_{piles-v}}{F_{LWMs}+F_L}$$

***FOS b* 1.9**

Note this value includes the piles and backfill.

Resistance to Sliding | *6.4.3*

LWM structures are also susceptible to failure through sliding.

Drag Force

LWM structures are pushed downstream by the fluid drag forces acting upon the wood by the flowing water.

$$F_d = \frac{C_D \times A_{LWM} \times \gamma_w \times U_c^2}{2 \times g}$$

	Design Value	Units / Notes
$C_D = drag\ coefficient$	1	Per Equations 23 and 24
$A_{LWM} = area\ of\ wetted\ wood\ normal\ to\ the\ flow\ direction$	$A_{LWM} = See\ Design\ Plan$	**A_{LWM} (ft^2) 105**
$U_c = velocity\ adjacent\ to\ the\ LWM\ structure$	10	ft/s — *Velocity value is conservative for all LWS locations. Value from max. 2D model results for LWS lactations.*
$g = acceleration\ due\ to\ gravity$	32.2	ft/s^2

F_d (lb) 10,174

Hydrostatic Force

Hydrostatic forces act on the upstream and downstream faces of a LWM structure. They account for differences in the upstream and downstream water depths against the structure.

$$F_{hu} = \tfrac{1}{2} \times \gamma_w \times Y_u \times A_u \qquad F_{hd} = \tfrac{1}{2} \times \gamma_w \times Y_d \times A_d$$

F_{hu} , $F_{hd} = hydrostatic\ force\ on\ upstream\ and\ downstream\ side\ of\ the\ wood\ structure$

Y_u , $Y_d = water\ depth\ upstream\ and\ downstream\ of\ the\ structue$

A_u , $A_d = area\ projected\ to\ flow\ direction\ on\ the\ upstream\ and\ downstream\ of\ the\ structure$

Variable	Design Value
Y_u (ft)	8
A_u (ft^2)	105
Post racking area	
Y_d (ft)	8
A_d (ft^2)	105
Plan downstream area	

$F_{hu} + F_{hd} = F_h$ (lb) 0

Impact Force

The impact force associated with debris impacting a large wood structure can be estimated by the impact force equation.

$$F_i = \frac{w_{debris}}{g} \times \frac{V_{channel}\text{^}2}{2 \times \Delta x} \times C_i \times C_o \times C_d \times C_b \times R_{max}$$

$w_{debris} = weight\ of\ debris$

$V_{channel} = channel\ approach\ velocity$

$\Delta x = deceleration\ distance$

Coefficients *(see Table 8 and Figures 11, 12 for values)*
$C_i = importance$, $C_o = orientation = 0.8$, $C_d = depth$, $C_b = blockage$, $R_{max} = impluse\ response\ ratio$

Variable	Design Value
W_{debris} (lb)	6,560
$V_{channel}$ (ft/s)	10
Δx (ft)	1
C_i	0.6
C_o	0.8
C_d	1.0
C_b	1.0
R_{max}	0.8

F_i (lb)	3,912

Friction Force

Accounts for the friction force between the LWM and the channel bed. Restraint force from piles is not included as it does not exert a pressure on the LWS / bed interface.

$$F_f = -\mu_{bed} \times \left(F_{LWMs} + F_L + F_{bouldersub} + F_{backfillsub}\right)$$

	Design Value	Units / Source
$\mu_{bed} = coefficient\ of\ bed\ friction = tan(\theta)$	0.78	unit less
$\theta = internal\ friction\ angle\ (degrees)$	38	*Value based on extensive snag proof load testing on other similar projects.*

F_f (lb)	-24,767

Negative values resist downstream displacement.

Lateral Resistance From Piles

Accounts for the lateral resistance provided by piles within the LWM structure. Assumes soil resistance is limiting, i.e. the pile pushes over before it breaks.

$$F_{pil} = N_{piles} \times \frac{L_{pile}^3 \times \frac{1}{2} \times (\gamma_s - \gamma_w) \times d_{pile} \times K_p}{h_{load} + L_{pile}}$$

		Design Values	Units
$N_{pile} = number\ of\ piles$	Number of effective piles varies based on best engineering judgment.	8	number
$L_{pile} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$		7.5	ft
$d_{pile} = diameter\ of\ the\ pile$		1.3	ft
$h_{load} = applied\ load\ height\ above\ the\ potential\ scour\ depth$		4.5	ft
$K_p = \frac{1 + \sin\theta}{1 - \sin\theta}$		4.2	unit less

$F_{piles\text{-}h}$ (lb)	-61,442

Negative values resist downstream displacement.

Sliding Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{sliding} = \frac{F_f + F_{piles-h}}{F_d + F_{hu} + F_{hd} + F_i}$$

FOS sliding **6.12**

Pile Strength Factor of Safety

The factor of safety for the timber bending stress capacity of the pile. This evaluates the potential for the pile(s) to break under load prior to the pile pushing over in the ground.

		Design Values	Units
$F_b = Timber\ Bending\ Stress\ Capacity$ per Timber Pile Manual Table 3-1 or AWC NDS Supplement Table 4D		1,000	psi
		144,000	psf
$d_{pile} = diameter\ of\ the\ pile$		1.33	ft
$I = circular\ cross-sectional\ moment\ of\ inertia$	$I = \frac{\pi\, d_{pile}^{\,4}}{64}$	0.16	ft^4
$S = circular\ section\ modulus$	$S = \frac{\pi\, d_{pile}^{\,3}}{32}$	0.233	ft^3
$C_F = strength\ reduction\ size\ factor$ for diameters greater than 12"	$C_F = \frac{1}{d_{pile}}^{(1/9)}$	0.969	--
$M_p = applied\ moment\ per\ pile$	$M_p = \frac{(F_d + F_i + F_h) \times h_{load}}{N_{piles}}$	7,923	ft-lb
$f_b = applied\ pile\ bending\ stress$	$f_b = \frac{M_p}{S}$	34,047	psf
$F_{bx} = Pile\ bending\ stress\ capacity$	$F_{bx} = F_b \times C_F$	969	psi
		139,470	psf

$$FOS_{pile\ stength} = \frac{F_{bx}}{f_b}$$

FOS pile strength **4.1**

References

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M. Knutson, J. Fealko. 2014. *Large Woody Material - Risk Based Design Guidelines.* U.S. Department of the Interior Bureau of Reclamation Pacific Northwest Region & Technical Services. Boise, Idaho. September 2014. Online at: http://www.usbr.gov/pn//fcrps/documents/lwm.pdf

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American Wood Council (2018) National Design Specifications for Wood Construction, Design Supplement.

Lower Chiwawa River Project Area D - Large Woody Structure Stability Evaluation

Structural Stability | *6.4*

Structural stability of large woody material placements is evaluated herein using the procedures, formulas, and recommendations provided in the Reclamation's *Large Woody Material - Risk Based Design Guidelines* (Knutson et. al. 2014) along with insight gained from professional experience and general engineering judgment.

Factors of Safety | *6.4.1*

Safety factors for structural stability were selected from Table 4.

Minimum recommended factors of safety given the site specific public safety and property damage risk levels are as follows:

Public Safety Risk	High	$FOS_{sliding}$	1.5
Property Damage Risk	Moderate	$FOS_{buoyancy}$	1.75
Stability Design Flow Criteria	100-year modeled flow approach velocity	$FOS_{rotation}$	N/A

Resistance to Flotation | *6.4.2*

Flotation is typically caused by the buoyant force and the lift force acting on the wood material from water passing over its surface.

Large Wood Material Force

Accounts for the vertical buoyant force of submerged large wood and the vertical weight force of unsubmerged large wood.

$$F_{LWMs} = V_{LWMs} \times (\gamma_{wood} - \gamma_w)$$

$$V_{LWMs} = total\ volume\ of\ submerged\ large\ wood\ material$$

$$V_{LWMs} = \sum N_{LWMi} \times V_{LWMi}$$

Variable	Design Value	Units	
$\gamma_{wood} = unit\ weight\ of\ wood$	33	lb/ft^3	*Typical of Douglas fir density*
$\gamma_{wood} = unit\ weight\ of\ wood$	28	lb/ft^3	*Typical of Cedar density*
$\gamma_w = unit\ weight\ of\ water$	62.4	lb/ft^3	
V_{LWMs} (Douglas Fir)	3570	ft^3	
V_{LWMs} (Cedar)	0	ft^3	

F $_{LWMs}$ (lb)	**104,953**	*Positive values are upward forces.*

Lift Force

Accounts for the lift force of large wood in flowing water. Not applicable to LWS where the bed will deform around the leading edges.

$$F_L = \frac{C_L \times A_{LWM} \times \gamma_w \times U_o^2}{2 \times g}$$

	Design Value	Units / Notes
$C_L = lift\ coefficient$	0.2	typ. LWM value
$A_{LWM} = area\ of\ large\ woody\ material\ perpendicular\ to\ flow$	$A_{LWM} = See\ Design\ Plan$	***A LWM (ft²)*** **135**
$U_u = upstream\ channel\ velocity\ at\ design\ event$	5	ft/s
$g = acceleration\ due\ to\ gravity$	32.2	ft/s²

F L (lb)	**N/A**

Boulder Ballast Force

Accounts for the ballasting force of large boulders directly attached to or placed over LWM.

$$_{bouldersub} = N_{bouldersub} \times {}^{\pi}/_{6} \times d^3_{bouldersub} \times (\gamma_{boulder} - \gamma_w)$$

	Design Value	Units / Notes
$_{bouldersub} = number\ of\ submerged\ boulders$	0	number
$_{bouldersub} = effective\ diameter\ of\ submerged\ boulders$	3	ft
$= unit\ weight\ of\ boulders$	156	lb/ft³

F bouldersub (lb)	**0**

Backfill Ballast Force

Accounts for the ballasting force of backfill placed directly over LWM members. Volume is based on the fill area over the log(s) and a the effective cover depth shown on the Drawings.

$$_{backfillsub} = V_{backfillsub} \times (\gamma_s - \gamma_w)$$

	Design Value	Units / Notes
$_{backfillsub} = volume\ of\ backfill\ over\ LWM\ members$	2,280	ft³
$weight\ of\ backfill\ material$	*See design plans* 132	lb/ft³

F backfillsub (lb)	**-158,688**

Pile Skin Friction

Accounts for the vertical resistance provided by piles within the LWM structure. USBR document equation modified by Inter-Fluve to match industry pile design standard formulations.

$$F_{piles-v} = N_{piles} \times \pi \times d_{piles} \times L_{piles} \times \left(k_s \times \tan\tfrac{2}{3}\theta \times \sigma'\right)$$

Assumes piles are connected to logs.

	Design Values	Units
$N_{piles} = number\ of\ piles$	12	number
$L_{piles} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$	7.0	ft
$d_{piles} = nominal\ diameter\ of\ the\ piles$	1.3	ft
$\sigma' = \left(L_{piles} \times (\gamma_{sat} - \gamma_w)\right)$	487.2	lb/ft^2
$K_s = coefficient\ of\ lateral\ earth\ pressure\ (0.5\ to\ 1.0)$	0.6	unit less
$\theta = internal\ friction\ angle\ of\ soils$	38	deg.

Value based on extensive pile proof load testing on other similar projects.

F piles-v (lb)	**-51,343**	*Negative values resist upward displacement.*

Piles Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bPiles} = \frac{F_{piles}}{F_{LWMs}+F_L}$$

FOS b	0.5

Note this value does not include the backfill assuming it's all lost but the piles are holding.

Backfill and Ballast Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bBackfill} = \frac{F_{backfillsub}}{F_{LWMs}+F_L}$$

FOS b	1.5

Note this value does not include the piles.

Net Buoyancy Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{bNet} = \frac{F_{backfillsub}+F_{piles}}{F_{LWMs}+F_L}$$

FOS b	**2.0**

Note this value includes the piles and backfill.

Resistance to Sliding | *6.4.3*

LWM structures are also susceptible to failure through sliding.

Drag Force

LWM structures are pushed downstream by the fluid drag forces acting upon the wood by the flowing water.

$$F_d = \frac{C_D \times A_{LWM} \times \gamma_w \times U_c^2}{2 \times g}$$

	Design Value	Units / Notes
$C_D = drag\ coefficient$	1	Per Equations 23 and 24
$A_{LWM} = area\ of\ wetted\ wood\ normal\ to\ the\ flow\ direction$	$A_{LWM} = See\ Design\ Plan$	***A LWM (ft²)*** **135**
$U_c = velocity\ adjacent\ to\ the\ LWM\ structure$	5	ft/s — *Velocity value is conservative for all LWS locations. Value from max. 2D model results for LWS lactations.*
$g = acceleration\ due\ to\ gravity$	32.2	ft/s²

F d (lb) **3,270**

Hydrostatic Force

Hydrostatic forces act on the upstream and downstream faces of a LWM structure. They account for differences in the upstream and downstream water depths against the structure.

$$F_{hu} = \tfrac{1}{2} \times \gamma_w \times Y_u \times A_u \qquad F_{hd} = \tfrac{1}{2} \times \gamma_w \times Y_d \times A_d$$

F_{hu} , $F_{hd} = hydrostatic\ force\ on\ upstream\ and\ downstream\ side\ of\ the\ wood\ structure$

Y_u , $Y_d = water\ depth\ upstream\ and\ downstream\ of\ the\ structue$

A_u , $A_d = area\ projected\ to\ flow\ direction\ on\ the\ upstream\ and\ downstream\ of\ the\ structure$

Variable	Design Value
Y_u (ft)	8
A_u (ft²)	135
Post racking area	
Y_d (ft)	8
A_d (ft²)	135
Plan downstream area	

F hu + F hd = F h (lb) **0**

Impact Force

The impact force associated with debris impacting a large wood structure can be estimated by the impact force equation.

$$F_i = \frac{w_{debris}}{g} \times \frac{V_{channel}\text{^}2}{2 \times \Delta x} \times C_i \times C_o \times C_d \times C_b \times R_{max}$$

$w_{debris} = weight\ of\ debris$

$V_{channel} = channel\ approach\ velocity$

$\Delta x = deceleration\ distance$

Coefficients *(see Table 8 and Figures 11, 12 for values)*
$C_i = importance$, $C_o = orientation = 0.8$, $C_d = depth$, $C_b = blockage$, $R_{max} = impluse\ response\ ratio$

Variable	Design Value
W_{debris} (lb)	6,560
$V_{channel}$ (ft/s)	5
Δx (ft)	1
C_i	0.6
C_o	0.8
C_d	1.0
C_b	1.0
R_{max}	0.8

F_i (lb)	978

Friction Force

Accounts for the friction force between the LWM and the channel bed. Restraint force from piles is not included as it does not exert a pressure on the LWS / bed interface.

$$F_f = -\mu_{bed} \times \left(F_{LWMs} + F_L + F_{bouldersub} + F_{backfillsub}\right)$$

	Design Value	Units / Source
$\mu_{bed} = coefficient\ of\ bed\ friction = tan(\theta)$	0.78	unit less
$\theta = internal\ friction\ angle\ (degrees)$	38	*Value based on extensive snag proof load testing on other similar projects.*

F_f (lb)	-41,982

Negative values resist downstream displacement.

Lateral Resistance From Piles

Accounts for the lateral resistance provided by piles within the LWM structure. Assumes soil resistance is limiting, i.e. the pile pushes over before it breaks.

$$F_{piles-h} = N_{piles} \times \frac{L_{pile}^3 \times \frac{1}{2} \times (\gamma_s - \gamma_w) \times d_{pile} \times K_p}{h_{load} + L_{pile}}$$

		Design Values	Units
$N_{pile} = number\ of\ piles$	Number of effective piles varies based on best engineering judgment.	12	number
$L_{pile} = avg.length\ of\ pile\ embedded\ below\ potential\ scour\ depth$		7.0	ft
$d_{pile} = diameter\ of\ the\ pile$		1.3	ft
$h_{load} = applied\ load\ height\ above\ the\ potential\ scour\ depth$		6.5	ft
$K_p = \frac{1 + \sin\theta}{1 - \sin\theta}$		4.2	unit less

$F_{piles-h}$ (lb)	-69,179

Negative values resist downstream displacement.

Sliding Factor of Safety

The factor of safety is the absolute value of the sum of resisting forces divided by the sum of driving forces.

$$FOS_{sliding} = \frac{F_f + F_{piles}}{F_d + F_{hu} + F_{hd} + F_i}$$

FOS sliding **26.17**

Pile Strength Factor of Safety

The factor of safety for the timber bending stress capacity of the pile. This evaluates the potential for the pile(s) to break under load prior to the pile pushing over in the ground.

		Design Values	Units
$F_b = Timber\ Bending\ Stress\ Capacity$ per Timber Pile Manual Table 3-1 or AWC NDS Supplement Table 4D		1,000	psi
		144,000	psf
$d_{pile} = diameter\ of\ the\ pile$		1.33	ft
$I = circular\ cross-sectional\ moment\ of\ inertia$	$I = \frac{\pi\, d_{pile}^{\,4}}{64}$	0.16	ft^4
$S = circular\ section\ modulus$	$S = \frac{\pi\, d_{pile}^{\,3}}{32}$	0.233	ft^3
$C_F = strength\ reduction\ size\ factor$ for diameters greater than 12"	$C_F = \frac{1}{d_{pile}}^{(1/9)}$	0.969	--
$M_p = applied\ moment\ per\ pile$	$M_p = \frac{(F_d + F_i + F_h) \times h_{load}}{N_{piles}}$	2,301	ft-lb
$f_b = applied\ pile\ bending\ stress$	$f_b = \frac{M_p}{S}$	9,888	psf
$F_{bx} = Pile\ bending\ stress\ capacity$	$F_{bx} = F_b \times C_F$	969	psi
		139,470	psf

$$FOS_{pile\ stength} = \frac{F_{bx}}{f_b}$$

FOS pile strength **14.1**

References

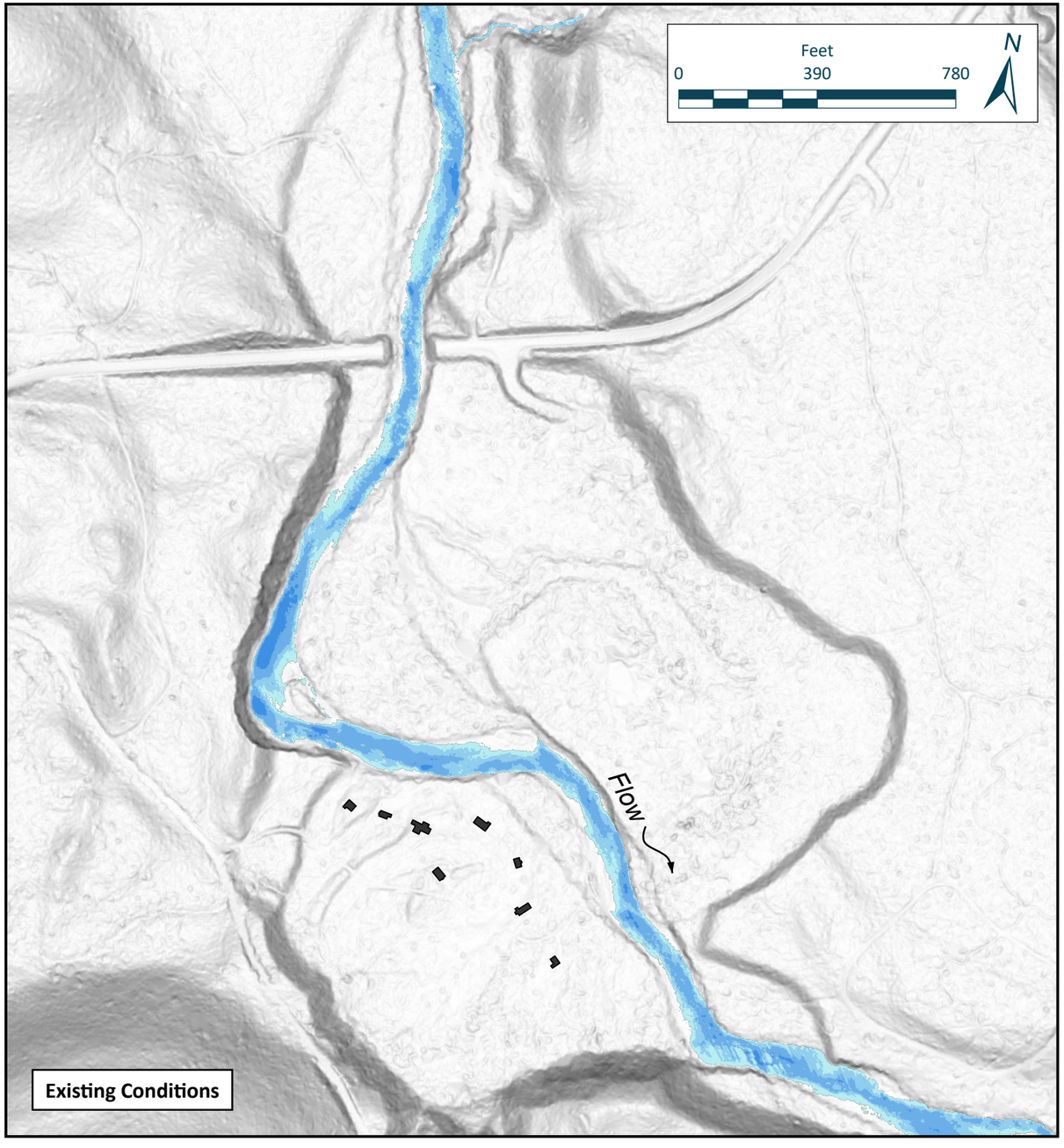
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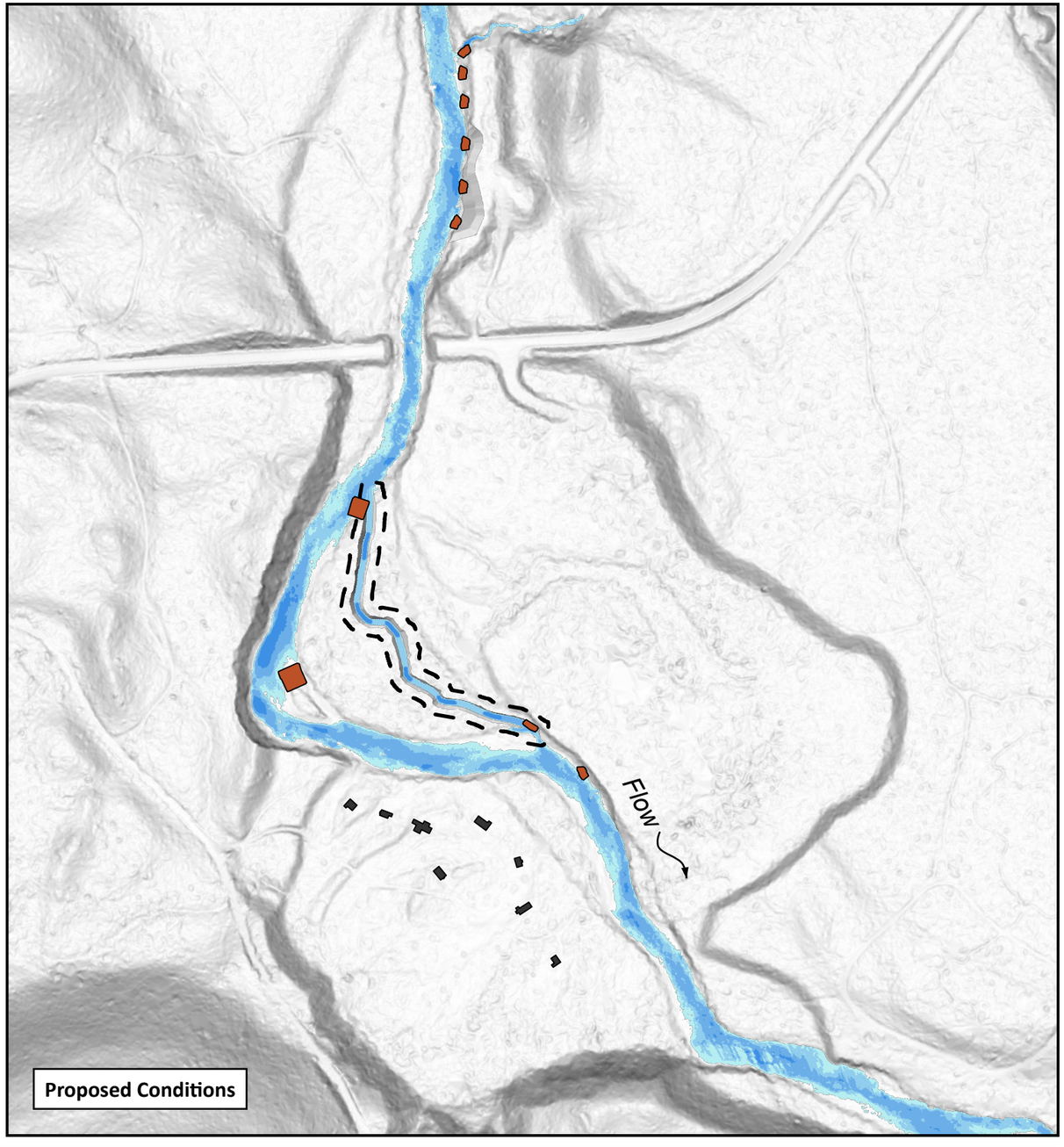
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Appendix C | Hydraulic Modeling Results





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

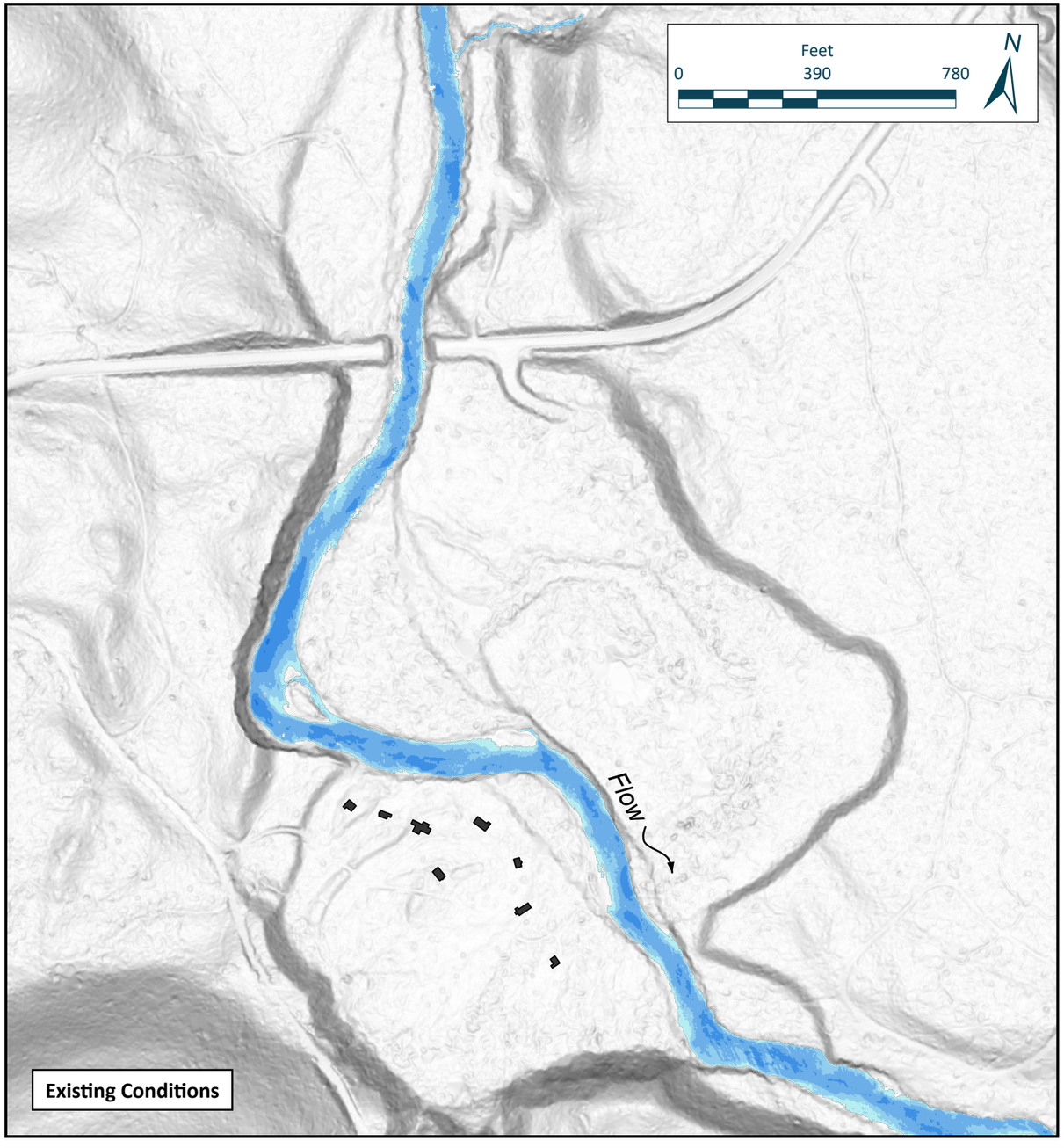
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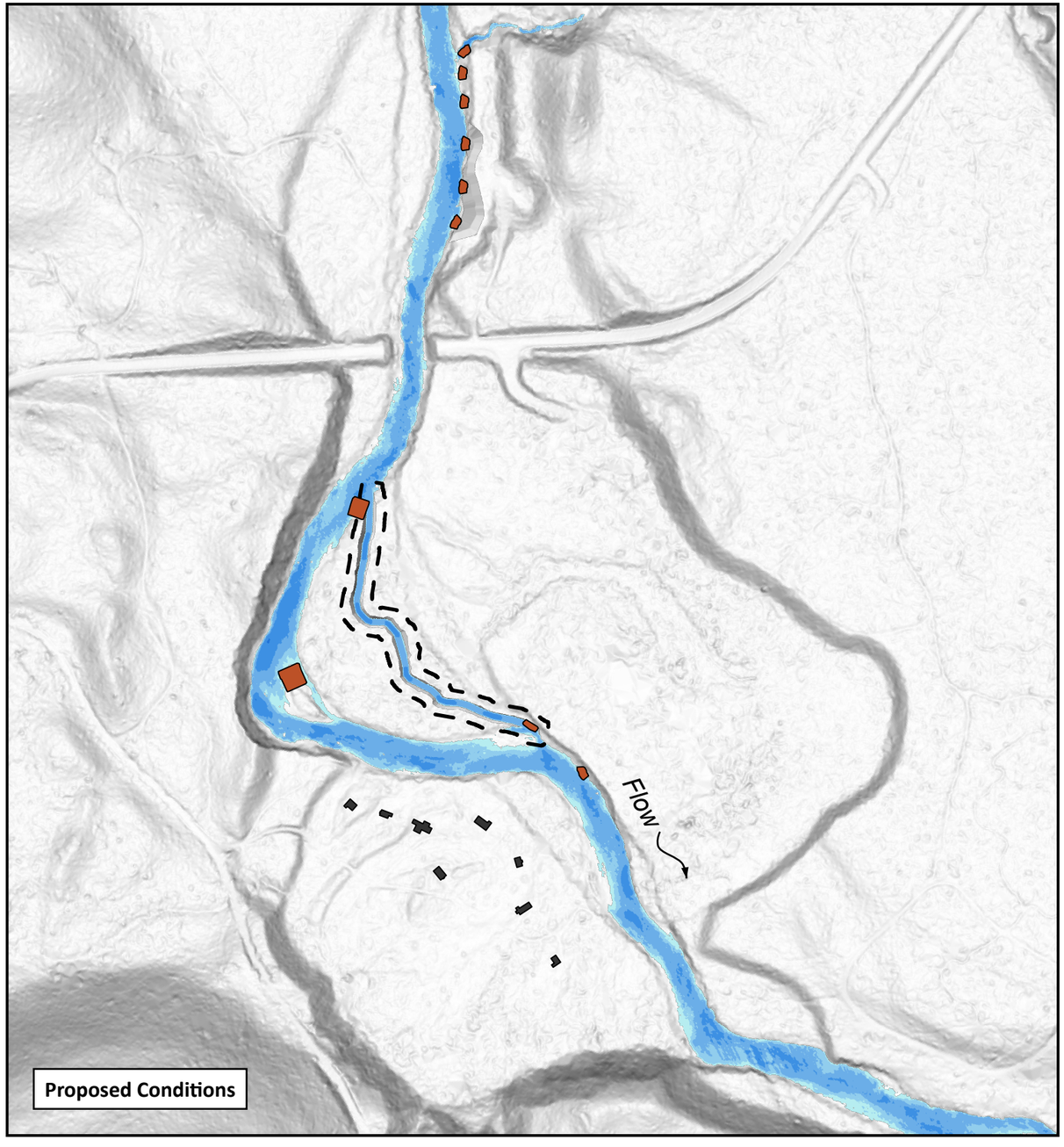
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

September Mean Daily Flow:

Modeled Discharge: 139 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

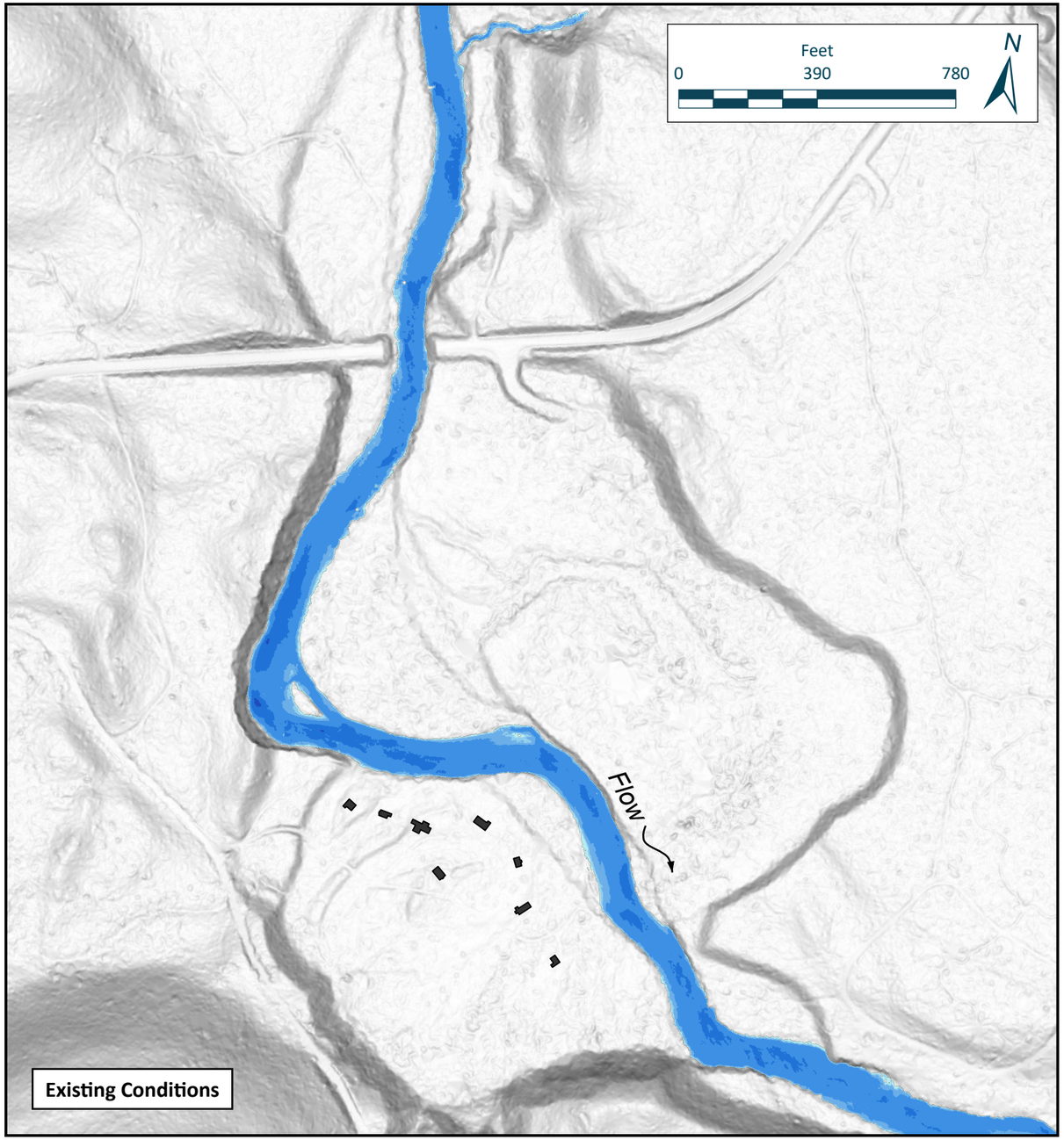
Modeled Depth (ft)

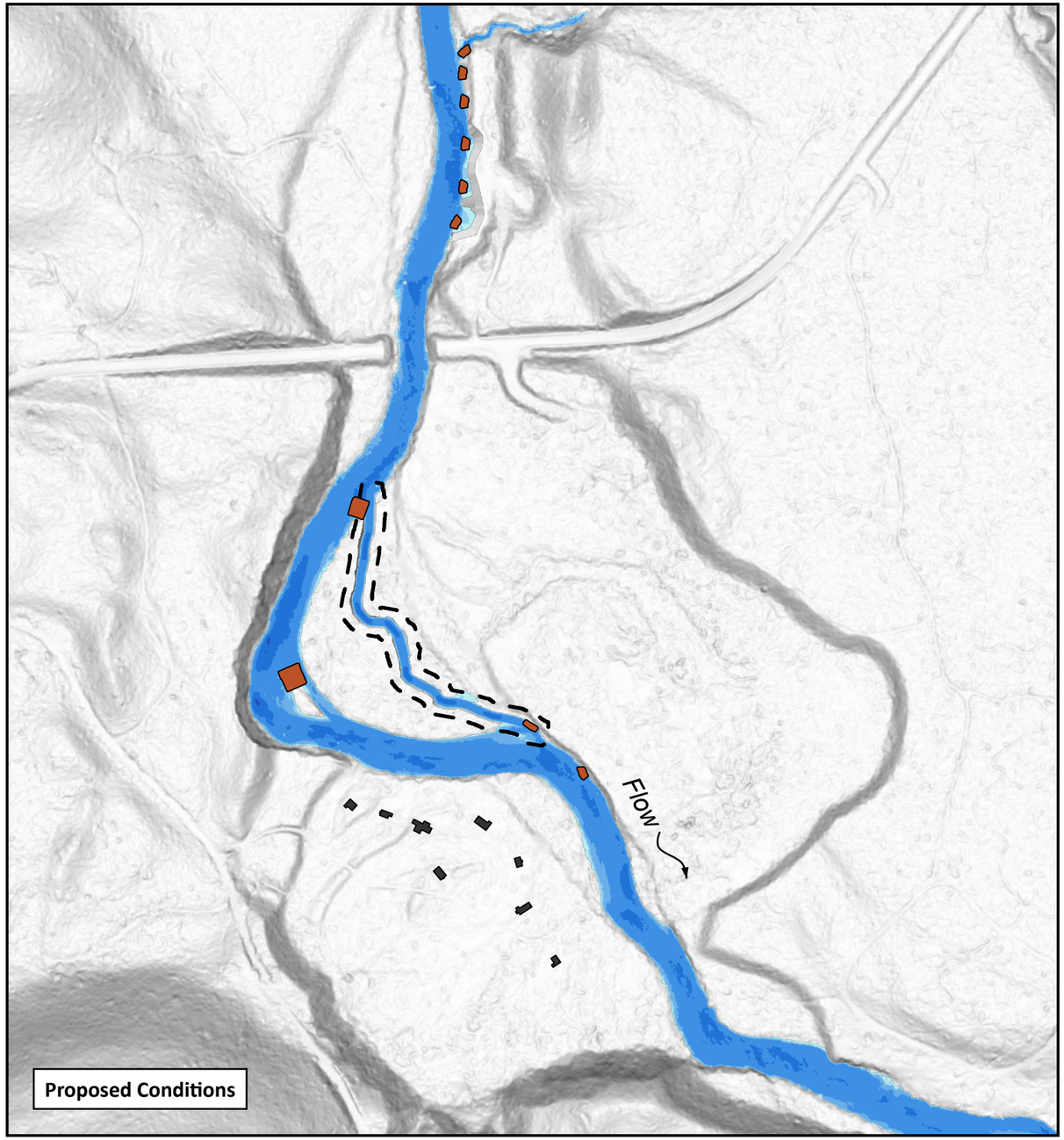
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

November Mean Daily Flow:

Modeled Discharge: 304 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

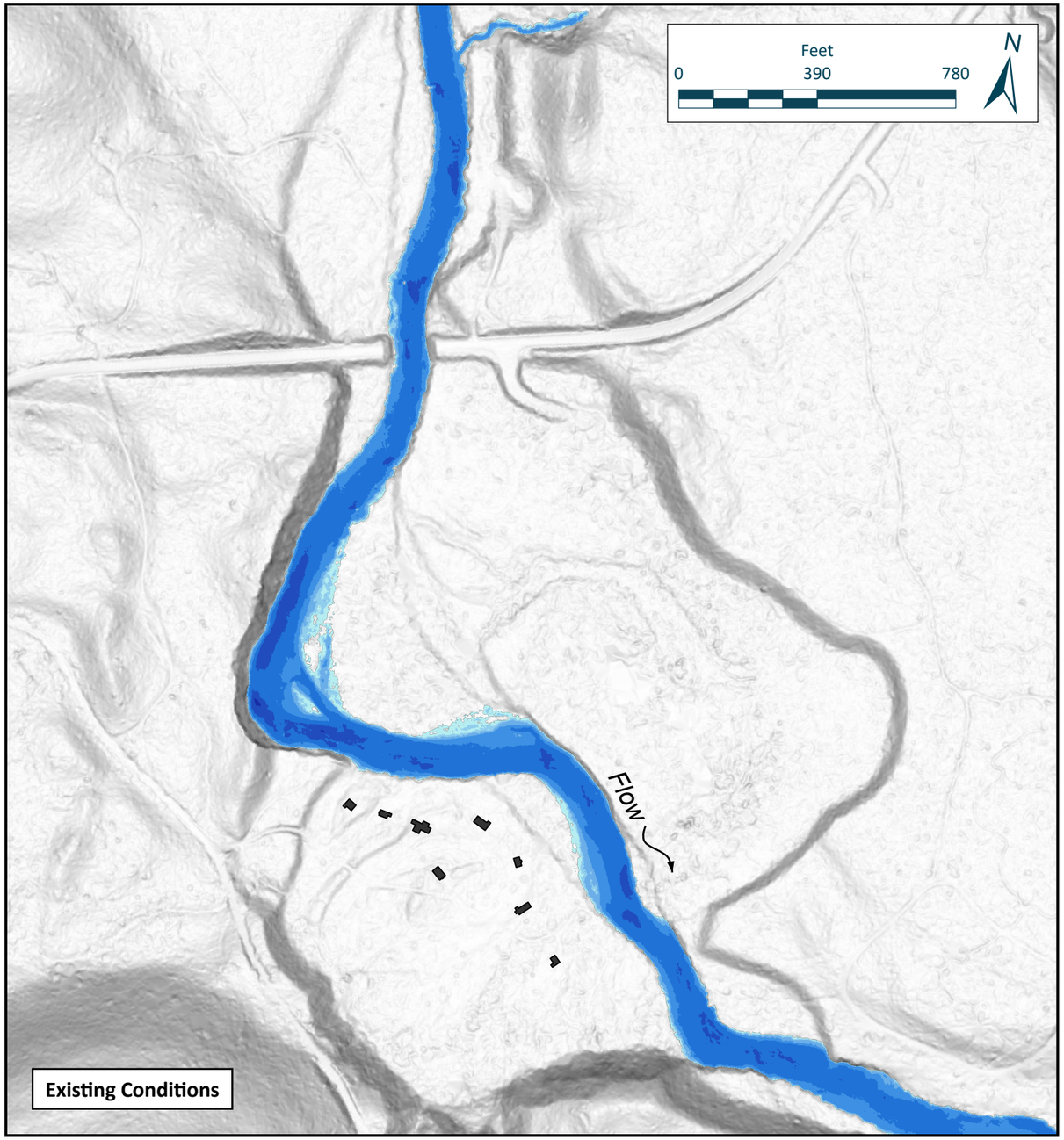
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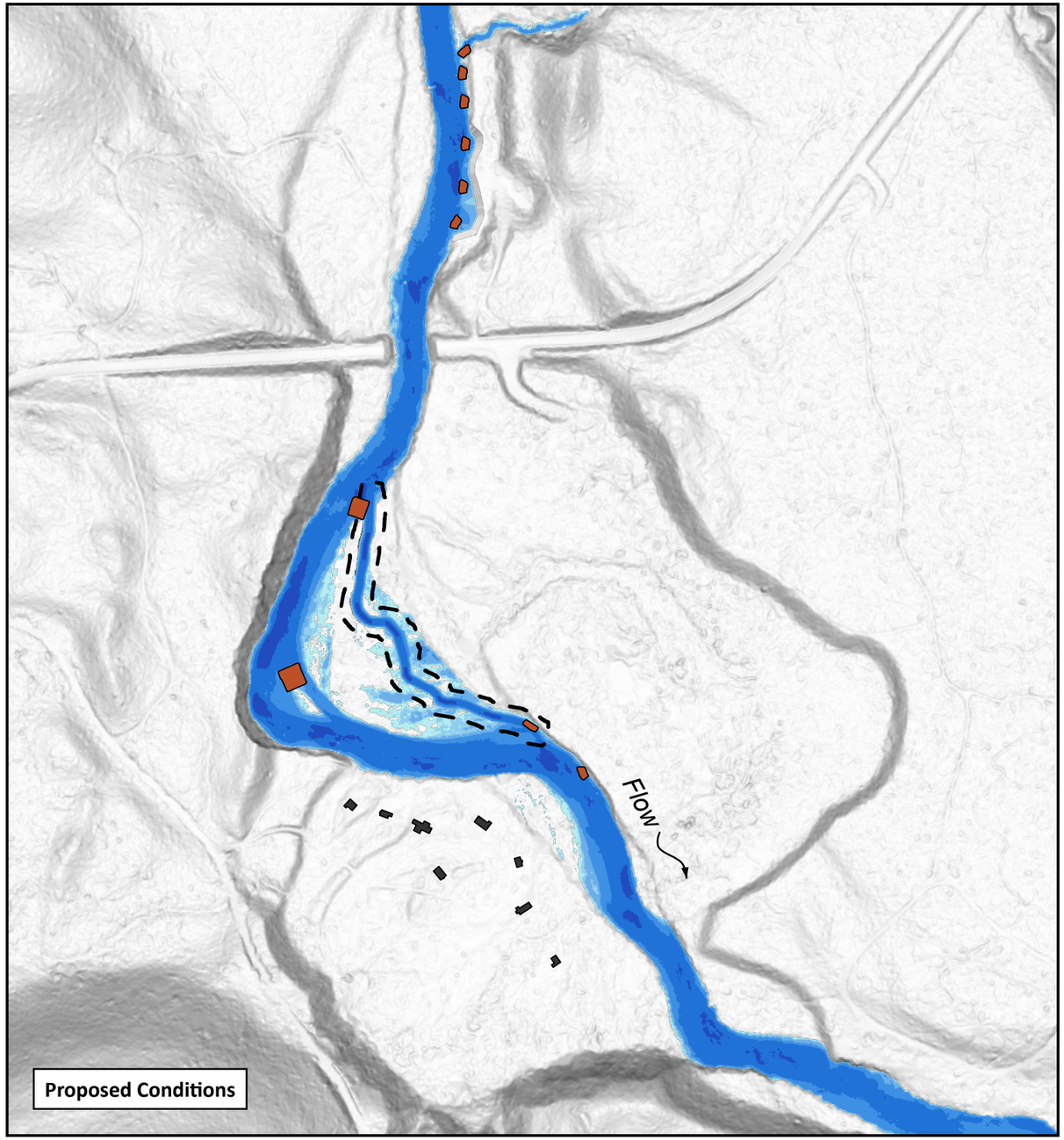
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

May Mean Daily Flow:

Modeled Discharge: 1,614 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

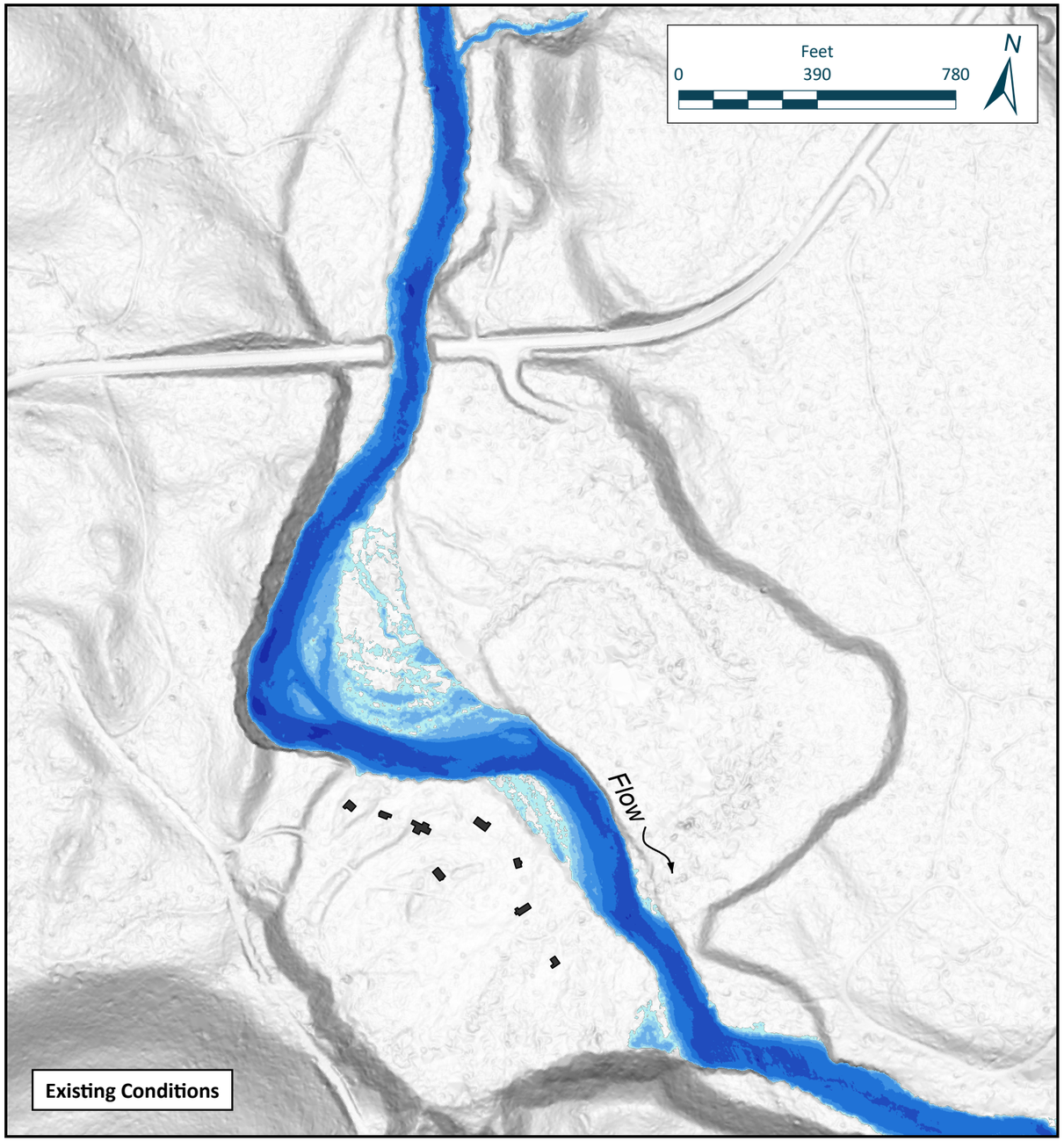
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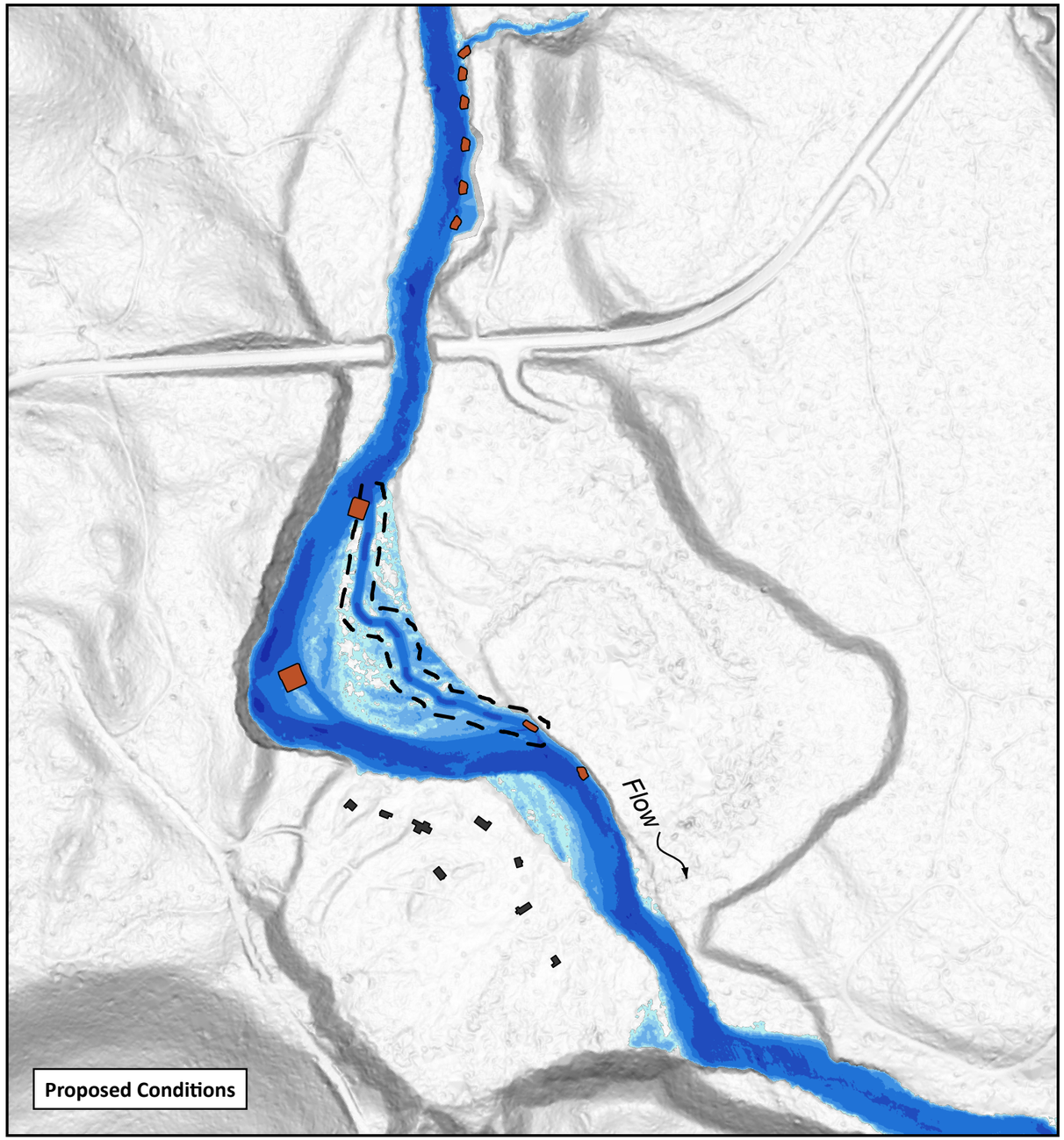
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

2-Year Return Period Peak Flow:

Modeled Discharge: 3,206 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

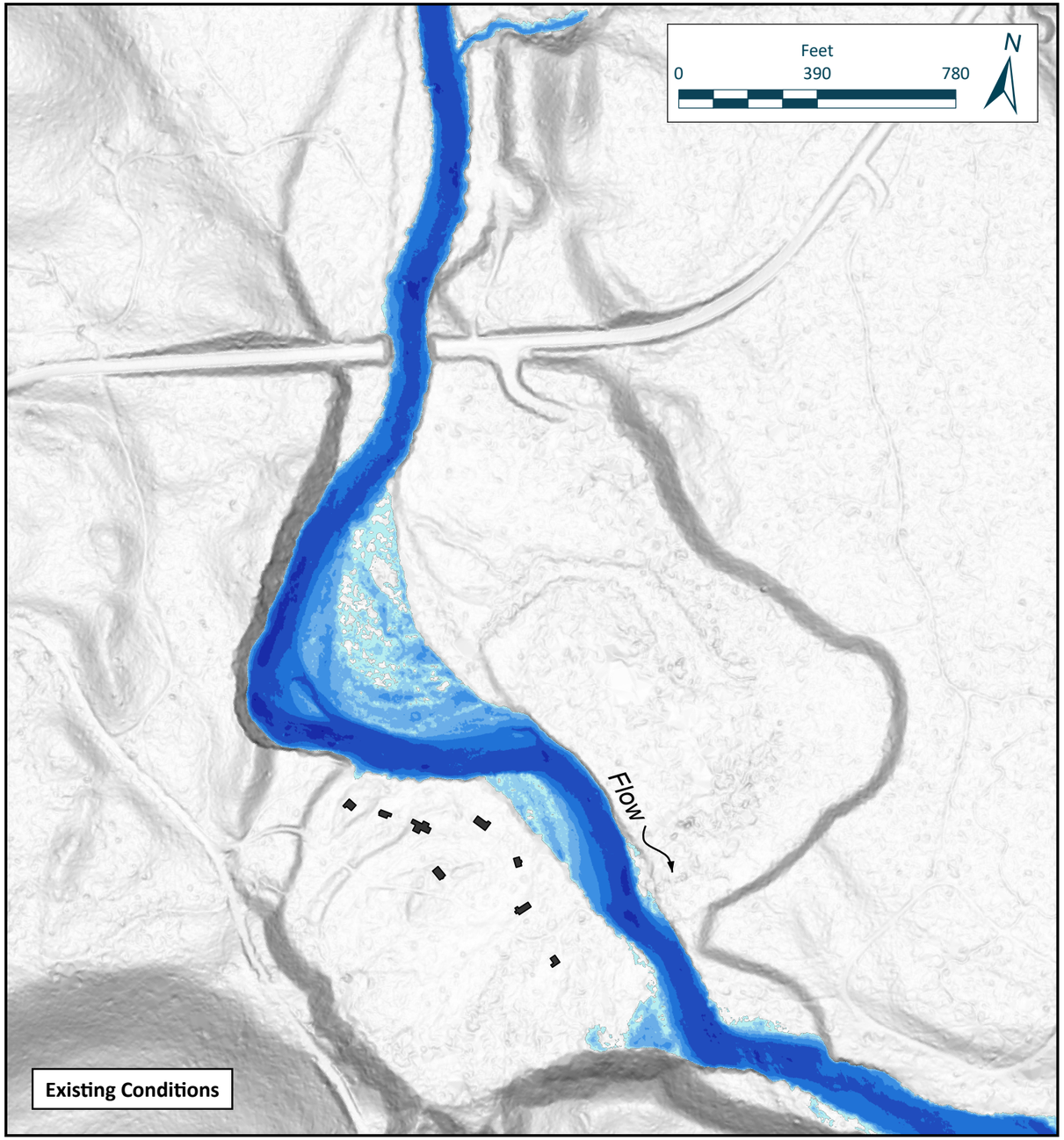
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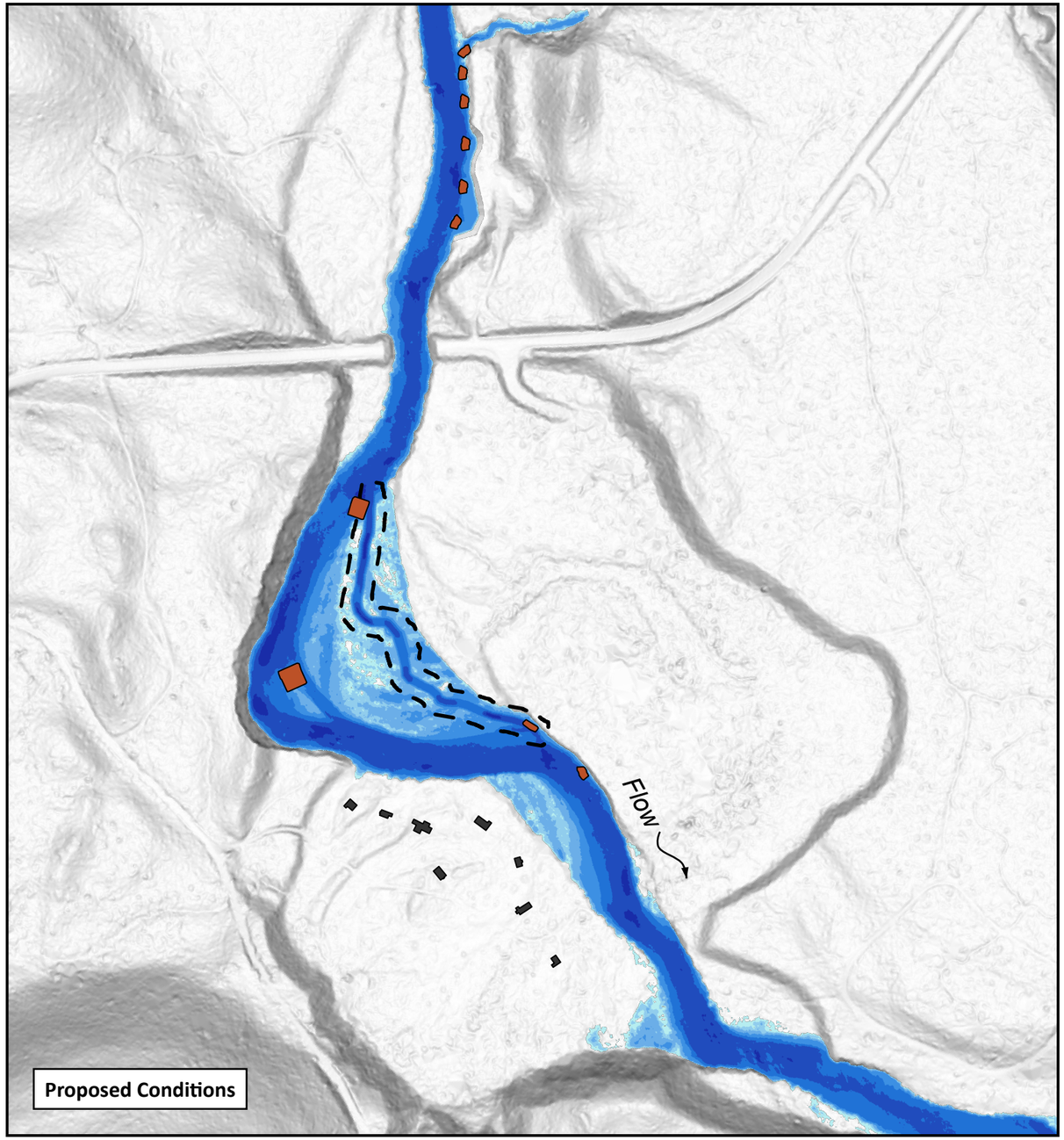
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

5-Year Return Period Peak Flow:

Modeled Discharge: 4,362 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

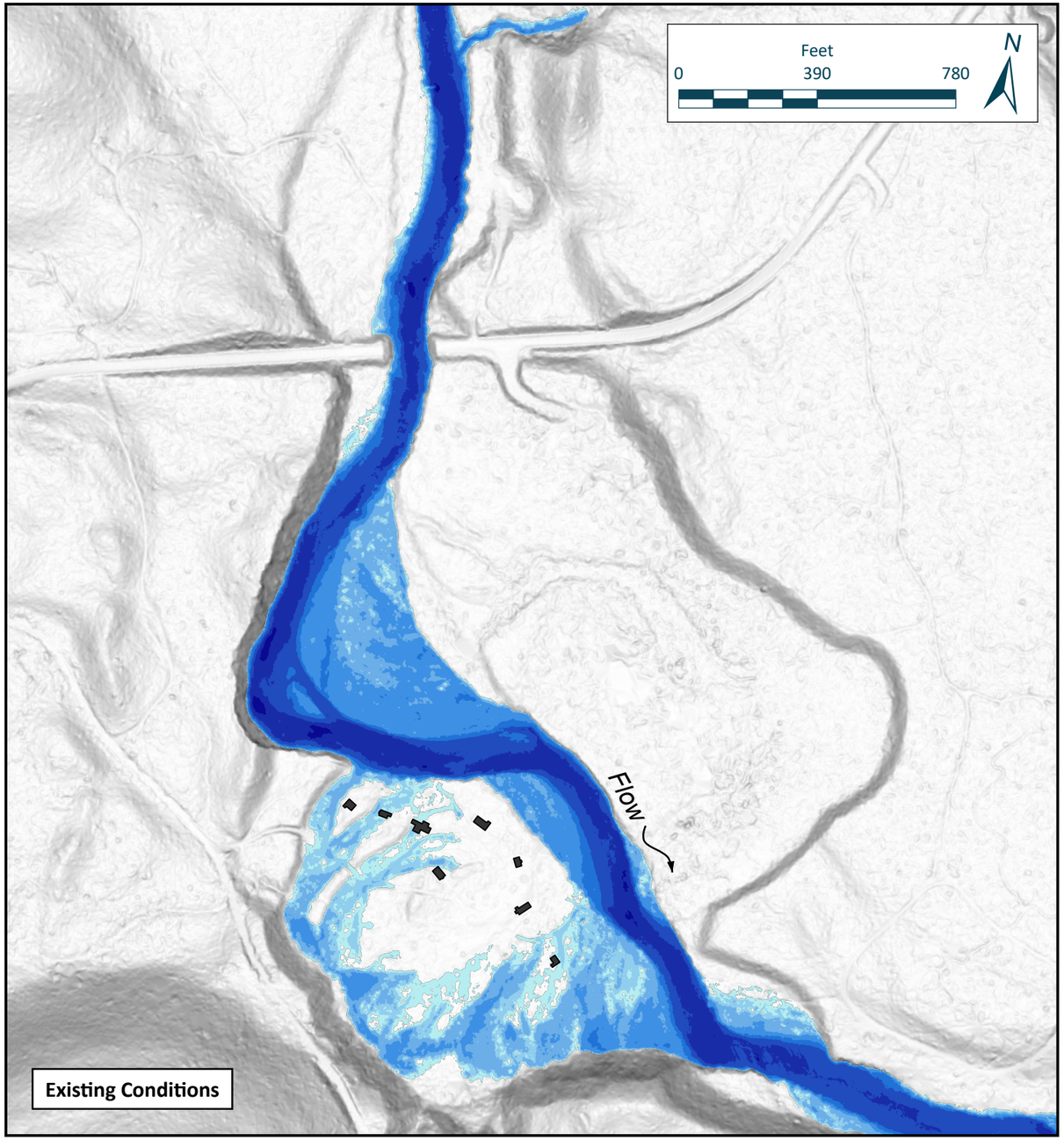
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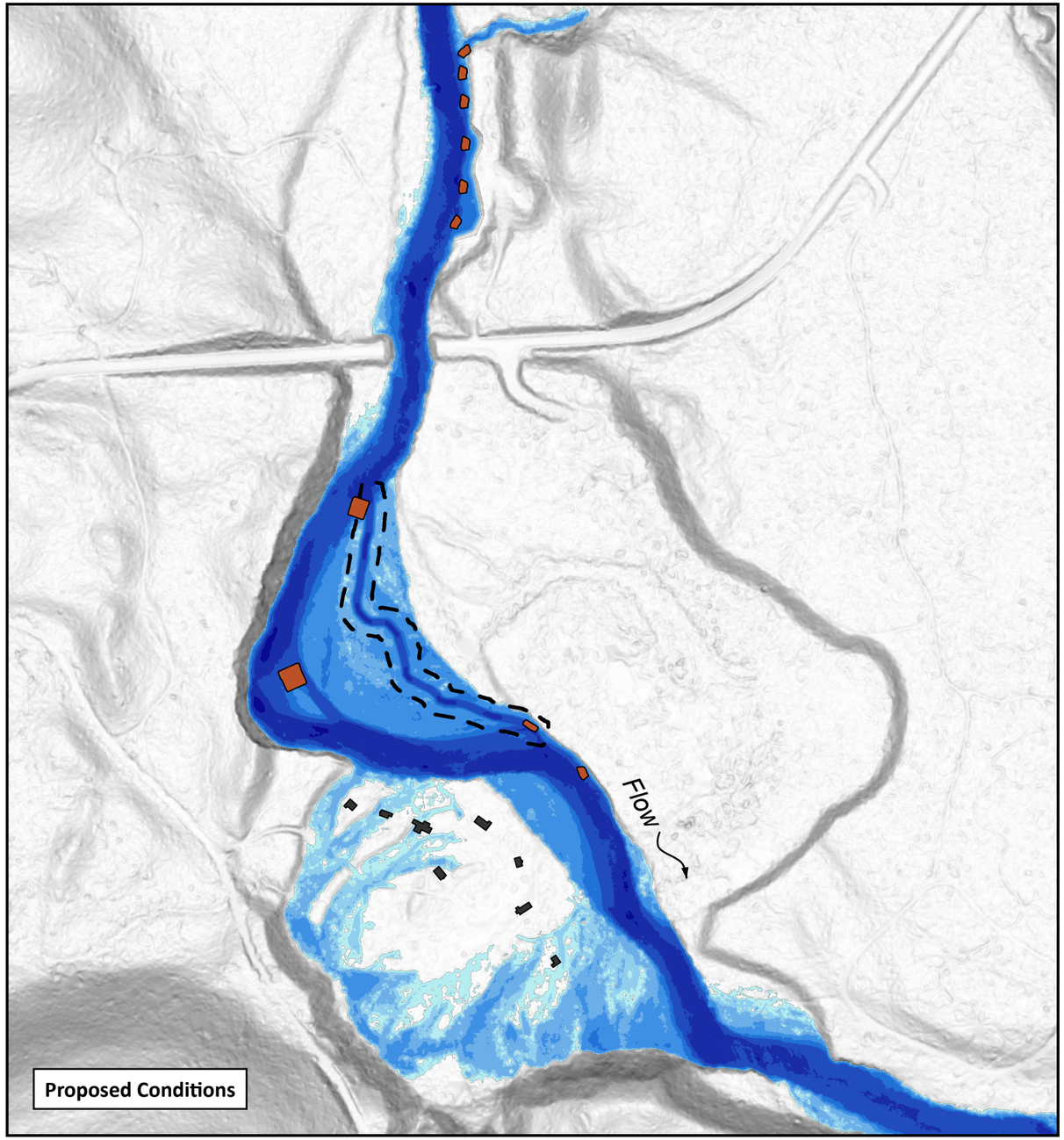
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

10-Year Return Period Peak Flow:

Modeled Discharge: 5,103 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

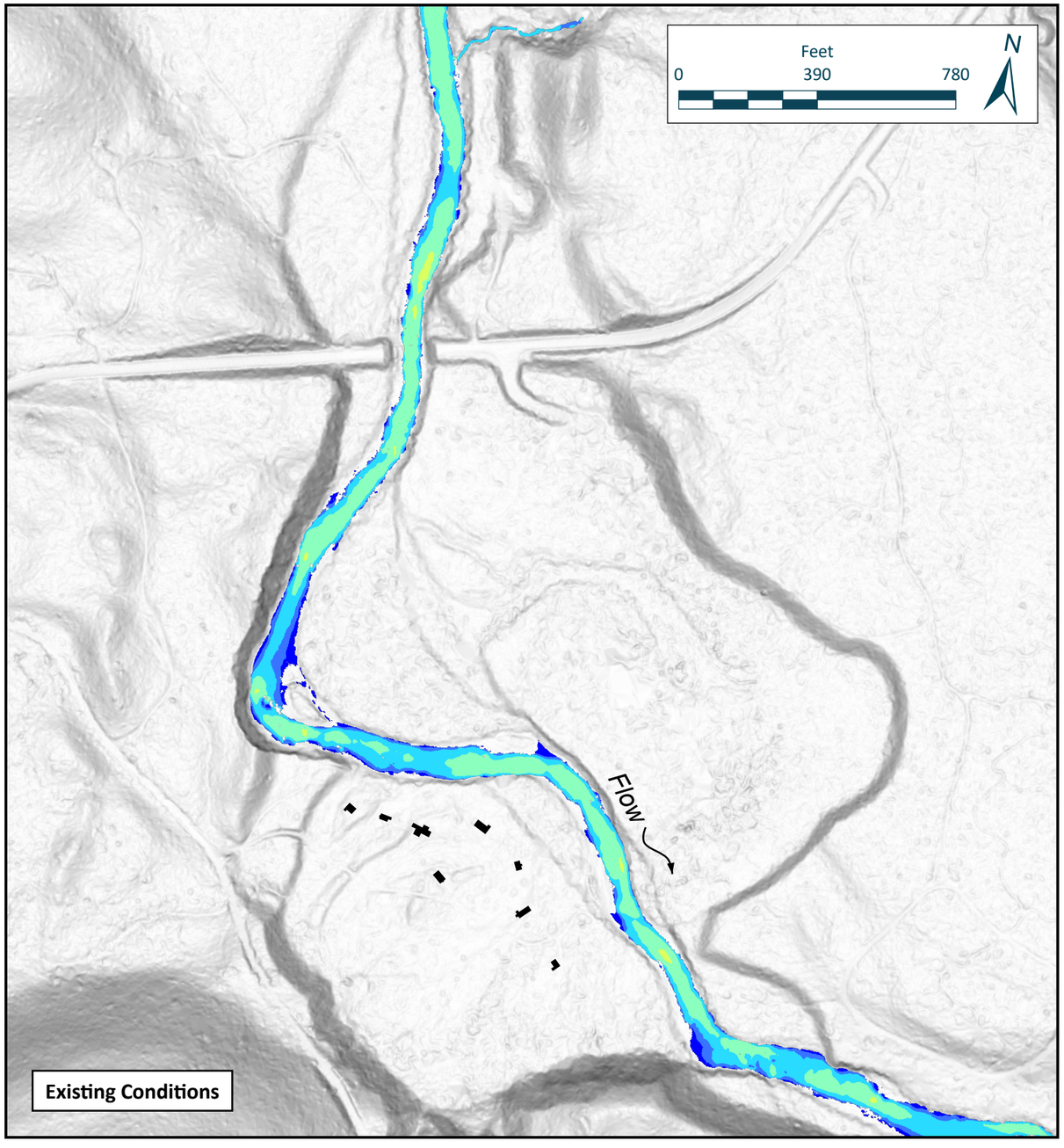
Modeled Depth (ft)

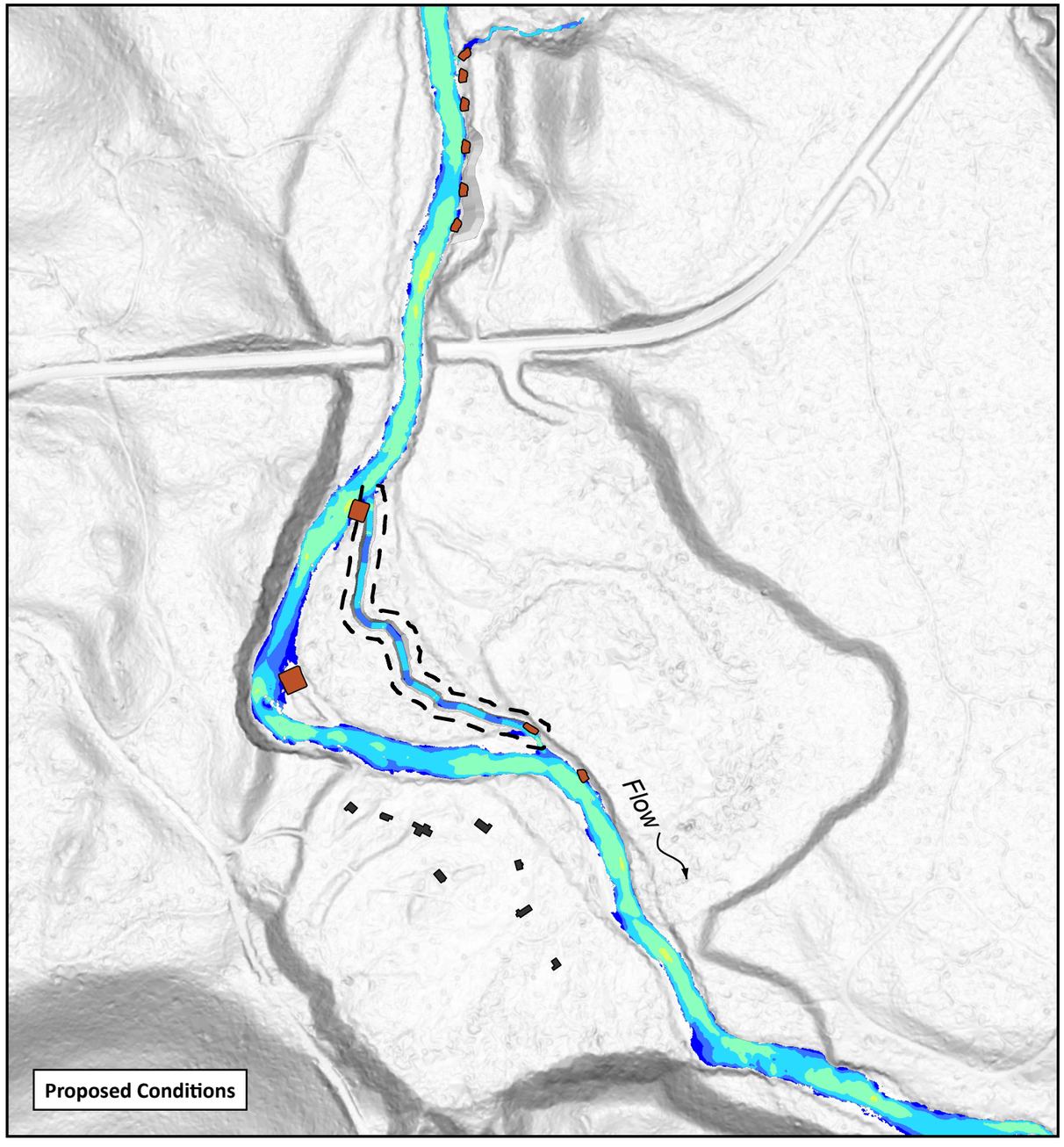
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Depth

100-Year Return Period Peak Flow:

Modeled Discharge: 7,328 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

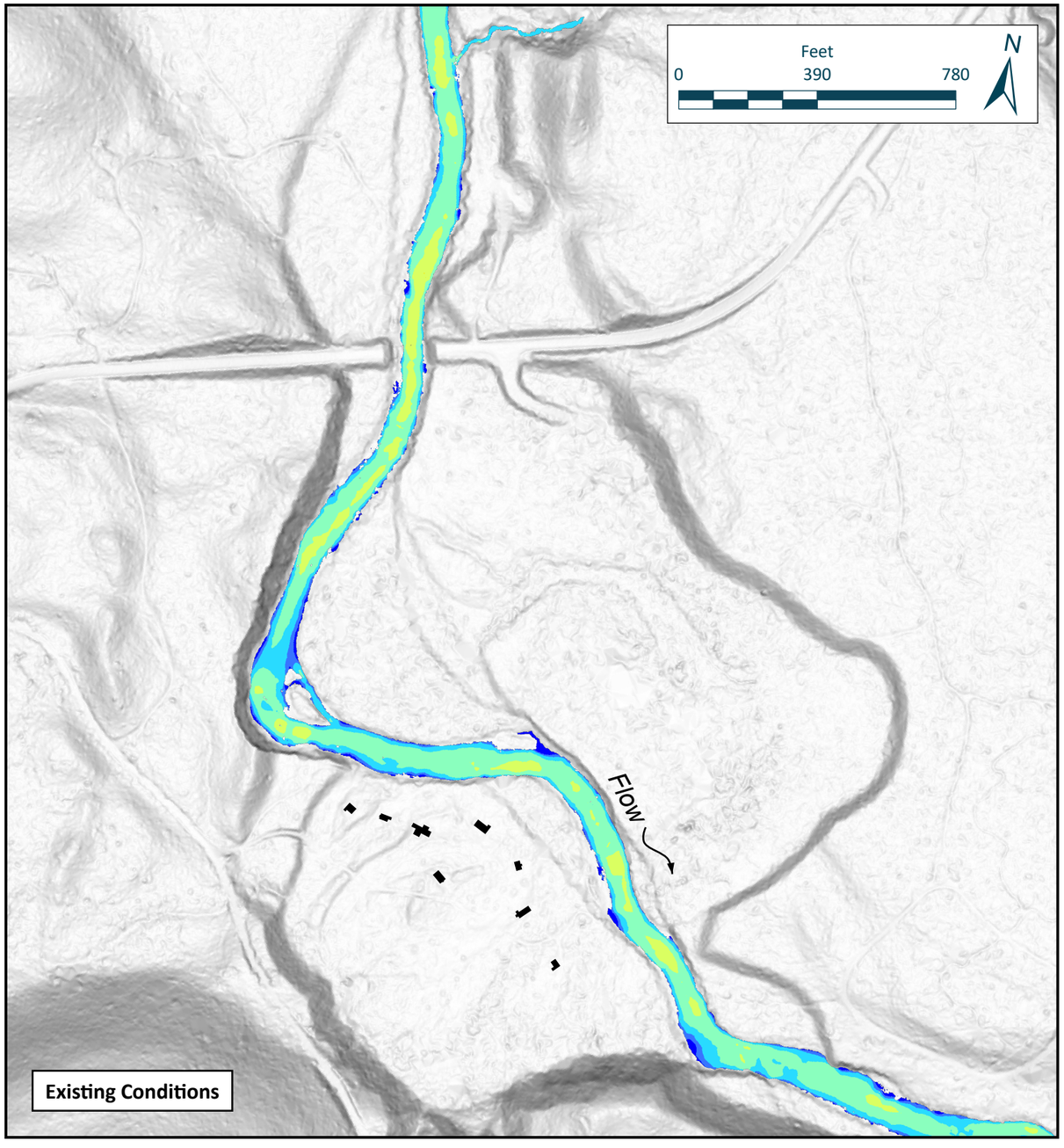
Modeled Velocity (ft/s)

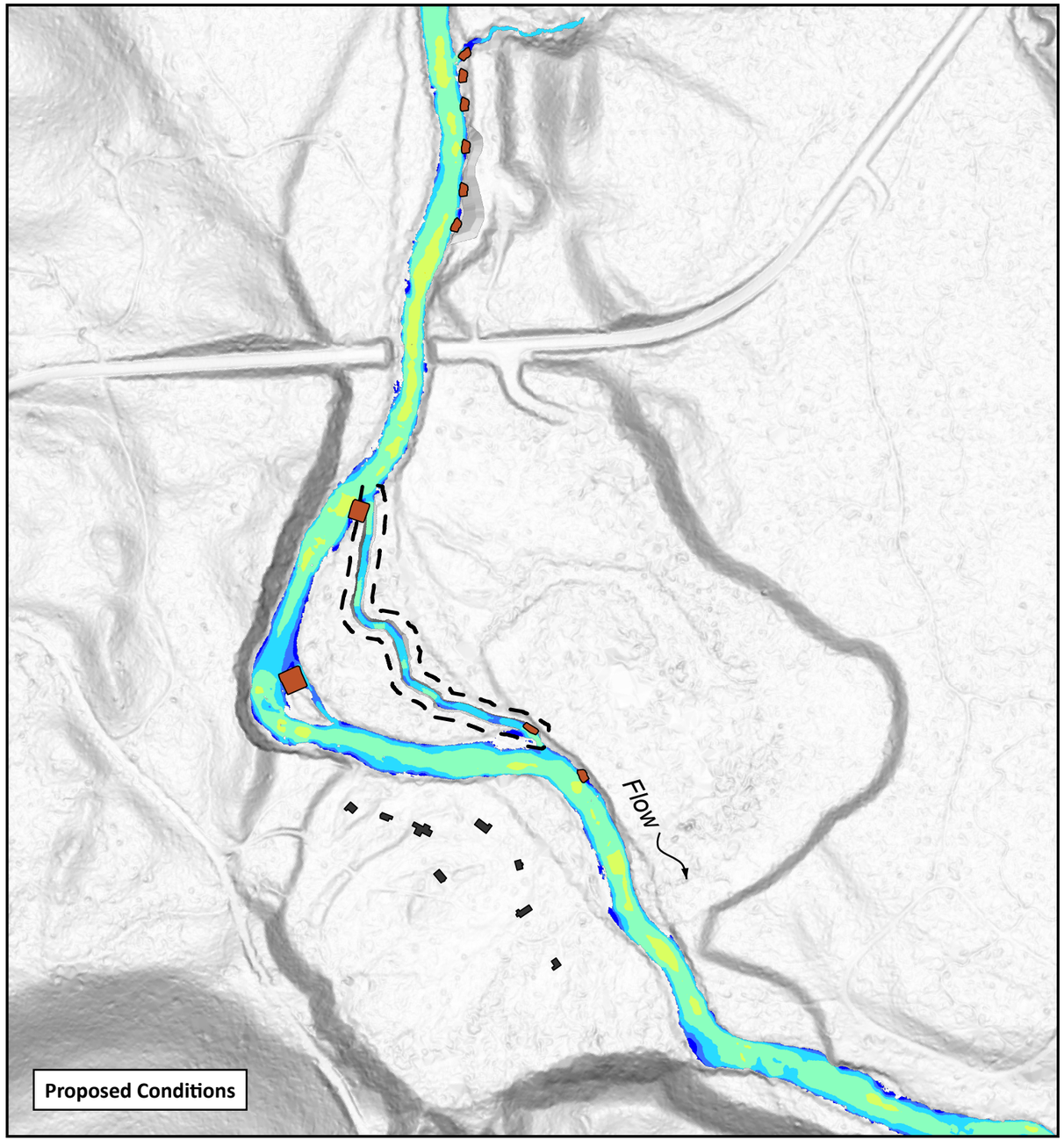
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

September Mean Daily Flow:

Modeled Discharge: 139 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

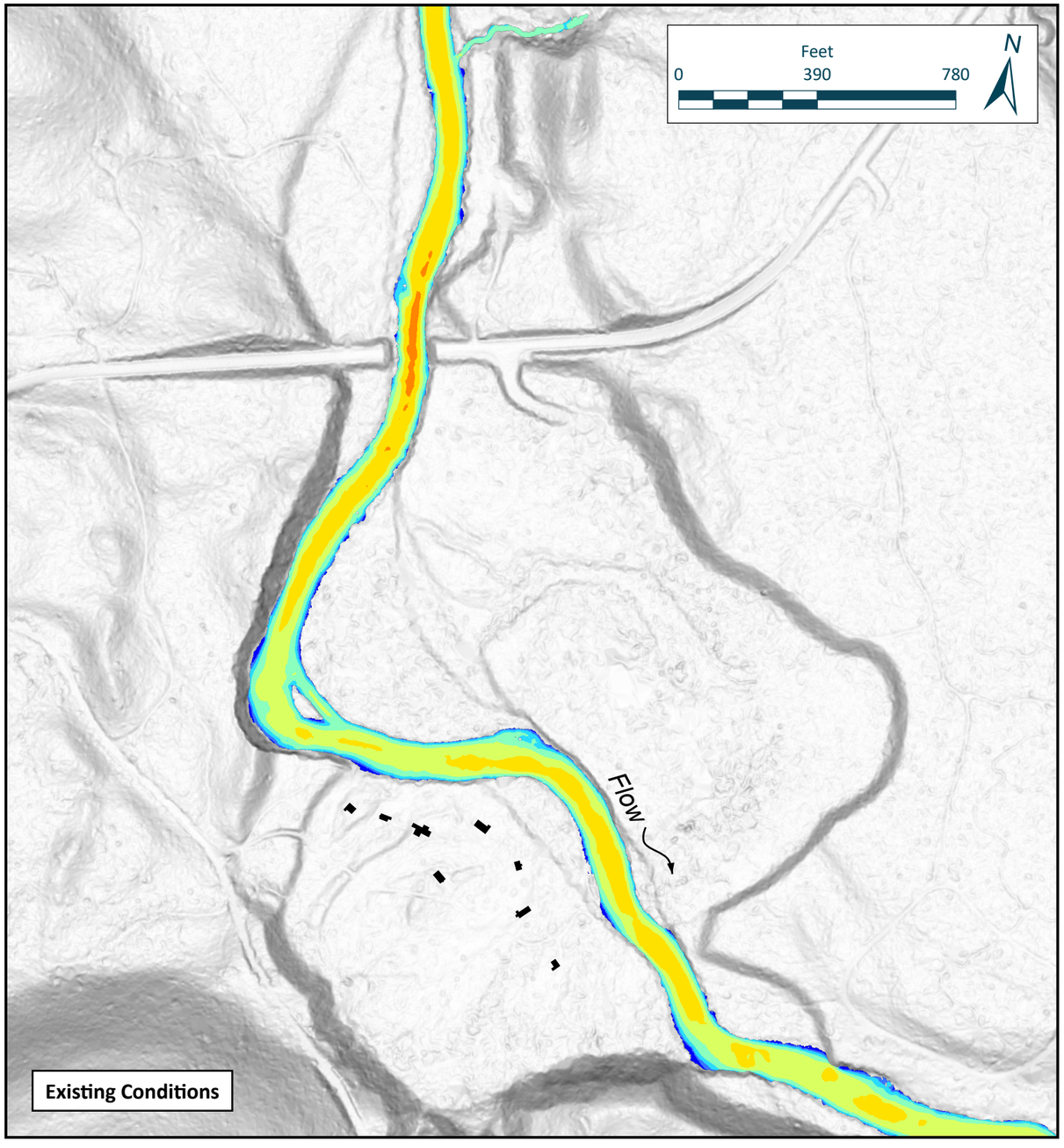
Modeled Velocity (ft/s)

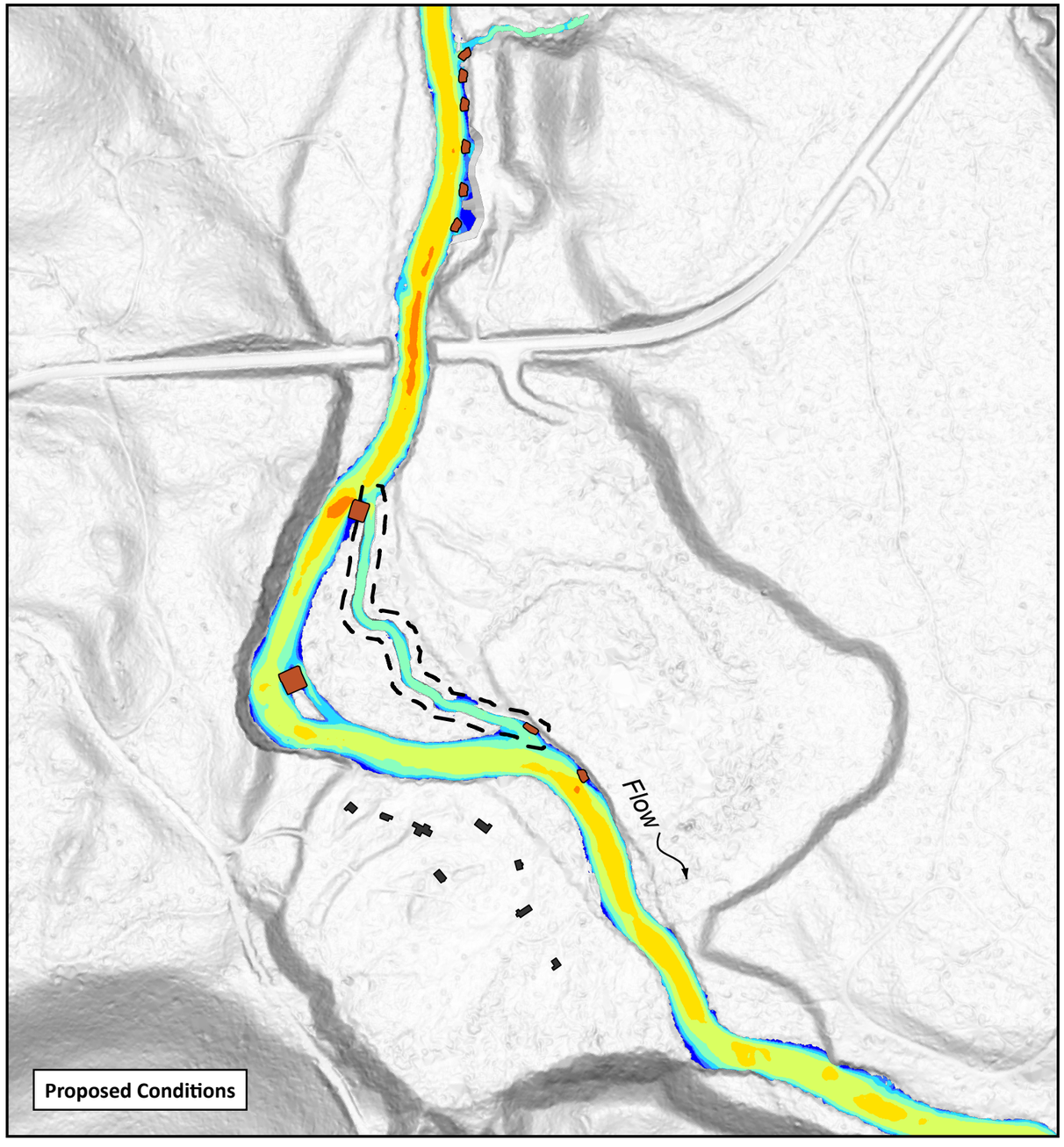
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

November Mean Daily Flow:

Modeled Discharge: 304 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

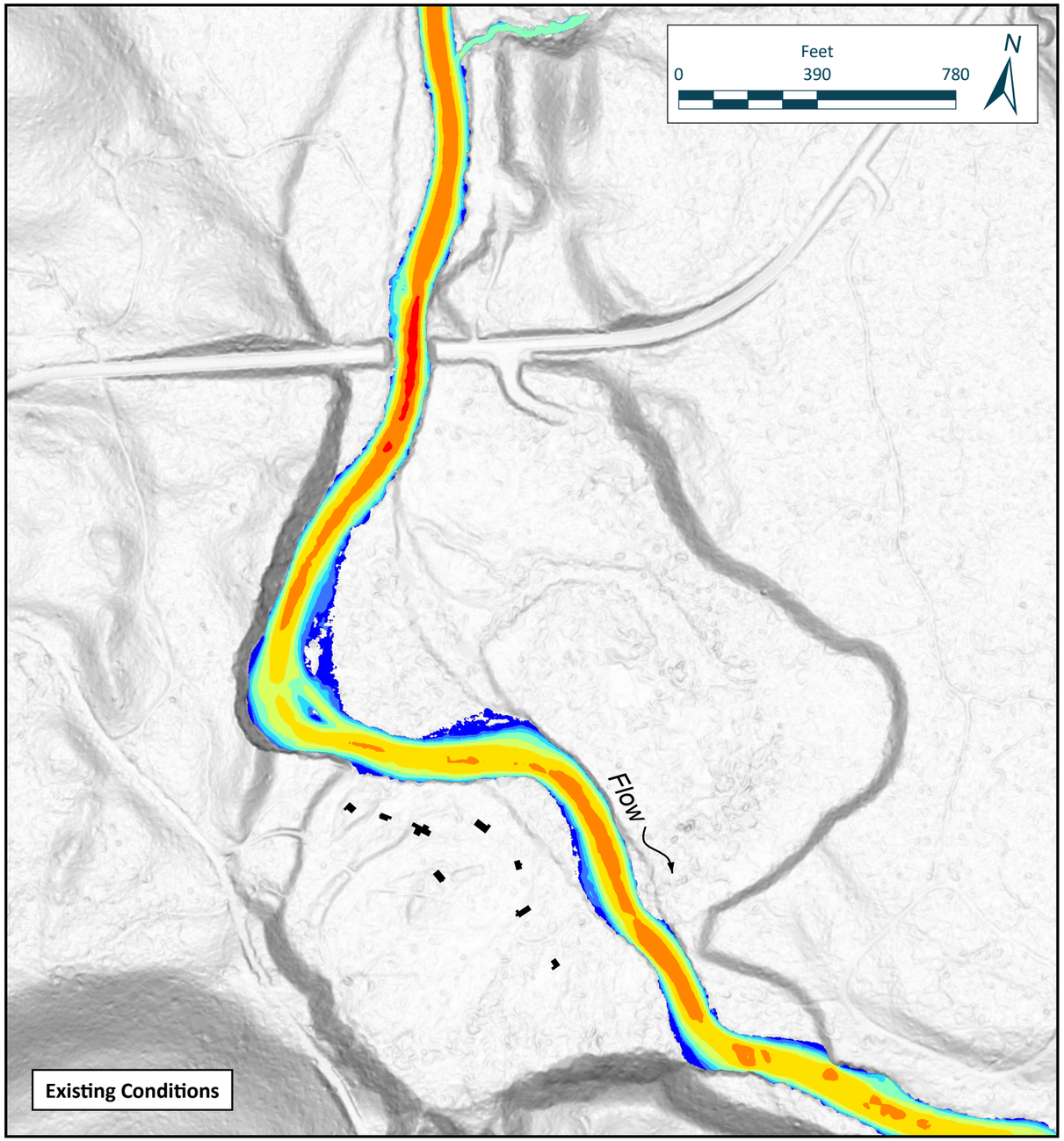
Modeled Velocity (ft/s)

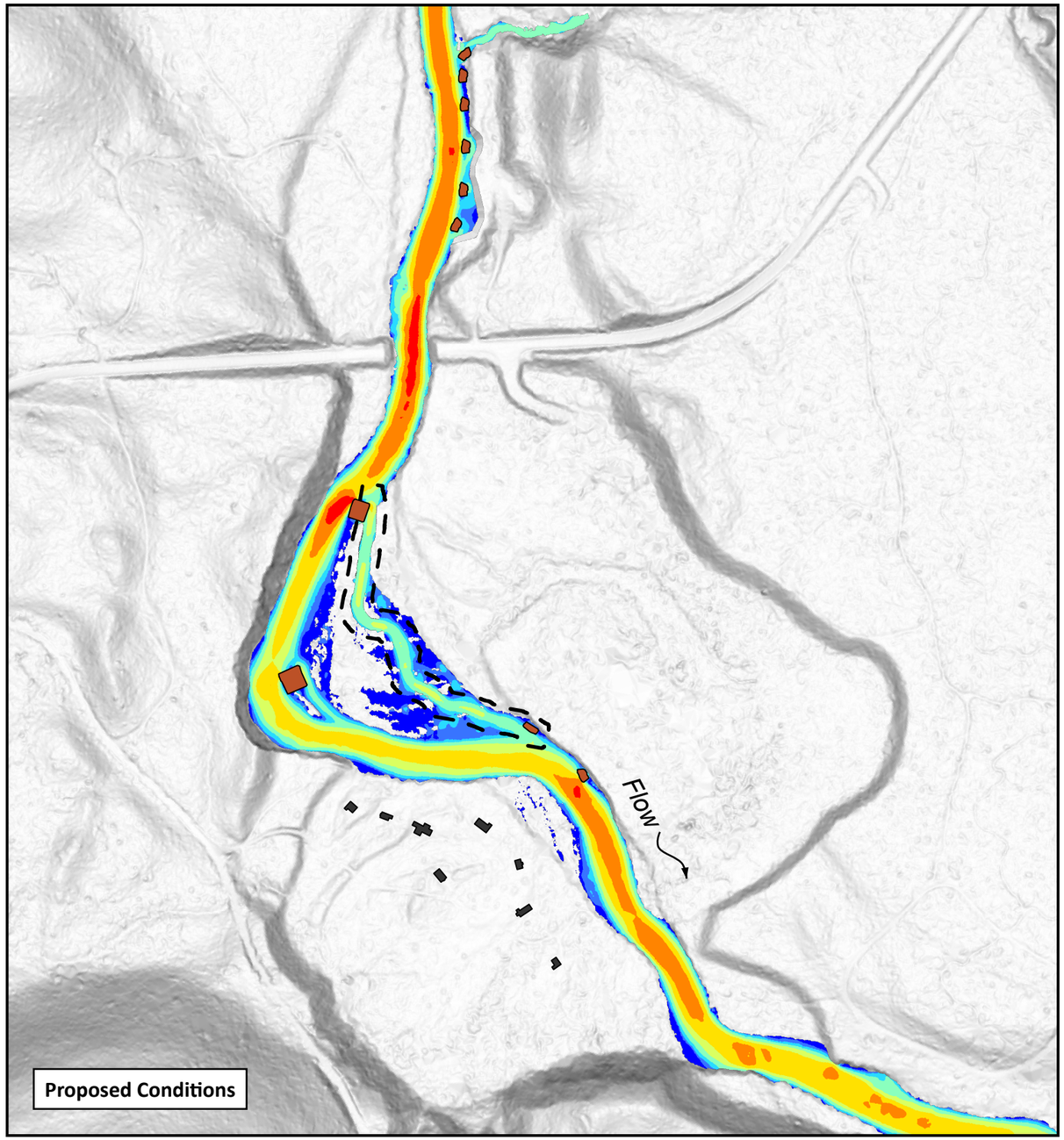
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

May Mean Daily Flow:

Modeled Discharge: 1,614 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

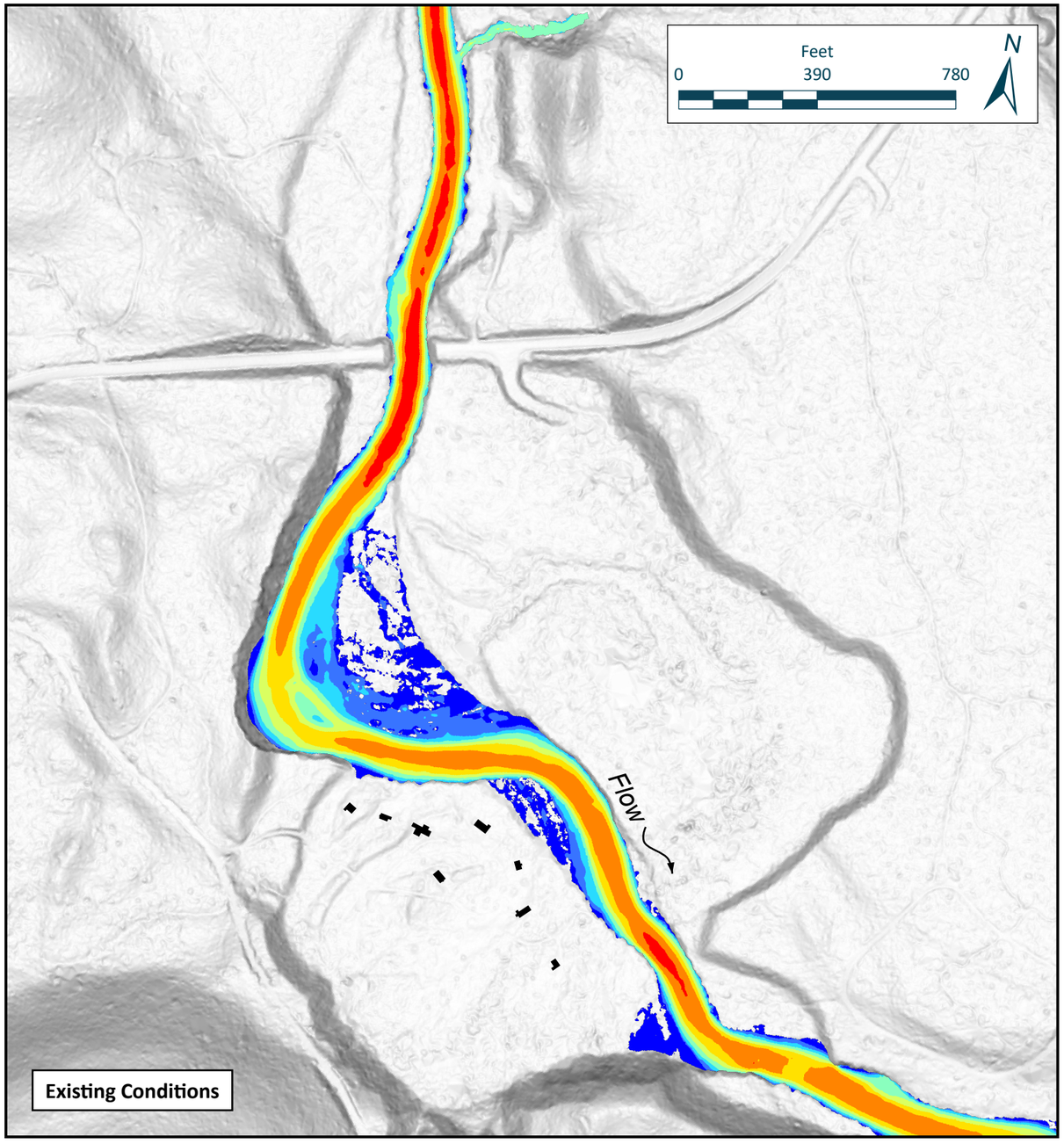
Modeled Velocity (ft/s)

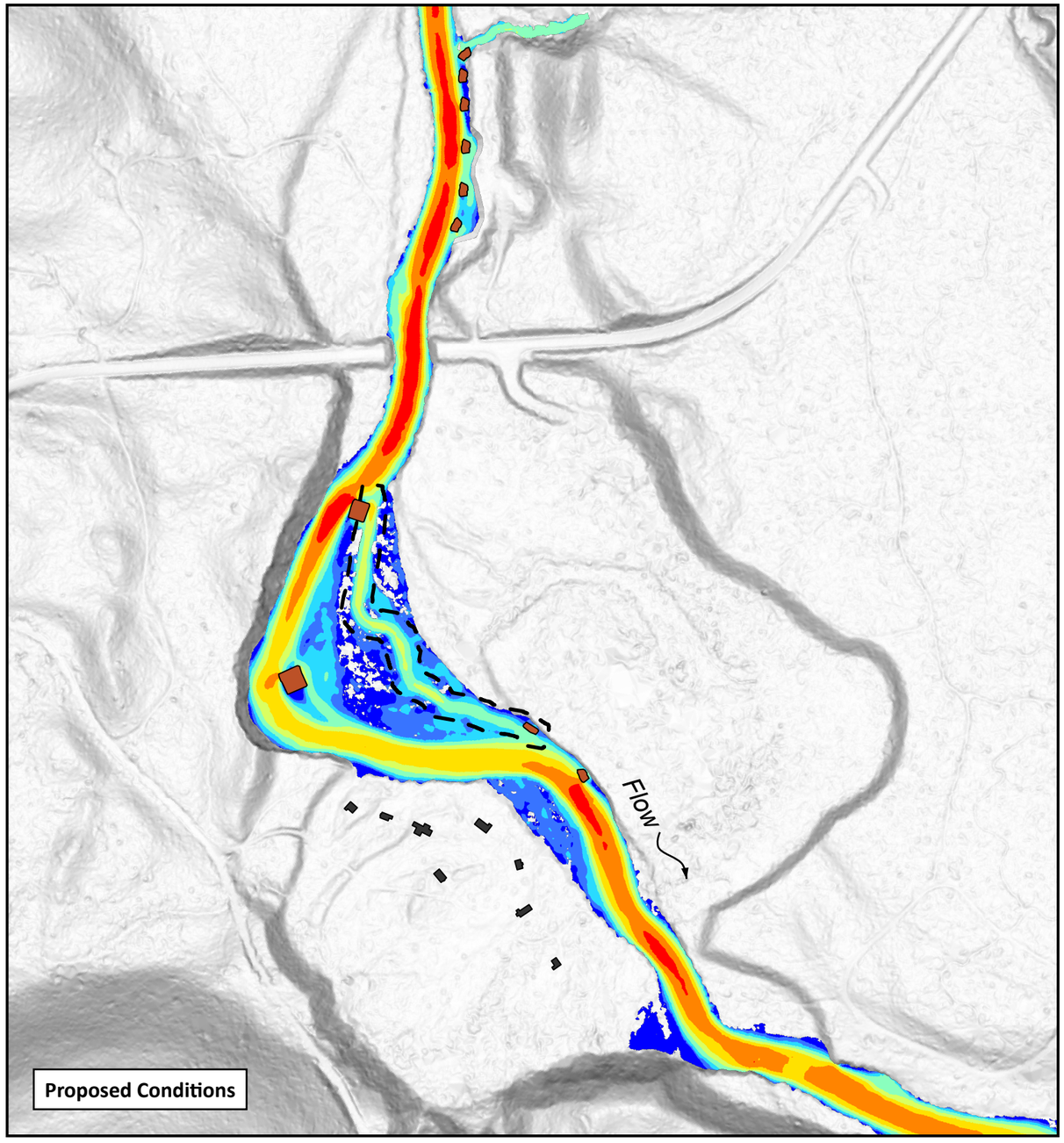
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

2-Year Return Period Peak Flow:

Modeled Discharge: 3,206 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

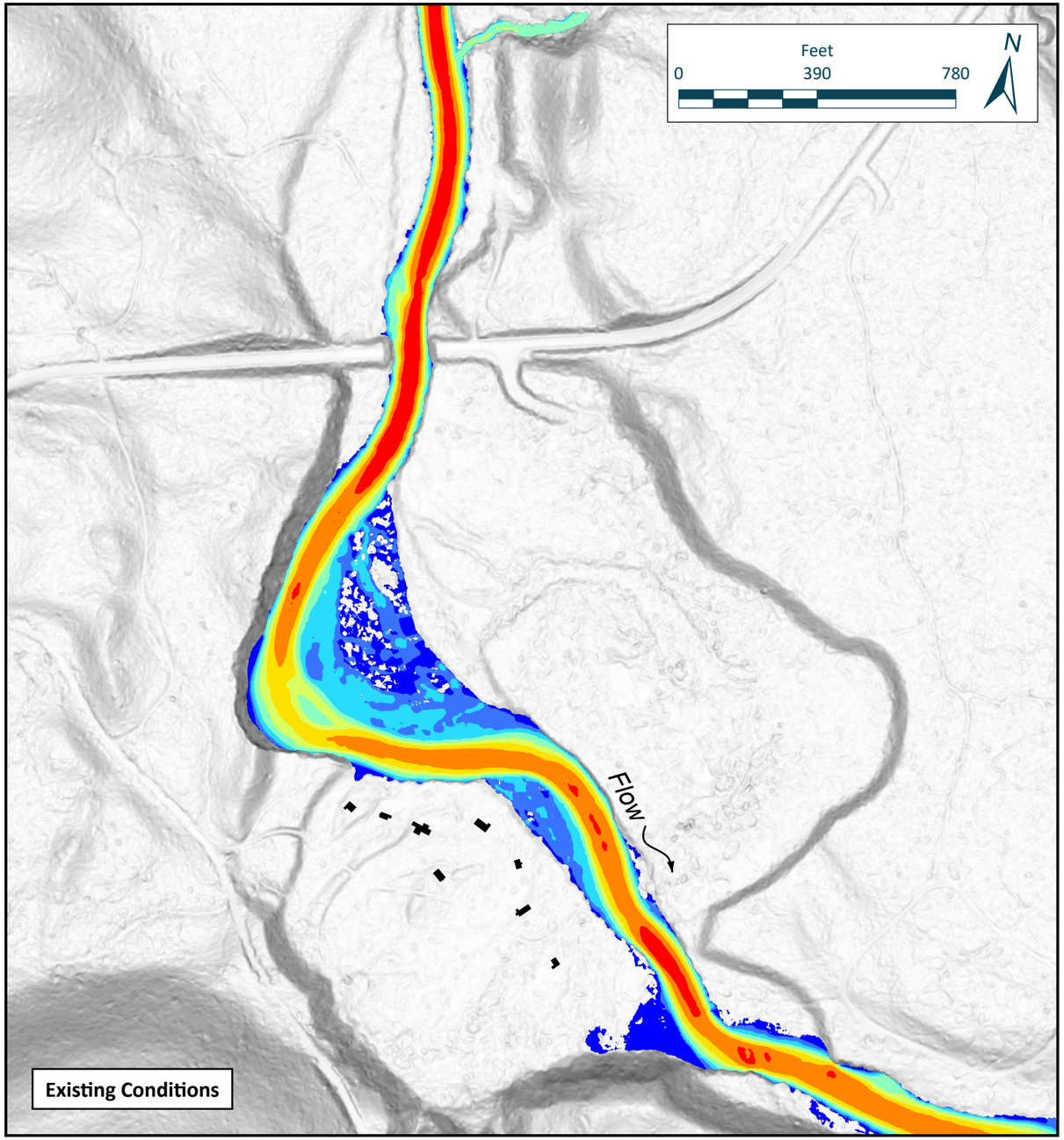
Modeled Velocity (ft/s)

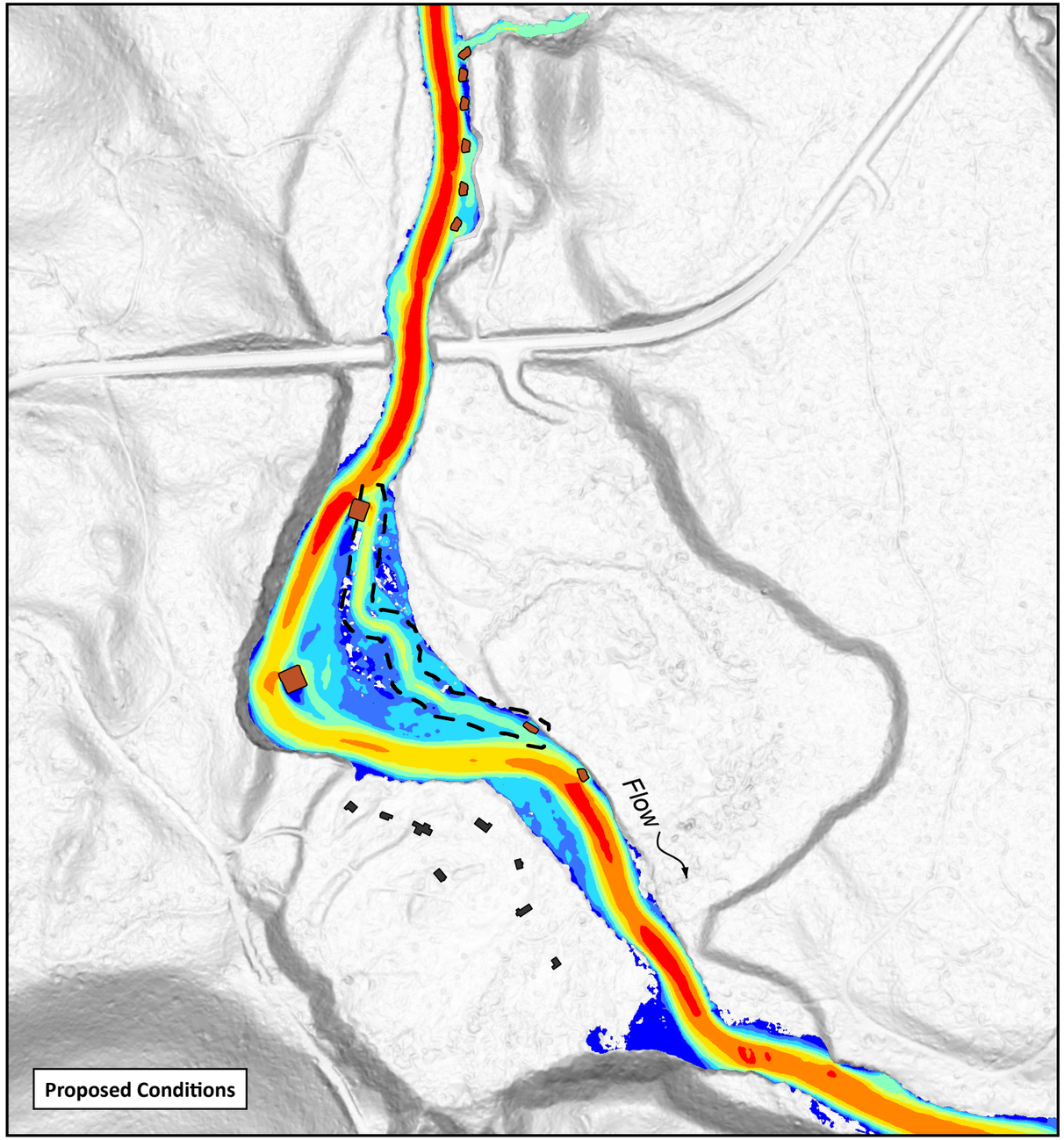
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

5-Year Return Period Peak Flow:

Modeled Discharge: 4,362 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

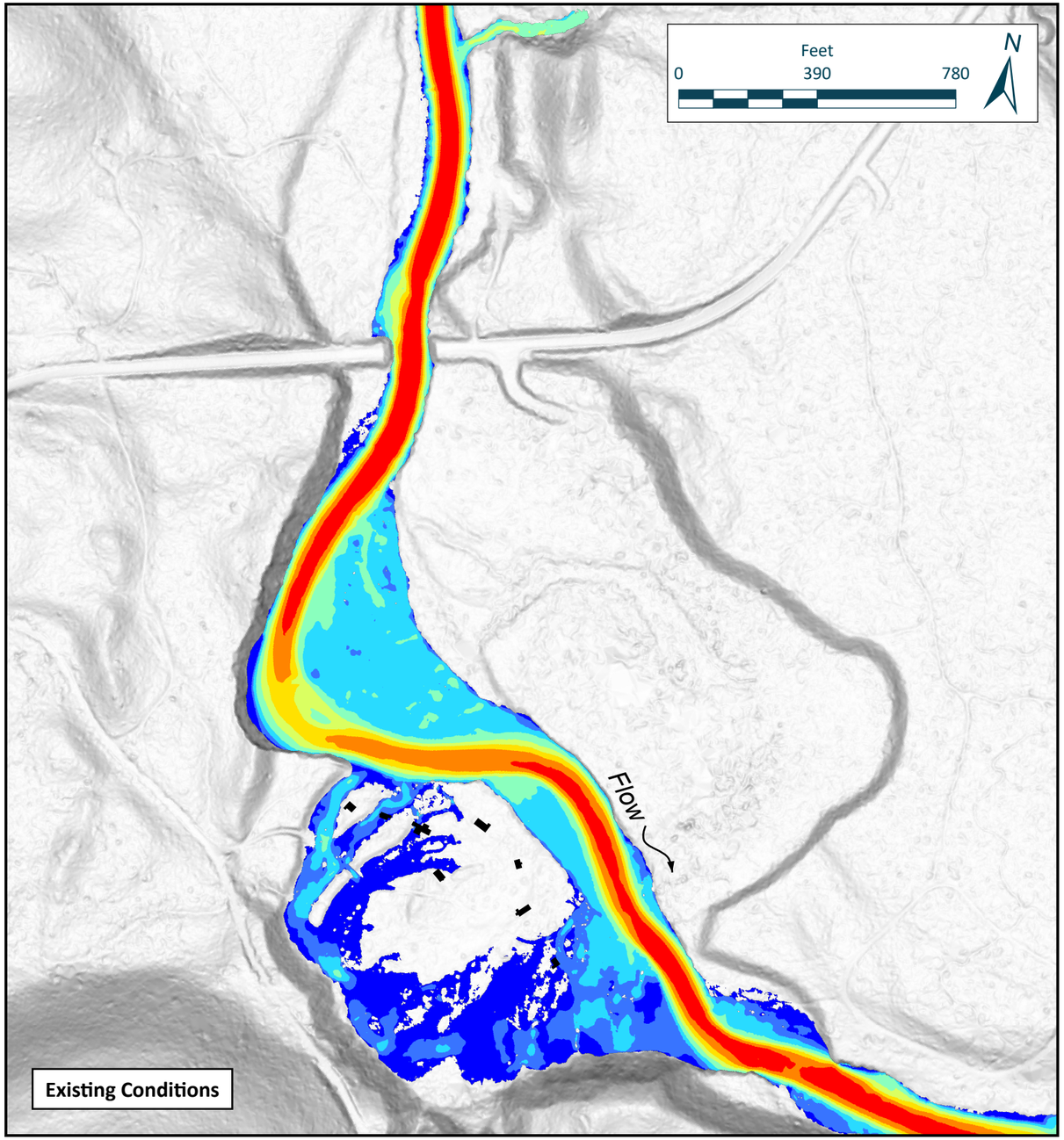
Modeled Velocity (ft/s)

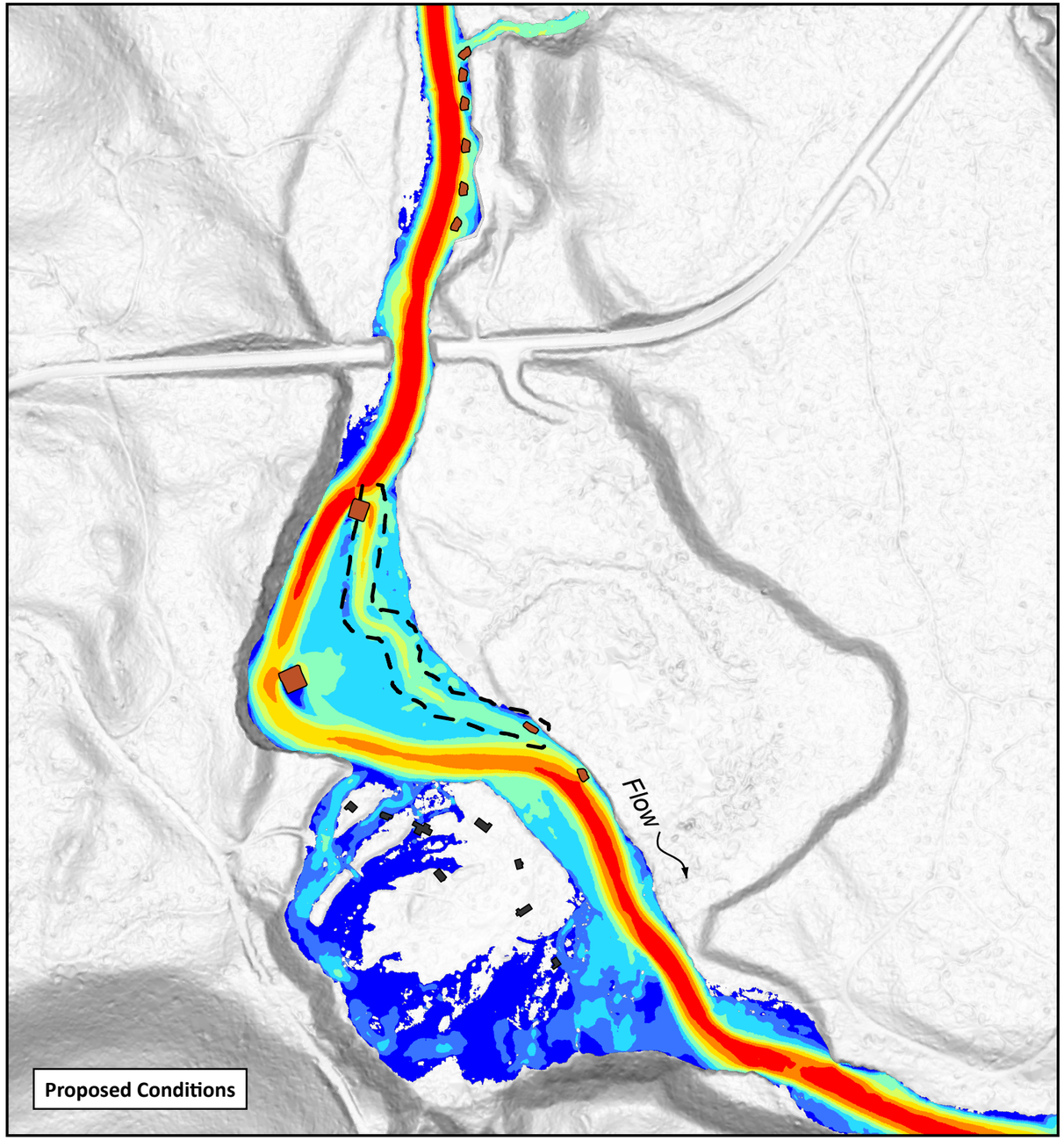
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

10-Year Return Period Peak Flow:

Modeled Discharge: 5,103 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

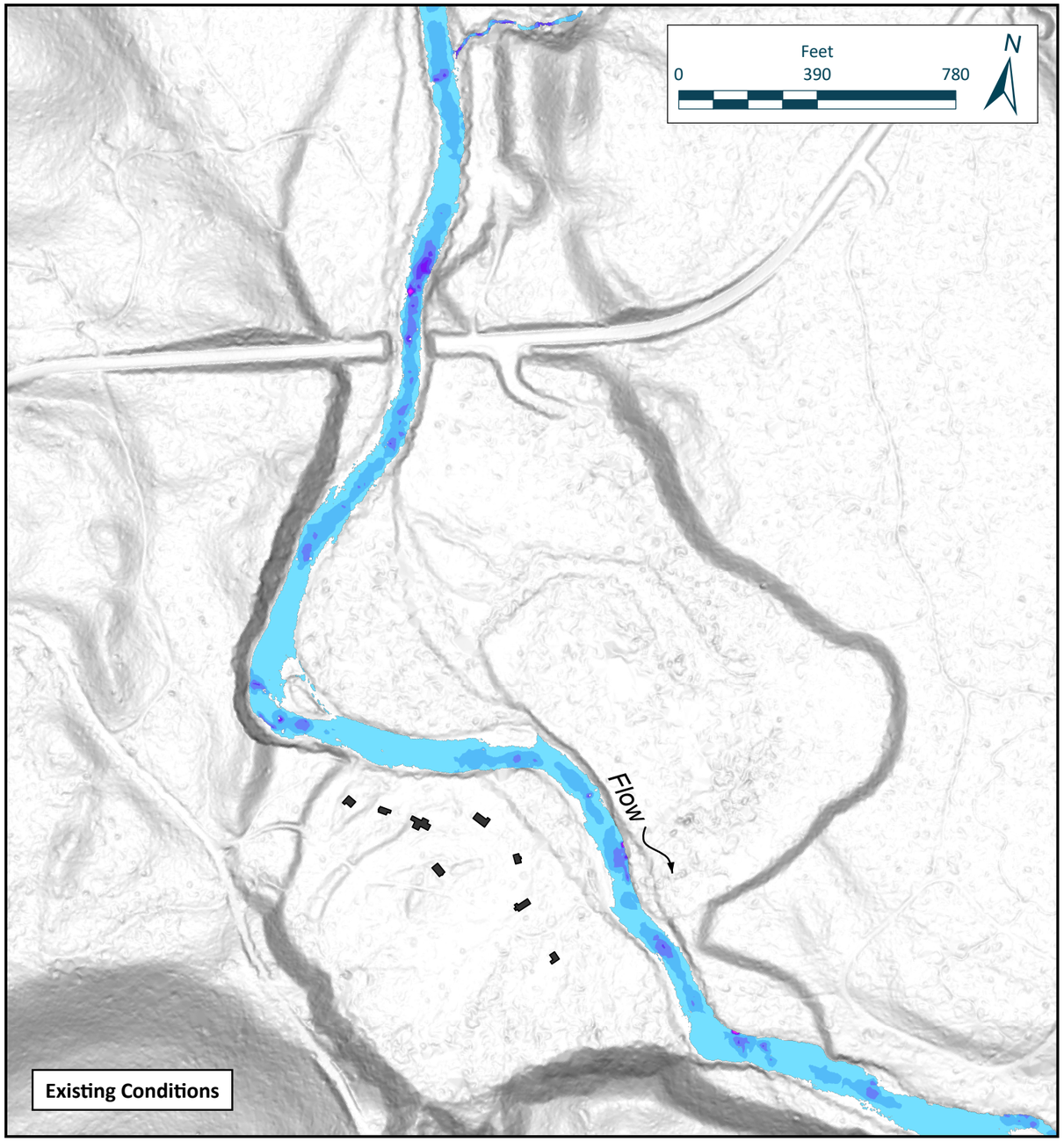
Modeled Velocity (ft/s)

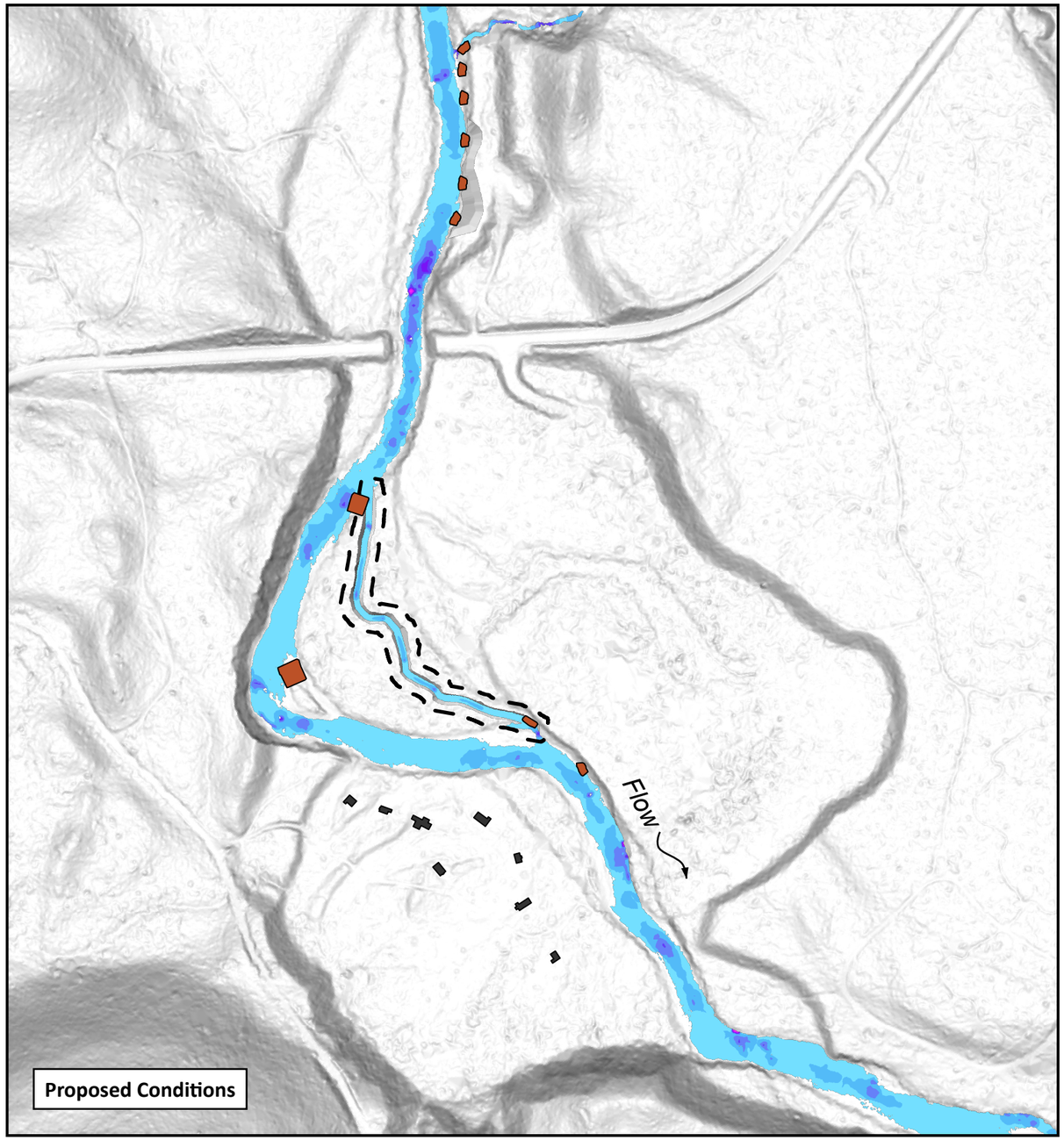
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Velocity

100-Year Return Period Peak Flow:

Modeled Discharge: 7,328 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

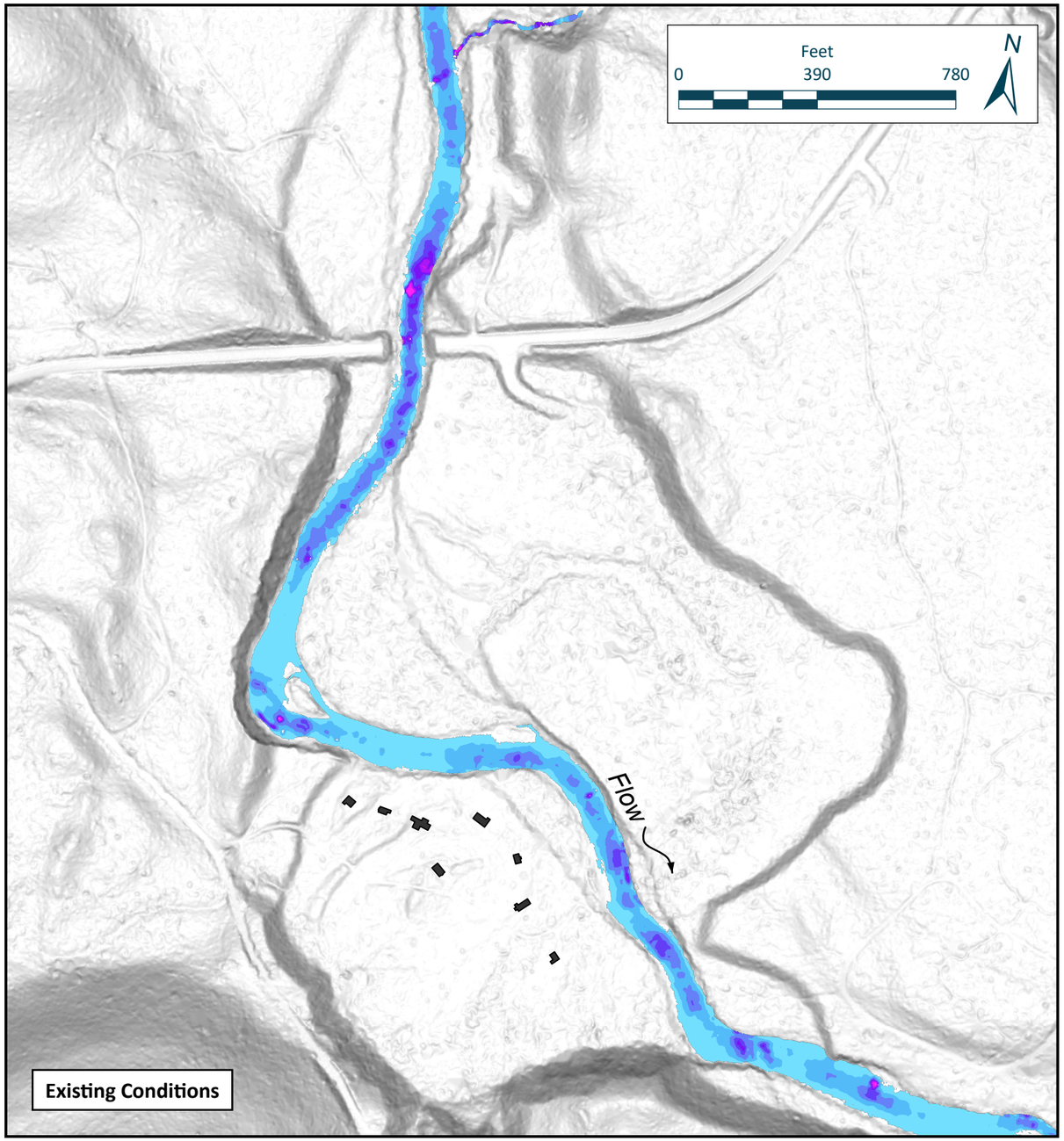
Modeled Shear Stress (lb/sq. ft)

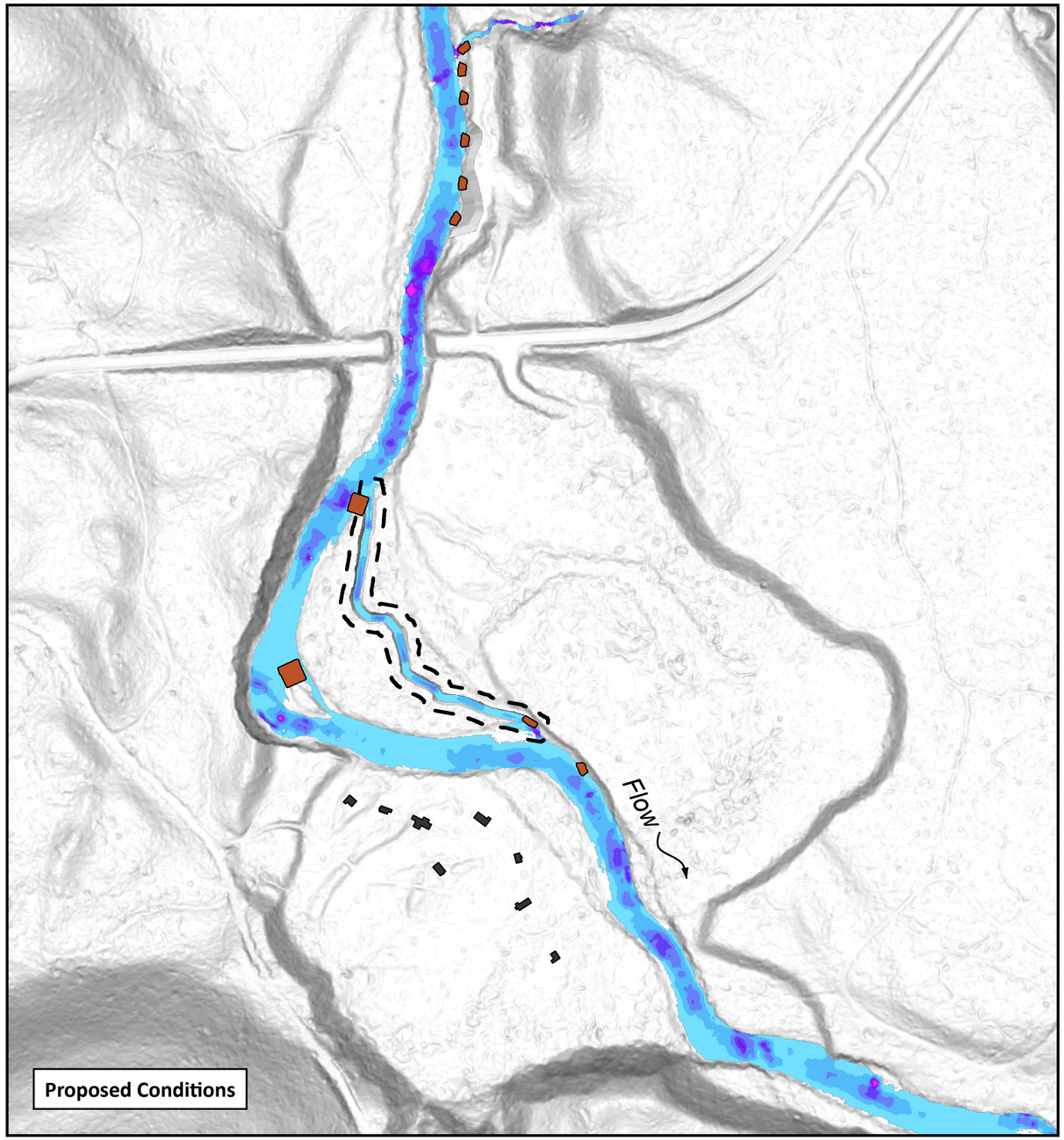
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

September Mean Daily Flow:

Modeled Discharge: 139 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

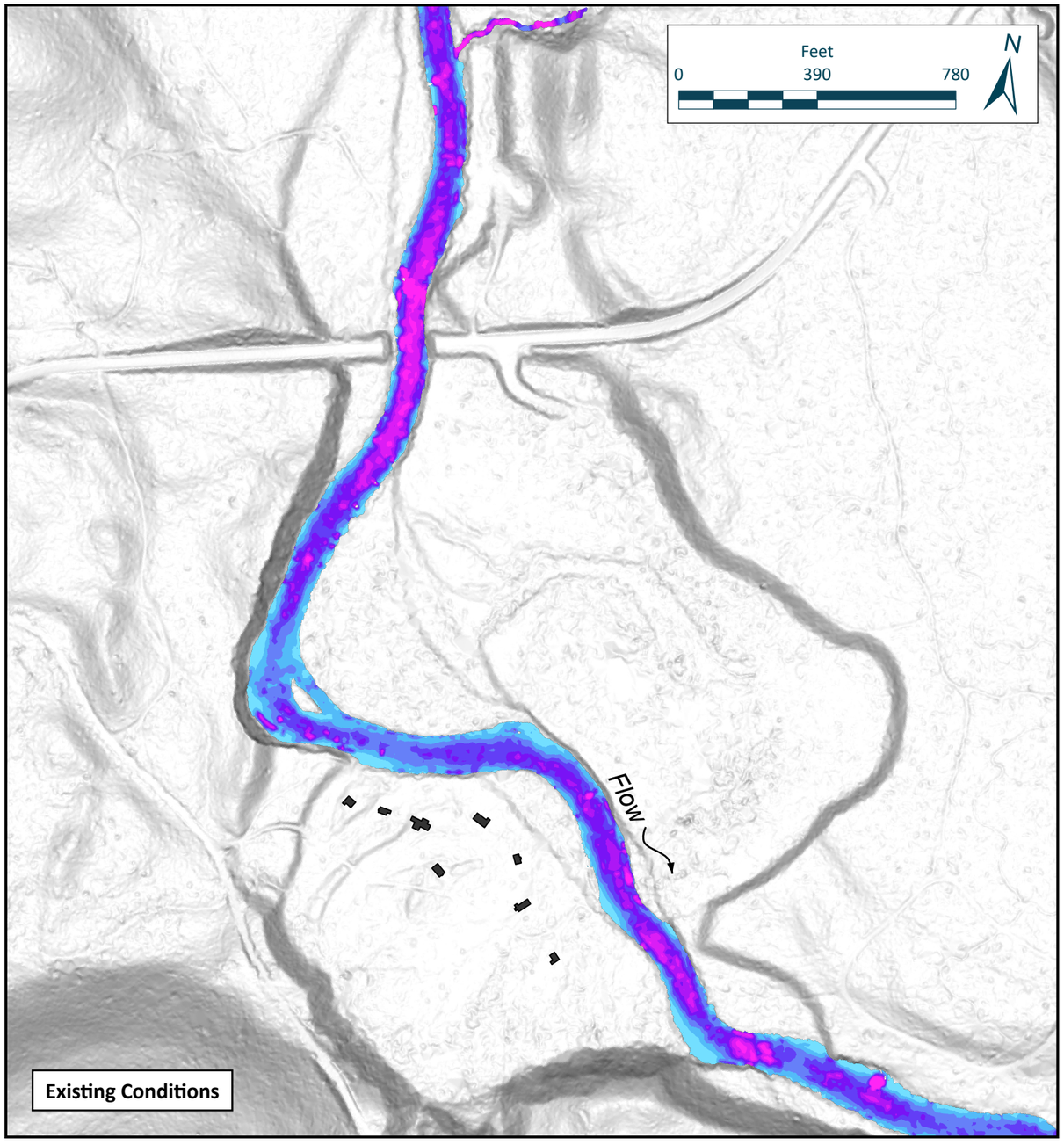
Modeled Shear Stress (lb/sq. ft)

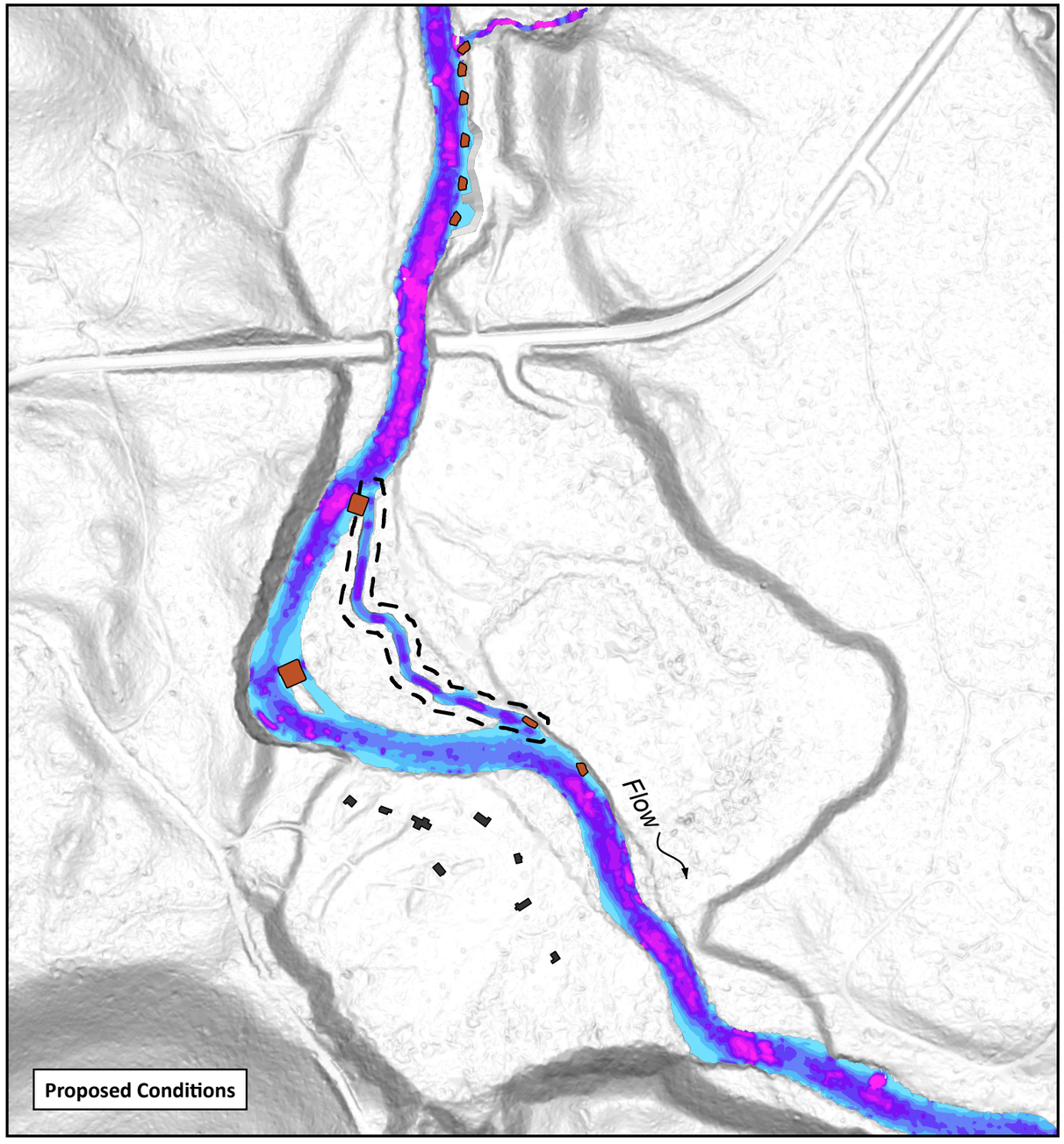
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

November Mean Daily Flow:

Modeled Discharge: 304 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

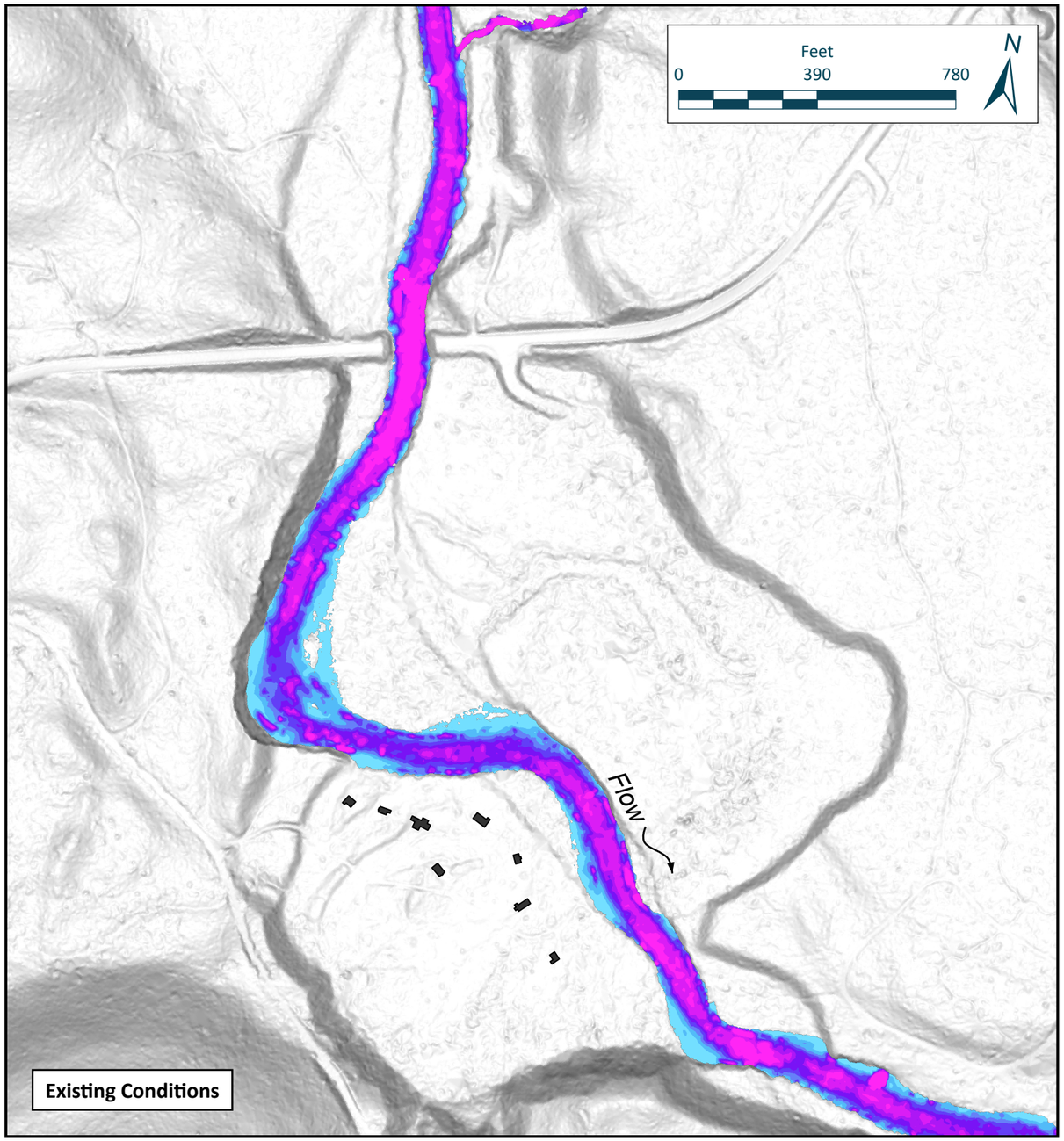
Modeled Shear Stress (lb/sq. ft)

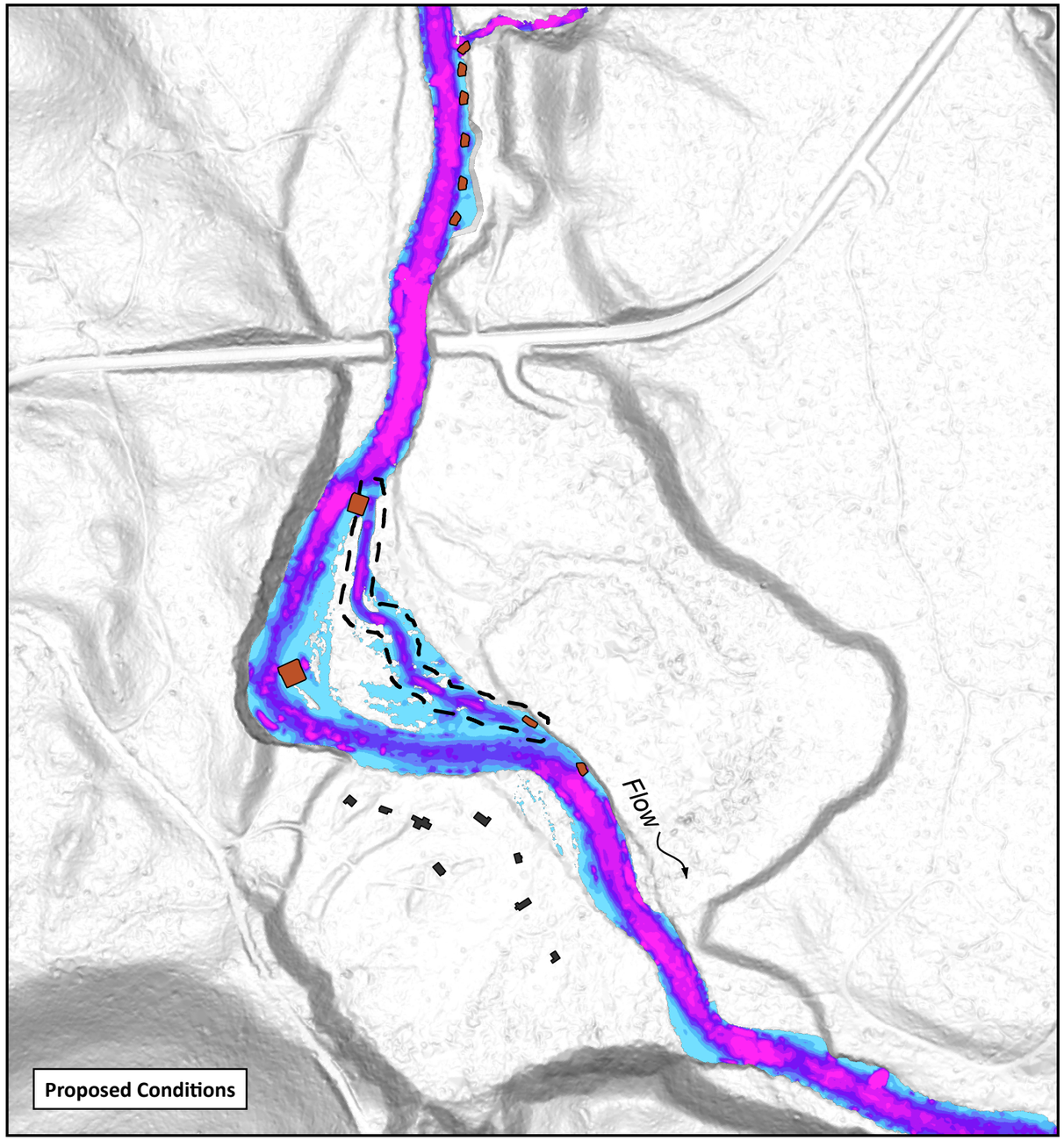
<0.25 | 0.25 – 0.5 | 0.5 – 0.75 | 0.75 – 1 | 1 – 1.25 | 1.25 – 1.5 | 1.5 – 2 | >2

Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

May Mean Daily Flow:

Modeled Discharge: 1,614 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

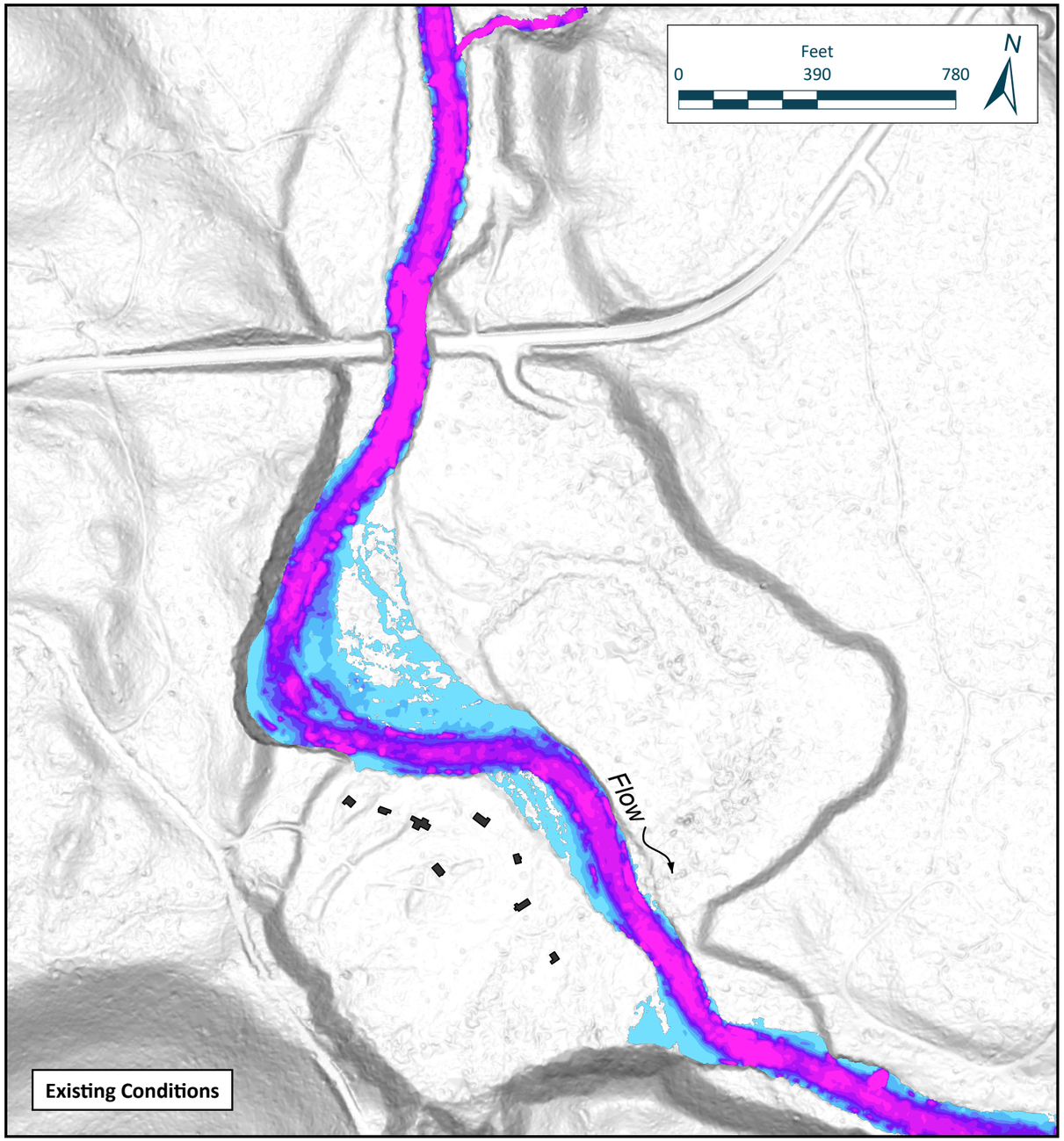
Modeled Shear Stress (lb/sq. ft)

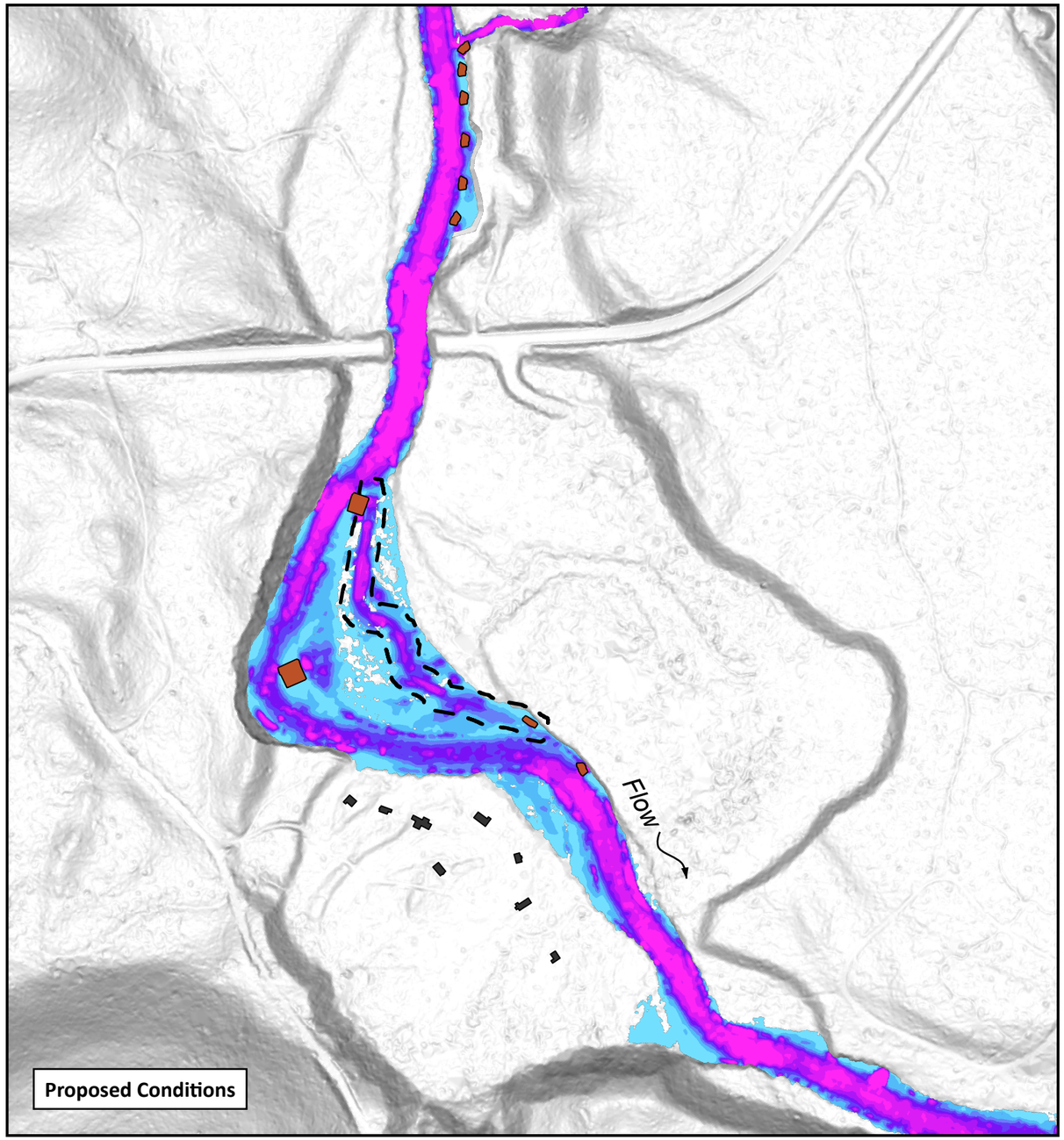
<0.25 | 0.25 – 0.5 | 0.5 – 0.75 | 0.75 – 1 | 1 – 1.25 | 1.25 – 1.5 | 1.5 – 2 | >2

Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

2-Year Return Period Peak Flow:

Modeled Discharge: 3,206 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

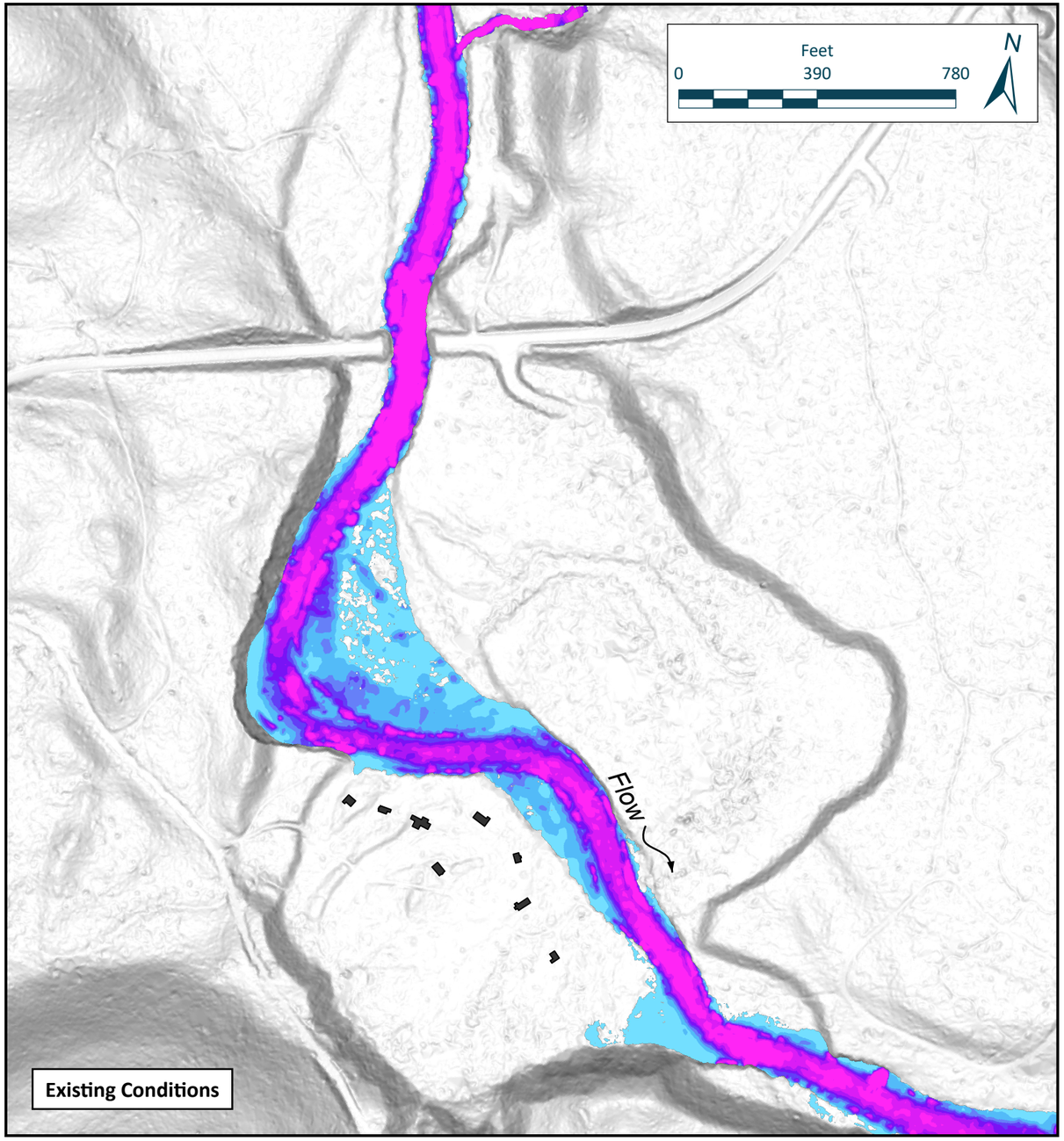
Modeled Shear Stress (lb/sq. ft)

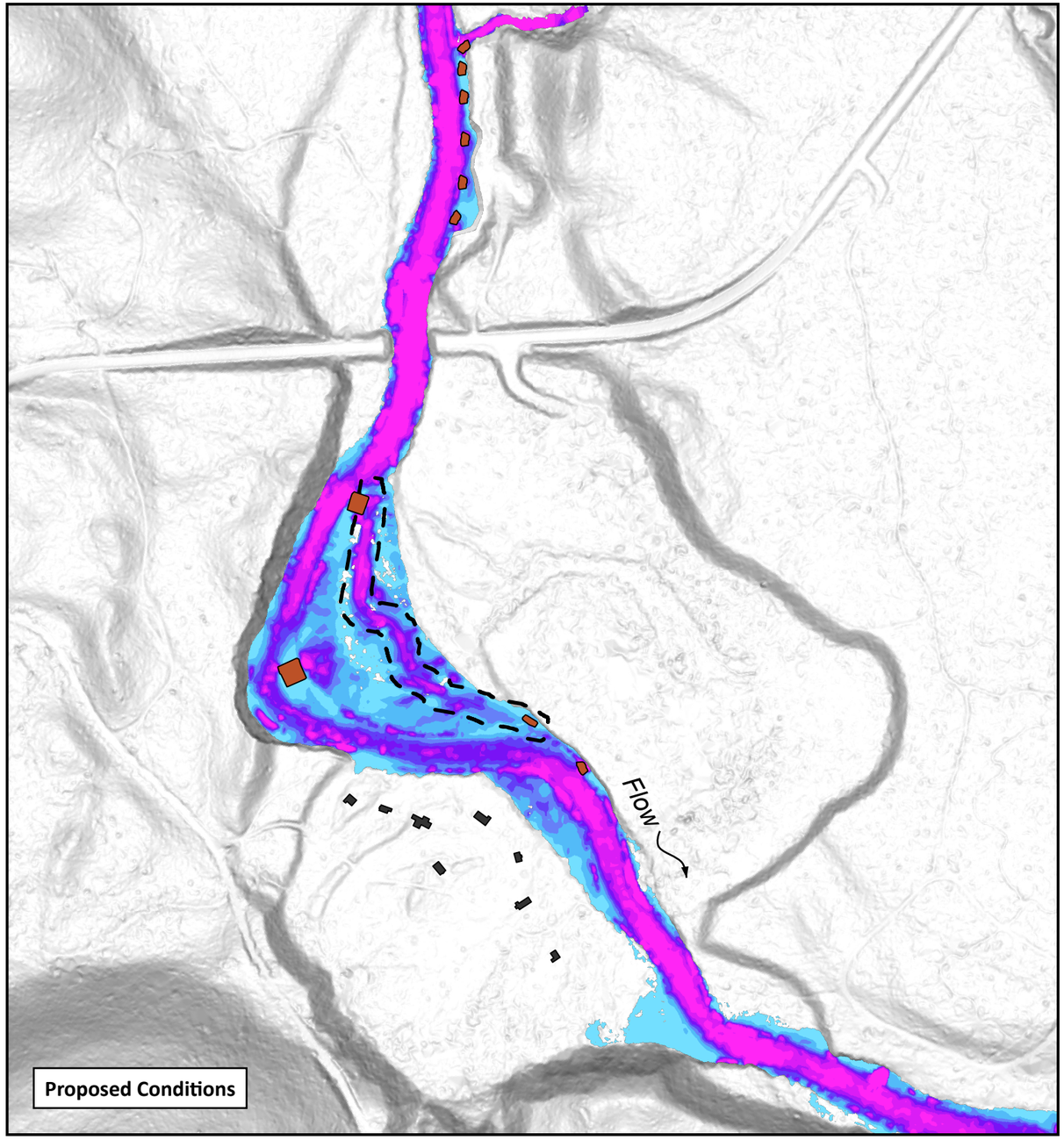
<0.25 | 0.25 – 0.5 | 0.5 – 0.75 | 0.75 – 1 | 1 – 1.25 | 1.25 – 1.5 | 1.5 – 2 | >2

Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

5-Year Return Period Peak Flow:

Modeled Discharge: 4,362 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

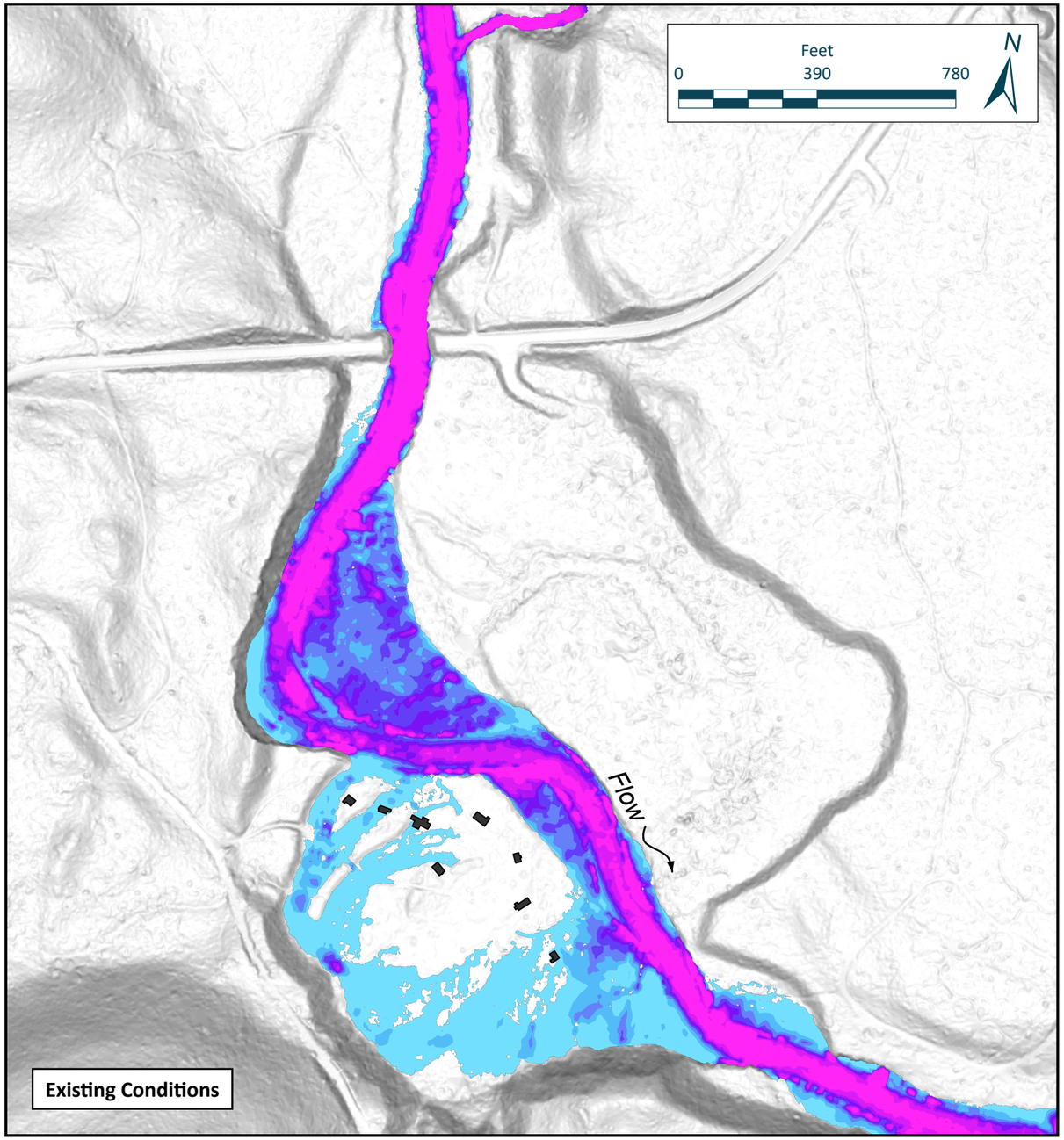
Modeled Shear Stress (lb/sq. ft)

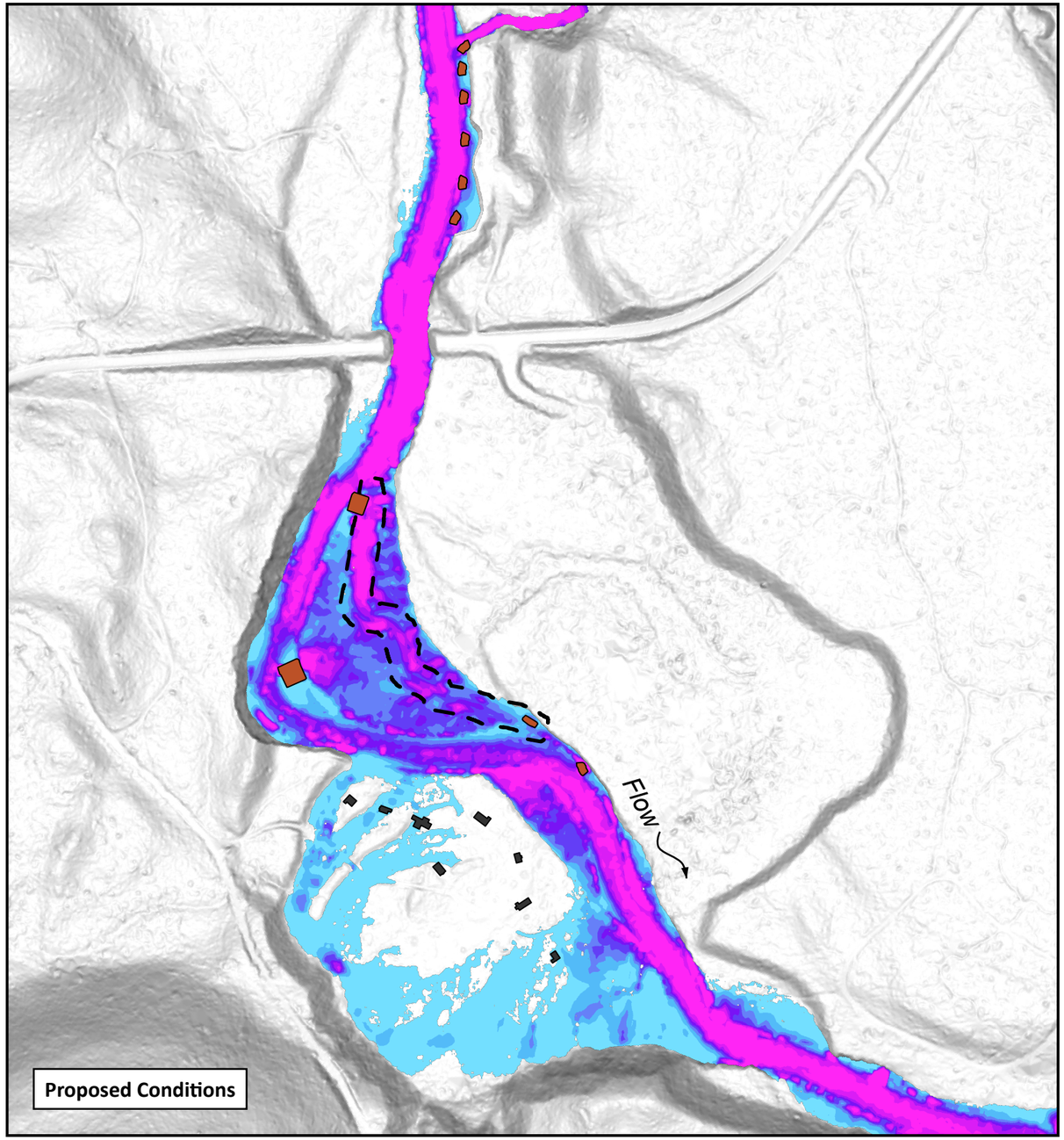
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Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

10-Year Return Period Peak Flow:

Modeled Discharge: 5,103 cfs





inter·fluve

COUNTY OF CHELAN

BUREAU OF RECLAMATION

Cabin Footprints

Area D Proposed Large Wood Structures

Area D Proposed Side Channel Alignment

Modeled Shear Stress (lb/sq. ft)

<0.25 | 0.25 – 0.5 | 0.5 – 0.75 | 0.75 – 1 | 1 – 1.25 | 1.25 – 1.5 | 1.5 – 2 | >2

Lower Chiwawa Area D: 60% Design Hydraulic Model Results -- Shear Stress

100-Year Return Period Peak Flow:

Modeled Discharge: 7,328 cfs

Appendix D | Engineer's Opinion of Probable Construction Cost

Engineer's Opinion of Probable Construction Costs
August 2025

Lower Chiwawa River Project- Area D
60% Design

No.	Item	Unit	Quantity	Unit Cost	Cost	Notes
1.00	**General Requirements**				**$ 100,000**	**Subtotal**
1.01	Mobilization/Demobilization	L.S.	1	$ 100,000	$ 100,000	Includes mobilization of all equipment and personnel to the project site, project site preparation not covered under other bid items, and other miscellaneous items that may be needed to perform the project work. Mobilization/Demobilization assumes a single mobilization/demobilization of equipment to the project site. Estimated as approximately 7% of Direct Costs.
2.00	**Site Preparation**				**$ 251,000**	**Subtotal**
2.01	Erosion, Pollution, and Sediment Control	L.S.	1	$ 60,000	$ 60,000	Includes development and implementation of required Erosion and Sediment Control Plan. Estimated as approximately 4% of Direct Costs.
2.02	Clearing, Grubbing, and Tree Salvage	AC	3	$ 5,000	$ 15,000	Includes Clearing and Grubbing of Side Channel, Riparian Bank Grading and Staging and Access Work Areas
2.03	Temporary Access and Staging	L.S.	1	$ 50,000	$ 50,000	Includes site prep, clearing, decomissioning, and restoration per USFS requirements as necessary. Assumes no major road building or stabilization. Road closure materials not included. Estimated as 3% of Direct Costs.
2.04	Diversion and Dewatering	L.S.	1	$ 126,000	$ 126,000	Includes Coffer Dams and pumping for in-channel work
3.00	**Earthwork**				**$ 120,200**	**Subtotal**
3.01	Side Channel Grading	CY	4,280	$ 20	$ 85,600	Assume excavation and channel geometry grading, onsite disposal with minimal shaping. Habitat Features covered under Large Wood Install
3.02	Riparian Bank Grading	CY	1,730	$ 20	$ 34,600	Assume excavation and bench geometry grading, onsite disposal with minimal shaping. Habitat Features covered under Large Wood Install
4.00	**Habitat Items**				**$ 795,500**	**Subtotal**
4.01	Apex Large Wood Structure	EA	1	$ 86,000	$ 86,000	Includes LW procurement, haul to install site, temporary/permanent excavation, LW install, Pile install, pinning, salvaged trees, slash, lives stakes
4.02	Apex - Narrow Large Wood Structure	EA	1	$ 79,000	$ 79,000	Includes LW procurement, haul to install site, temporary/permanent excavation, LW install, Pile install, pinning, salvaged trees, slash, lives stakes
4.03	Bank-Buried Large Wood Structures	EA	7	$ 44,000	$ 308,000	Includes LW procurement, haul to install site, temporary/permanent excavation, LW install, Pile install, pinning, salvaged trees, slash, lives stakes
4.04	Side Channel Confluence Large Wood Structure	EA	1	$ 54,000	$ 54,000	Includes LW procurement, haul to install site, temporary/permanent excavation, LW install, Pile install, pinning, salvaged trees, slash, lives stakes
4.05	Side Channel Habitat Wood - Imported	EA	179	$ 1,400	$ 250,600	Includes procurement and haul to install site of imported rootwad logs, logs without rootwads and piles. Also Includes temporary/permanent excavation, LW install, small salvaged trees, slash
4.06	Side Channel Habitat Wood - Salvaged Trees	EA	21	$ 850	$ 17,850	Includes salvaging/placing large trees within the Side Channel with excavator
5.00	**Site Restoration**				**$ 14,780**	**Subtotal**
5.01	Riparian Live Plants Zone	AC	0.15	$ 26,000	$ 3,900	Includes revegetation of disturbed surfaces associated with habitat work and surrounding floodplain areas. Excludes areas where recreational improvements are being designed
5.02	Transitional/ Upland Zone	AC	0.2	$ 36,900	$ 7,380	Includes revegetation of disturbed surfaces associated with habitat work and surrounding floodplain areas. Excludes areas where recreational improvements are being designed
5.03	Seed Mix Area	AC	1.4	$ 2,500	$ 3,500	Excludes areas where recreational improvements are being designed
6.00	**Recreation Plans[3]**				**$ 403,050**	**Subtotal**
6.01	Restoration Site 1	LS	5	$ 1,250	$ 7,813	Areas of fallen logs anchored to partially buried boulders
6.02	Restoration Site 2	LS	35	$ 1,250	$ 54,688	Areas of fallen logs and partially buried boulders
6.03	Boulders, 1-2 Man	EA	311	$ 24	$ 9,330	Approximately 20 tons @ $450/ton
6.04	Boulders. 3-4 Man	EA	192	$ 210	$ 50,400	Approximately 115 tons @ $450/ton
6.05	Willow Fascines for Erosion Control	LF	420	$ 17.50	$ 7,350	Placed down slope of rivulets and deepened swales.
6.06	Fallen Logs	EA	126	$ 50	$ 7,875	$80 per segment, assuming 1/2 are tied down. To be sourced locally.
6.07	Native Seeding Mix 1	SF	67,510	$ 0.25	$ 15,823	Assuming 75% coverage, to be broadcast seeded.
6.08	Native Seeding Mix 2	SF	176,420	$ 0.25	$ 33,079	Assuming 60% coverage, to be broadcast seeded.
6.09	Native Trees (4x14 ci)	EA	400	$ 20	$ 10,000	Approx 400 Trees
6.10	Native Shrubs (live stakings)	EA	1,700	$ 2.75	$ 5,844	Approx 1700 Shrubs, assuming 30% coverage with average 4' Dia
6.11	Channels/Berms Regrading	SF	11,485	$ 2.25	$ 32,302	Moderate grading (cut/fill, slope adjustments)
6.12	Rivulets and Berms - Regrading	SF	24,423	$ 2.25	$ 68,690	Lighting grading (minimal cut/fill, reshaping)
6.13	D2 Road/Dispersed Site Access	SF	18,740	$ 1.35	$ 31,624	Targeted improvements for erosion control
6.14	D3 Road/Dispersed Site Access	SF	11,200	$ 1.35	$ 18,900	Targeted improvements for erosion control
6.15	Mulch	SF	157,873	$ 0.25	$ 49,335	Straw mulch for reseeded/disturbed areas including wood mulch around trees/shrubs
	Construction Sub-Total				**$ 1,684,530**	
	20% Contingency (rounded to nearest hundred)				*$ 336,900*	*20% of Construction Sub-Total*
	Construction Total (including 20% Contingency)				**$ 2,021,430**	

Notes

1 Contingencies account for variability in project design and construction costs, rounded up.

2 Costs are in dollars as of 2025.

3 Recreation Plans cost estimate was developed by SCJ

4 Costs do NOT include construction observation

5 In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market condition or the Contractor's method of pricing, and the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

Abbreviations

EA - each, L.S. - lump sum, LW - Large Wood

Appendix E | 60% Planset

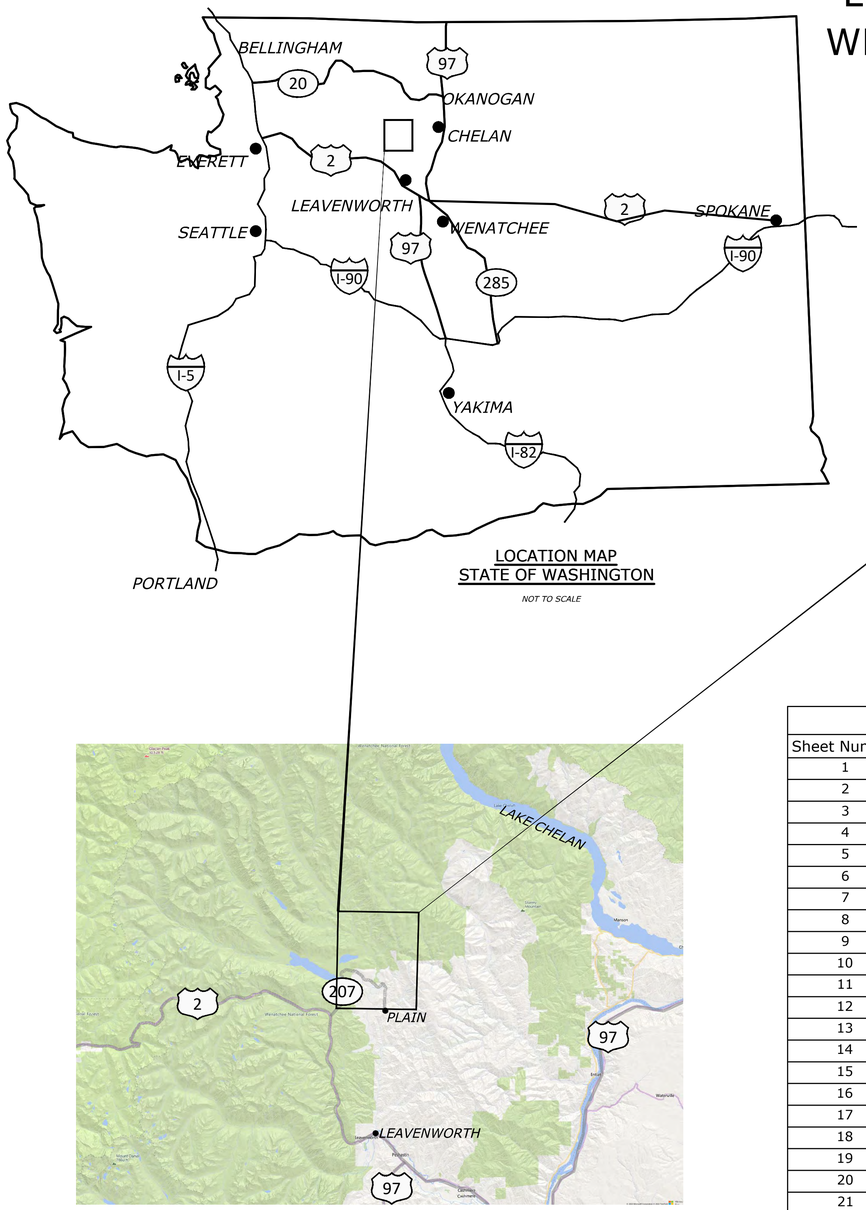
LOWER CHIWAWA RIVER PROJECT

PROJECT AREA D

LOWER CHIWAWA RIVER ASSESSMENT UNIT

WENATCHEE RIVER SUB-BASIN, WASHINGTON

60% DESIGN DRAWINGS

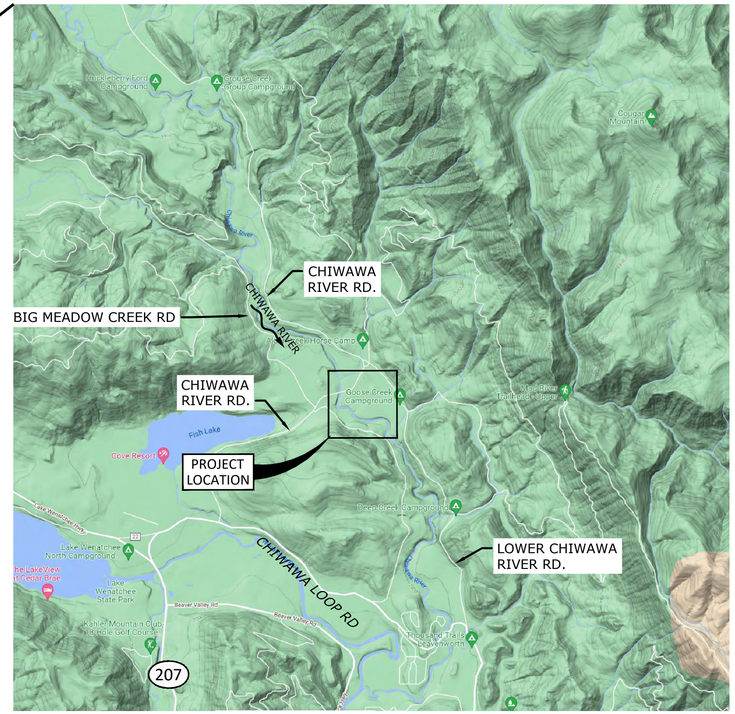


LOCATION MAP
STATE OF WASHINGTON

NOT TO SCALE

VICINITY MAP
NOT TO SCALE

Sheet List Table	
Sheet Number	Sheet Title
1	COVER SHEET
2	GENERAL NOTES
3	JURISDICTIONAL QUANTITIES TABLES
4	GENERAL CONSERVATION MEASURES (1 OF 3)
5	GENERAL CONSERVATION MEASURES (2 OF 3)
6	GENERAL CONSERVATION MEASURES (3 OF 3)
7	TYPICAL SEDIMENT CONTOL DETAIL
8	EXISTING CONDITIONS, ACCESS AND STAGING
9	SITE OVERVIEW AND SHEET INDEX
10	PROPOSED CONDITIONS (1 OF 2)
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13	TYPICAL DETAILS (1 OF 5)
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18	REVEGETATION PLAN
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21	SPECIFICATIONS (2 OF 2)
LA-01	AREA D-1 RECOMMENDATIONS
LA-02	AREA D-2 RECOMMENDATION
LA-03	AREA D-3 RECOMMENDATIONS
LA-04	SITE DETAILS & NOTES



PROJECT LOCATION MAP
SCALE 1" = 5000'

PREPARED FOR:
CHELAN COUNTY NATURAL RESOURCES
DEPARTMENT
CONTACT: SCOTT BAILEY
411 WASHINGTON STREET, SUITE 201
WENATCHEE, WA 98801

PREPARED BY:
INTER-FLUVE
501 PORTWAY AVE, SUITE 101
HOOD RIVER, OR 97031

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION,
PACIFIC NORTHWEST REGION
CONTACT: STEVE KOLK, P.E.
1150 N. CURTIS RD.
BOISE, ID 83706

BUREAU OF RECLAMATION

COUNTY OF CHELAN

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FCRPS HABITAT IMPROVEMENT PROGRAM

LOWER CHIWAWA ASSESSMENT UNIT
PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS,JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

COVER SHEET

SHEET 1

SHEET 1 OF 21

LAST SAVED DATE
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EXISTING DATA

TOPOGRAPHY AND BATHYMETRY WAS COLLECTED ON AUGUST 3RD AND 4TH, 2021 BY NV5G USING RED/GREEN LIDAR. AS DOCUMENTED IN THE REPORT: NV5, GEOSPATIAL, OCTOBER 5, 2021. CHEWAWA RIVER, WASHINGTON. TOPOBATHYMETRIC LIDAR TECHNICAL DATA REPORT.

DATA SOLICITED BY INTER-FLUVE DELIVERED BY: NV5 GEOSPATIAL. CERTIFIED BY: VON PETER SILVIA, PLS NO. 53957.

THE USFS CABINS WERE SURVEYED IN MAY 2025. A PARTIAL TREE SURVEY WAS CONDUCTED IN MAY 2025 AND INCLUDED TRES 12" DBH AND LARGER IN THE VICINICTY OF PROPOSED GRADING AREAS.

AERIAL IMAGERY PROVIDED BY NV5

WETLANDS AND WATERS OF THE US

ORDINARY HIGH WATER DEPICTED ON THESE PLANS IS BASED ON HYDRAULIC MODEL RESULTS FOR THE 2-YEAR FLOOD.

A WETLAND ASSESSMENT WAS PERFORMED BY INTER FLUVE INC. IN 2023.

THESE DO NOT NECESSARILY REPRESENT JURISDICTIONAL BOUNDARIES. WITHIN THE STATE OF WASHINGTON, THE ARMY CORPS OF ENGINEERS AND THE DEPARTMENT OF ECOLOGY HAVE THE FINAL AUTHORITY IN DETERMINING WATERS AND WETLAND BOUNDARIES AND REGULATIONS.

SOILS

SOILS AT THE SITE ARE EXPECTED TO CONSIST OF LOWER CHIWAWA RIVER ALLUVIUM (BOULDERS/COBBLES/GRAVELS) AND FLOODPLAIN SOILS (SILT/SAND WITH COBBLES AND GRAVELS). CHORALMONT CINDERY SANDY LOAM IN THE OVERBANK AND UPLAND AREAS, PER NRCS WEB SOIL SURVEY (https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx)

UTILITIES

THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR HAVING UTILITIES LOCATED PRIOR TO CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL CALL (800-424-5555) FOR UTILITY LOCATE PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE EFFECTED UTILITY SERVICE TO REPORT ANY DAMAGED OR DESTROYED UTILITIES. THE CONTRACTOR SHALL PROVIDE EQUIPMENT AND LABOR TO AID THE EFFECTED UTILITY SERVICE IN REPAIRING DAMAGED OR DESTROYED UTILITIES AT NO ADDITIONAL COST TO OWNER OR PROJECT SPONSOR.

CONSTRUCTION TIMING

ALL IN-WATER CONSTRUCTION WORK SHALL OCCUR WITHIN THE DESIGNATED IN-WATER WORK WINDOW. UNLESS OTHERWISE APPROVED BY WDFW AND OTHERS IN WRITING. ALL OTHER SITE WORK SHALL OCCUR WITHIN THE DESIGNATED SEASONAL GENERAL CONSTRUCTION WORK WINDOW.

EROSION CONTROL

CONTRACTOR SHALL BE SOLELY RESPONSIBLE, AT OWN EXPENSE, FOR PROVIDING AND MAINTAINING ALL NECESSARY EROSION CONTROL FACILITIES TO COMPLY WITH APPLICABLE EROSION CONTROL REGULATIONS AND TO MAINTAIN CLEAN ACCESS ROUTES. SEE GENERAL AQUATIC CONSERVATION MEASURES ON SHEETS 3 -5 FOR ADDITIONAL REQUIREMENTS.

EROSION CONTROL SEED MIX

APPLY AT 20 LB/ACRE. PRIOR TO DISTRIBUTION, MIX SEED WITH 50:50 CRACKED CORN TO FACILITATE EVEN DISTRIBUTION. ALL AREAS WITHIN LIMITS OF DISTURBANCE TO BE SEEDED AND MULCHED.

FISH SALVAGE

TO BE COMPLETED BY EXPERIENCED FISH BIOLOGIST AND COORDINATED WITH OWNER. SEE USFS ARBOII

EQUIPMENT

SEE GENERAL AQUATIC CONSERVATION MEASURES ON SHEETS 3 -5 FOR ADDITIONAL REQUIREMENTS.

CULTURAL RESOURCES

PLACE HOLDER

CONSTRUCTION MEETINGS

THE CONTRACTOR SHALL ATTEND A MANDATORY PRE-BID SITE MEETING.

THE CONTRACTOR SHALL ATTEND A PRE-CONSTRUCTION MEETING WITH THE OWNER'S REPRESENTATIVE PRIOR TO BEGINNING CONSTRUCTION.

CONSTRUCTION PLANS AND SPECIFICATIONS

ALL WORK SHALL CONFORM TO THE CURRENT EDITIONS OF STANDARD PLANS AND SPECIFICATIONS OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT), AND LOCAL STANDARDS UNLESS INDICATED OTHERWISE BY THE CONTRACT DOCUMENTS.

CONSTRUCTION STAKING

CONTRACTOR SHALL STAKE PROJECT LIMITS AND INSTALL GRADE STAKES AND ELEVATION CONTROL POINTS. SOME FIELD ADJUSTMENTS TO THE LINES AND GRADES ARE TO BE EXPECTED.

CONTRACTOR SHALL MEET WITH THE OWNER TO DEFINE AND MARK ACCESS ROUTES AND LIMITS OF DISTURBANCE PRIOR TO MOBILIZATION OF EQUIPMENT OR MATERIALS ONTO THE SITE.

THE CONTRACTOR SHALL REPLACE DAMAGED OR DESTROYED CONSTRUCTION STAKES AT NO ADDITIONAL COST TO OWNER OR PROJECT SPONSOR.

CONSTRUCTION ACCESS

CONTRACTOR SHALL SUBMIT AN ACCESS, STAGING, AND STOCKPILE PLAN TO THE OWNER FOR APPROVAL.

THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING ANY REQUIRED TRAFFIC CONTROL INCLUDING, BUT NOT LIMITED TO, SIGNAGE AND FLAGGERS; AND FOR OBTAINING ANY REQUIRED ACCESS PERMITS.

FOR DURATION OF PROJECT, CONTRACTOR SHALL KEEP ALL PRIVATE AND PUBLIC ROADS USED FOR ACCESS FREE OF DEBRIS AND MUD.

SEE ARBO GENERAL AQUATIC CONSERVATION MEASURES FOR ADDITIONAL REQUIREMENTS.

TREE SALVAGE

ALL TREES TO BE REMOVED SHALL BE APPROVED AND CLEARLY MARKED BY THE OWNER'S REPRESENTATIVE.

ALL REMOVED NON-INVASIVE VEGETATION SHALL BE INCORPORATED INTO LARGE WOOD STRUCTURES AS APPROVED BY THE OWNER'S REPRESENTATIVE. IF EXCESS MATERIAL NEEDS DISPOSAL OUTSIDE OF CHANNEL WORK, IT SHALL BE DISTRIBUTED ON THE FLOODPLAIN AS APPROVED BY THE OWNER'S REPRESENTATIVE.

ALL TREES REMOVED WITHIN CLEARING LIMITS, UNLESS OTHERWISE NOTED, SHALL BE REMOVED WHOLE WITH ROOTS INTACT AND UTILIZED IN OTHER PROJECT WORK AS APPROVED BY OWNER'S REPRESENTATIVE.

REMOVE SOIL FROM ROOTS OF SALVAGED TREES BEFORE PLACEMENT IN THE WATERWAY.

LIVE TREES

ALL TREES NOT MARKED FOR REMOVAL SHALL BE PRESERVED AND UNDISTURBED. CONSTRUCTION ACTIVITY SHALL NOT DEBARK OR DAMAGE LIVE TREES.

KEEP OUT OF DRIP LINE OF ALL PRESERVED EXISTING TREES.

PRELIMINARY CONSTRUCTION QUANTITIES -LWS

LWS TYPE	NO. OF STRUCTURES	ROOTWAD LOG PER LWS	WHOLE TREE PER LWS	LOGS/PILE PER LWS	EXCAVATED QTY (CY) PER LWS
APEX NARROW LWS	1	30	6	17	225
APEX LWS	1	37	8	20	300
CONFLUENCE LWS	1	25	5	12	300
BANK BURIED LWS	7	20	2	8	100
SIDE CHANNEL	0	179	21	0	4270
RIPARIAN BANK TREATMENT	0	0	0	0	1675
PROJECT TOTAL	**10**	**411**	**54**	**105**	**7470**

LEAVE TREES

Tree no.	Northing	Easting	DBH (in)	Species
1	306924	1681607	22	Fir
2	306838	1681544	24	Fir
3	306842	1681538	16	Cedar
4	306840	1681539	24	Fir
5	306824	1681555	31	Cedar
6	306828	1681533	30	Cedar
7	306817	1681559	50	Fir
8	306795	1681552	30	Fir
9	306794	1681533	12	Fir
10	306758	1681614	28	Fir
11	306762	1681561	16	Fir
12	306762	1681560	16	Fir
13	306717	1681610	30	Fir
14	306706	1681610	30	Fir
15	306701	1681560	28	Fir
16	306703	1681555	20	Cedar
17	306698	1681548	20	Cedar
18	306719	1681551	18	Fir
19	306723	1681550	18	Cedar
20	306683	1681549	38	Fir
21	306617	1681553	40	Fir
22	306643	1681605	34	Fir
23	306635	1681627	32	Fir
24	306608	1681622	40	Fir
25	306608	1681629	16	Fir
26	306599	1681644	14	Fir
27	306559	1681603	26	Fir
28	306555	1681611	14	Fir
29	306544	1681659	30	Fir
30	306614	1681675	18	Fir
31	306631	1681704	36	Cottonwood
32	306575	1681762	28	Cottonwood
33	306578	1681768	38	Pine
34	306544	1681752	12	Fir
35	306450	1681714	24	Fir
36	306453	1681728	24	Pine
37	306463	1681681	22	Fir
38	306491	1681670	14	Fir
39	306486	1681686	14	Fir
40	306490	1681685	18	Fir
41	306514	1681696	34	Fir
42	306508	1681705	15	Fir
43	306458	1681779	28	Pine
44	306459	1681824	48	Cottonwood
45	306445	1681835	16	Fir
46	306452	1681838	20	Fir
47	306380	1681803	54	Cottonwood
48	306376	1681800	18	Pine
49	306385	1681808	22	Fir
50	306394	1681807	22	Fir
51	306386	1681830	22	Fir
52	306387	1681833	16	Pine
53	306345	1681890	12	Fir
54	306335	1681886	12	Fir
55	306333	1681882	26	Pine
56	306332	1681844	14	Fir
57	306326	1681855	28	Pine
58	306364	1681921	28	Fir
59	306360	1681953	20	Pine
60	306396	1681982	16	Cottonwood
61	306405	1681984	18	Fir
62	306410	1681965	20	Cedar
63	306412	1681961	18	Fir
64	306419	1681963	24	Fir
65	306392	1682024	12	Cottonwood
66	306351	1682005	12	Pine
67	306397	1682080	36	Pine
68	306397	1682033	36	Fir
69	308217	1681634	21	Fir
70	308208	1681634	33	Fir
71	308173	1681605	26	Cedar
72	308163	1681625	26	Fir
73	308183	1681629	23	Fir
74	308195	1681634	14	Fir
75	308198	1681638	11	Fir
76	308210	1681656	40	Fir
77	308183	1681669	14	Fir
78	308178	1681677	12	Fir
79	308174	1681675	19	Fir
80	308164	1681679	19	Fir
81	308133	1681680	20	Fir
82	308130	1681675	16	Fir
83	308124	1681682	19	Fir
84	308126	1681690	19	Fir
85	308109	1681666	15	Fir
86	308085	1681640	14	Cedar
87	308084	1681637	32	Cedar
88	308036	1681656	28	Cedar
89	308071	1681684	43	Fir
90	308015	1681680	25	Fir
91	307976	1681709	12	Fir
92	307970	1681728	23	Fir
93	307962	1681723	25	Fir
94	307948	1681731	22	Spruce
95	307945	1681737	17	Spruce
96	307941	1681742	16	Spruce
97	307909	1681714	35	Fir
98	307879	1681722	31	Pine
99	307817	1681736	30	Fir
100	307769	1681761	38	Fir
101	307661	1681685	14	Fir
102	307660	1681728	28	Fir

TAKE TREES

Tree no.	Northing	Easting	DBH (in)	Species
103	306861	1681593	35	Fir
104	306868	1681597	28	Fir
105	306852	1681592	13	Fir
106	306819	1681567	12	Fir
107	306786	1681570	12	Fir
108	306788	1681599	31	Fir
109	306766	1681567	16	Fir
110	306723	1681600	12	Fir
111	306709	1681592	27	Fir
112	306711	1681578	24	Fir
113	306686	1681585	26	Fir
114	306685	1681587	20	Fir
115	306669	1681591	28	Fir
116	306665	1681568	38	Pine
117	306649	1681595	14	Fir
118	306599	1681599	20	Fir
119	306588	1681632	32	Fir
120	306556	1681633	27	Pine
121	306560	1681653	14	Fir
122	306556	1681697	14	Fir
123	306543	1681711	12	Fir
124	306549	1681718	18	Fir
125	306482	1681748	20	Fir
126	306428	1681819	12	Fir
127	306403	1681814	20	Fir
128	306403	1681803	20	Fir
129	306398	1681822	26	Pine
130	306364	1681946	20	Fir
131	307972	1681696	19	Fir
132	307976	1681665	14	
133	307960	1681669	17	Pine
134	307957	1681692	14	Fir
135	307951	1681687	28	Fir
136	307924	1681658	31	Pine
137	307907	1681682	17	Fir
138	307808	1681727	22	Fir
139	307803	1681707	21	Fir
140	307802	1681691	19	Fir
141	307778	1681747	19	Fir
142	307781	1681743	21	Fir
143	307747	1681704	15	Fir
144	307729	1681724	21	Spruce
145	307727	1681695	15	Fir
146	307720	1681690	19	Fir
147	307707	1681677	30	Fir
148	307682	1681676	13	Fir
149	307692	1681718	29	Fir
150	308217	1681625	11	Cedar
151	308194	1681613	7	Cedar
152	308187	1681614	20	Cedar
153	308191	1681609	11	Cedar
154	308188	1681610	13	Cedar
155	308160	1681619	15	Cedar
156	308055	1681651	12	Cedar

ABBREVIATIONS

°	DEGREE
'	FEET
"	INCH
%	PERCENT
APPROX.	APPROXIMATE
CY.	CUBIC YARD
DIA.	DIAMETER
ELEV	ELEVATION
ESC	EROSION SEDIMENT AND CONTROL
EXIST	EXISTING
FT	FEET
IN	INCH
INV	INVERT
LWD	LARGE WOODY DEBRIS
LWS	LARGE WOOD STRUCTURE
MAX	MAXIMUM
MIN	MINIMUM
NO.	NUMBER
OHW	ORDINARY HIGH WATER
RD	ROAD
STA	STATION
TYP	TYPICAL
WA	WASHINGTON
YR	YEAR

BUREAU OF RECLAMATION

COUNTY OF CHELAN

inter-fluve
501 Portway Avenue, Suite 101
Hood River, OR 97031
541.386.9003
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Preliminary
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ACCEPTED

BOISE, ID AUGUST 2025

GENERAL NOTES

SHEET 2

SHEET 2 OF 21

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JURISDICTIONAL AREA IMPACTS

JURISDICTIONAL QUANTITIES (WETLANDS)

ACTIVITY	IMPACT LOCATION	DURATION OF IMPACT	WETLAND NAME AND TYPE	IMPACT AREA
EXCAVATON AND BACK FILL	SIDE CHANNEL	PERMANENT	WETLAND B/RAVINE	780 SF
EXCAVATION AND BACKFILL	SC1	PERMANENT	WETLAND B/RAVINE	1800 SF
WORKSITE ISOLATION	SC1	TEMPORARY	WETLAND B/RAVINE	150 SF
LARGE WOOD PLACEMENT	SC1	PERMANENT	WETLAND B/RAVINE	800 SF

JURISDICTIONAL QUANTITIES (BELOW OHW)

ACTIVITY	IMPACT LOCATION	DURATION OF IMPACT	VOLUME OF MATERIAL PLACED OR REMOVED BELOW OHW (CY)	IMPACT AREA OR LENGTH
LARGE WOOD PLACEMENT	B1	PERMANENT	44 WOOD(FILL)	550 SF
EXCAVATION AND BACKFILL	B1	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B1	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B1	TEMPORARY	33 TEMP. COFFERDAM (FILL)	100 LF
LARGE WOOD PLACEMENT	B2	PERMANENT	50 WOOD(FILL)	625 SF
EXCAVATION AND BACKFILL	B2	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B2	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B2	TEMPORARY	26 TEMP. COFFERDAM (FILL)	85 LF
LARGE WOOD PLACEMENT	B3	PERMANENT	9 WOOD (FILL)	730 SF
EXCAVATION AND BACKFILL	B3	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B3	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B3	TEMPORARY	33 TEMP. COFFERDAM(FILL)	100 LF
LARGE WOOD PLACEMENT	B4	PERMANENT	36 WOOD (FILL)	450 SF
EXCAVATION AND BACKFILL	B4	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B4	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B4	TEMPORARY	28 TEMP. COFFERDAM (FILL)	85 LF
LARGE WOOD PLACEMENT	B5	PERMANENT	32 WOOD (FILL)	400 SF
EXCAVATION AND BACKFILL	B5	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B5	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B5	TEMPORARY	33 TEMP. COFFERDAM (FILL)	100 LF
LARGE WOOD PLACEMENT	B6	PERMANENT	40 WOOD(FILL)	500 SF
EXCAVATION AND BACKFILL	B6	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B6	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B6	TEMPORARY	37 TEMP. COFFERDAM (FILL)	110 LF
LARGE WOOD PLACEMENT	B7	PERMANENT	62 WOOD(FILL)	770 SF
EXCAVATION AND BACKFILL	B7	TEMPORARY	35 (REMOVAL/FILL)	150 SF
EXCAVATION AND BACKFILL	B7	PERMANENT	100 (REMOVAL)	800 SF
WORKSITE ISOLATION	B7	TEMPORARY	37 TEMP. COFFERDAM (FILL)	110 LF
LARGE WOOD PLACEMENT	A1	PERMANENT	188 WOOD (FILL)	2540 SF
EXCAVATION AND BACKFILL	A1	PERMANENT	225 (REMOVAL/FILL)	1650 SF
WORKSITE ISOLATION	A1	TEMPORARY	70 TEMP. COFFERDAM (FILL)	210 LF
LARGE WOOD PLACEMENT	A2	PERMANENT	190 WOOD (FILL)	3000 SF
EXCAVATION AND BACKFILL	A2	PERMANENT	300 (REMOVAL/FILL)	1800 SF
WORKSITE ISOLATION	A2	TEMPORARY	58 (FILL)	175 LF
LARGE WOOD PLACEMENT	SC1	PERMANENT	50 WOOD (FILL)	803 SF
EXCAVATION AND BACKFILL	SC1	PERMANENT	300 (REMOVAL/FILL)	1800 SF
WORKSITE ISOLATION	SC1	TEMPORARY	25 (FILL)	75 LF
EXCAVATION AND BACKFILL	SIDE CHANNEL	PERMANENT	500 (REMOVAL)	5000 SF

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FCRPS HABITAT IMPROVEMENT PROGRAM

LOWER CHIWAWA ASSESSMENT UNIT
PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS,JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

JURISDICTIONAL QUANTITIES TABLES

SHEET 3

SHEET 3 OF 21

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CMCCONNELL

CAD SYSTEM
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GENERAL CONSERVATION MEASURES APPLICABLE TO ALL ACTIONS

THE ACTIVITIES COVERED UNDER ARBO ARE INTENDED TO PROTECT AND RESTORE FISH AND WILDLIFE HABITAT WITH LONG-TERM BENEFITS TO ESA-LISTED SPECIES. THE FOLLOWING GENERAL CONSERVATION MEASURES (DEVELOPED IN COORDINATION WITH USFWS, NMFS AND ADAPTED FROM THE HIP GENERAL CONSERVATION MEASURES.) WILL BE APPLIED TO ALL ACTIONS OF THIS PROJECT.

PROJECT DESIGN AND SITE PREPARATION

1. STATE AND FEDERAL PERMITS

A. ALL APPLICABLE REGULATORY PERMITS AND OFFICIAL PROJECT AUTHORIZATIONS WILL BE OBTAINED BEFORE PROJECT IMPLEMENTATION.

B. THESE PERMITS AND AUTHORIZATIONS INCLUDE, BUT ARE NOT LIMITED TO, NATIONAL ENVIRONMENTAL POLICY ACT, NATIONAL HISTORIC PRESERVATION ACT, THE APPROPRIATE STATE AGENCY REMOVAL AND FILL PERMIT, USACE CLEAN WATER ACT (CWA) 404 PERMITS, AND CWA SECTION 401 WATER QUALITY CERTIFICATIONS.

2. TIMING OF IN-WATER WORK

A. APPROPRIATE STATE (OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW), WASHINGTON DEPARTMENT OF FISH AND WILDLIFE (WDFW), IDAHO DEPARTMENT OF FISH AND GAME (IDFG), AND MONTANA FISH WILDLIFE AND PARKS (MFWP)) GUIDELINES FOR TIMING OF IN-WATER WORK WINDOWS (IWW) WILL BE FOLLOWED.

B. CHANGES TO ESTABLISHED WORK WINDOWS WILL BE APPROVED BY REGIONAL STATE BIOLOGISTS AND REGULATORY AGENCIES.

C. BULL TROUT. FOR AREAS WITH DESIGNATED IN-WATER WORK WINDOWS FOR BULL TROUT OR AREAS KNOWN TO HAVE BULL TROUT, PROJECT PROPONENTS WILL CONTACT THE APPROPRIATE USFWS FIELD OFFICE TO INSURE THAT ALL REASONABLE IMPLEMENTATION MEASURES ARE CONSIDERED AND AN APPROPRIATE IN-WATER WORK WINDOW IS BEING USED TO MINIMIZE PROJECT EFFECTS.

D. LAMPREY. WORKING IN STREAM OR RIVER CHANNELS THAT CONTAIN PACIFIC LAMPREY WILL BE AVOIDED FROM MARCH 1 TO JULY 1 FOR REACHES <5,000 FEET IN ELEVATION AND FROM MARCH 1 TO AUGUST 1 FOR REACHES >5,000 FEET. IF EITHER TIMEFRAME IS INCOMPATIBLE WITH OTHER OBJECTIVES, THE AREA WILL BE SURVEYED FOR NESTS AND LAMPREY PRESENCE, AND AVOIDED IF POSSIBLE. IF LAMPREYS ARE KNOWN TO EXIST, THE PROJECT SPONSOR WILL UTILIZE DEWATERING AND SALVAGE PROCEDURES (SEE FISH SALVAGE AND ELECTROFISHING SECTIONS) TO MINIMIZE ADVERSE EFFECTS.

E. THE IN-WATER WORK WINDOW WILL BE JULY 1 THROUGH JULY 31.

3. CONTAMINANTS

A. EXCAVATION OF MORE THAN 20 CUBIC YARDS WILL REQUIRE A SITE VISIT AND DOCUMENTED ASSESSMENT FOR POTENTIAL CONTAMINANT SOURCES. THE SITE ASSESSMENT WILL BE STORED WITH PROJECT FILES OR AS AN APPENDIX TO THE BASIS OF DESIGN REPORT.

B. THE SITE ASSESSMENT WILL SUMMARIZE:

1. THE SITE VISIT, CONDITION OF THE PROPERTY, AND IDENTIFICATION OF ANY AREAS USED FOR VARIOUS INDUSTRIAL PROCESSES;
2. AVAILABLE RECORDS, SUCH AS FORMER SITE USE, BUILDING PLANS, AND RECORDS OF ANY PRIOR CONTAMINATION EVENTS;
3. INTERVIEWS WITH KNOWLEDGEABLE PEOPLE, SUCH AS SITE OWNERS, OPERATORS, OCCUPANTS, NEIGHBORS, OR LOCAL GOVERNMENT OFFICIALS; AND
4. THE TYPE, QUANTITY, AND EXTENT OF ANY POTENTIAL CONTAMINATION SOURCES.

4. SITE LAYOUT AND FLAGGING

A. CONSTRUCTION AREAS TO BE CLEARLY FLAGGED PRIOR TO CONSTRUCTION

B. AREAS TO BE FLAGGED WILL INCLUDE:

1. SENSITIVE RESOURCE AREAS, SUCH AS AREAS BELOW ORDINARY HIGH WATER, SPAWNING AREAS, SPRINGS, AND WETLANDS;
2. EQUIPMENT ENTRY AND EXIT POINTS;
3. ROAD AND STREAM CROSSING ALIGNMENTS;
4. STAGING, STORAGE, AND STOCKPILE AREAS; AND
5. NO-SPRAY AREAS AND BUFFERS.

5. TEMPORARY ACCESS ROADS AND PATHS

A. EXISTING ACCESS ROADS AND PATHS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER AND LENGTH OF TEMPORARY ACCESS ROADS AND PATHS THROUGH RIPARIAN AREAS AND FLOODPLAINS WILL BE MINIMIZED.

B. VEHICLE USE AND HUMAN ACTIVITIES, INCLUDING WALKING, IN AREAS OCCUPIED BY TERRESTRIAL ESA-LISTED SPECIES WILL BE MINIMIZED.

C. TEMPORARY ACCESS ROADS AND PATHS WILL NOT BE BUILT ON SLOPES WHERE GRADE, SOIL, OR OTHER FEATURES SUGGEST A LIKELIHOOD OF EXCESSIVE EROSION OR FAILURE. IF SLOPES ARE STEEPER THAN 30%, THEN THE ROAD WILL BE DESIGNED BY A CIVIL ENGINEER WITH EXPERIENCE IN STEEP ROAD DESIGN.

D. THE REMOVAL OF RIPARIAN VEGETATION DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS WILL BE MINIMIZED. WHEN TEMPORARY VEGETATION REMOVAL IS REQUIRED, VEGETATION WILL BE CUT AT GROUND LEVEL (NOT GRUBBED). TREES SUITABLE FOR USE IN LARGE WOOD STRUCTURES WILL BE HARVESTED WITH ROOTS AND BRANCHES INTACT TO THE EXTENT PRACTICABLE. SOIL WILL BE REPLACED INTO THE ROOT CAVITY AND SMOOTHED TO THE NATIVE CONTOURS.

E. AT PROJECT COMPLETION, ALL TEMPORARY ACCESS ROADS AND PATHS WILL BE OBLITERATED, AND THE SOIL WILL BE STABILIZED AND REVEGETATED. ROAD AND PATH OBLITERATION REFERS TO THE MOST COMPREHENSIVE DEGREE OF DECOMMISSIONING AND INVOLVES DECOMPACTING THE SURFACE AND DITCH, PULLING THE FILL MATERIAL ONTO THE RUNNING SURFACE, AND RESHAPING TO MATCH THE ORIGINAL CONTOUR.

6. TEMPORARY STREAM CROSSINGS

A. EXISTING STREAM CROSSINGS OR BEDROCK WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER OF TEMPORARY STREAM CROSSINGS WILL BE MINIMIZED.

B. TEMPORARY BRIDGES AND CULVERTS WILL BE INSTALLED TO ALLOW FOR EQUIPMENT AND VEHICLE CROSSING OVER PERENNIAL STREAMS DURING CONSTRUCTION. TREATED WOOD SHALL NOT BE USED ON TEMPORARY BRIDGE CROSSINGS OR IN LOCATIONS IN CONTACT WITH OR DIRECTLY OVER WATER.

C. FOR PROJECTS THAT REQUIRE EQUIPMENT AND VEHICLES TO CROSS IN THE WET:

1. THE LOCATION AND NUMBER OF ALL WET CROSSINGS SHALL BE APPROVED BY THE EC LEAD AND DOCUMENTED IN THE CONSTRUCTION PLANS;
2. VEHICLES AND MACHINERY SHALL CROSS STREAMS AT RIGHT ANGLES TO THE MAIN CHANNEL WHENEVER POSSIBLE;
3. NO STREAM CROSSINGS WILL OCCUR 300 FEET UPSTREAM OR 100 FEET DOWNSTREAM OF AN EXISTING REDD OR SPAWNING FISH; AND
4. AFTER PROJECT COMPLETION, TEMPORARY STREAM CROSSINGS WILL BE OBLITERATED AND BANKS RESTORED.

7. STAGING, STORAGE, AND STOCKPILE AREAS

A. STAGING AREAS (USED FOR CONSTRUCTION EQUIPMENT STORAGE, VEHICLE STORAGE, FUELING, SERVICING, AND HAZARDOUS MATERIAL STORAGE) WILL BE 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND. STAGING AREAS CLOSER THAN 150 FEET WILL BE APPROVED BY THE EC LEAD.

B. NATURAL MATERIALS USED FOR IMPLEMENTATION OF AQUATIC RESTORATION, SUCH AS LARGE WOOD, GRAVEL, AND BOULDERS, MAY BE STAGED WITHIN 150 FEET IF CLEARLY INDICATED IN THE PLANS THAT AREA IS FOR NATURAL MATERIALS ONLY.

C. ANY LARGE WOOD, TOPSOIL, AND NATIVE CHANNEL MATERIAL DISPLACED BY CONSTRUCTION WILL BE STOCKPILED FOR USE DURING SITE RESTORATION AT A SPECIFICALLY IDENTIFIED AND FLAGGED AREA.

D. ANY MATERIAL NOT USED IN RESTORATION, AND NOT NATIVE TO THE FLOODPLAIN, WILL BE DISPOSED OF OUTSIDE THE 100-YEAR FLOODPLAIN.

8. EQUIPMENT

A. MECHANIZED EQUIPMENT AND VEHICLES WILL BE SELECTED, OPERATED, AND MAINTAINED IN A MANNER THAT MINIMIZES ADVERSE EFFECTS ON THE ENVIRONMENT (E.G., MINIMALLY-SIZED, LOW PRESSURE TIRES; MINIMAL HARD-TURN PATHS FOR TRACKED VEHICLES; TEMPORARY MATS OR PLATES WITHIN WET AREAS OR ON SENSITIVE SOILS).

B. EQUIPMENT WILL BE STORED, FUELED, AND MAINTAINED IN AN CLEARLY IDENTIFIED STAGING AREA THAT MEETS STAGING AREA CONSERVATION MEASURES.

C. EQUIPMENT WILL BE REFUELED IN A VEHICLE STAGING AREA OR IN AN ISOLATED HARD ZONE, SUCH AS A PAVED PARKING LOT OR ADJACENT, ESTABLISHED ROAD (THIS MEASURE APPLIES ONLY TO GAS-POWERED EQUIPMENT WITH TANKS LARGER THAN 5 GALLONS).

D. BIODEGRADABLE LUBRICANTS AND FLUIDS WILL BE USED ON EQUIPMENT OPERATING IN AND ADJACENT TO THE STREAM CHANNEL AND LIVE WATER.

E. EQUIPMENT WILL BE INSPECTED DAILY FOR FLUID LEAKS BEFORE LEAVING THE VEHICLE STAGING AREA FOR OPERATION WITHIN 150 FEET OF ANY NATURAL WATER BODY OR WETLAND.

F. EQUIPMENT WILL BE THOROUGHLY CLEANED BEFORE OPERATION BELOW ORDINARY HIGH WATER, AND AS OFTEN AS NECESSARY DURING OPERATION, TO REMAIN GREASE FREE.

9. EROSION CONTROL

A. TEMPORARY EROSION CONTROL MEASURES INCLUDE:

1. TEMPORARY EROSION CONTROLS WILL BE IN PLACE BEFORE ANY SIGNIFICANT ALTERATION OF THE ACTION SITE AND APPROPRIATELY INSTALLED DOWNSLOPE OF PROJECT ACTIVITY WITHIN THE RIPARIAN BUFFER AREA UNTIL SITE REHABILITATION IS COMPLETE;
2. IF THERE IS A POTENTIAL FOR ERODED SEDIMENT TO ENTER THE STREAM, SEDIMENT BARRIERS WILL BE INSTALLED AND MAINTAINED FOR THE DURATION OF PROJECT IMPLEMENTATION;
3. TEMPORARY EROSION CONTROL MEASURES MAY INCLUDE SEDGE MATS, FIBER WATTLES, SILT FENCES, JUTE MATTING, WOOD FIBER MULCH AND SOIL BINDER, OR GEOTEXTILES AND GEOSYNTHETIC FABRIC;
4. SOIL STABILIZATION UTILIZING WOOD FIBER MULCH AND TACKIFIER (HYDRO-APPLIED) MAY BE USED TO REDUCE EROSION OF BARE SOIL IF THE MATERIALS ARE NOXIOUS WEED FREE AND NONTOXIC TO AQUATIC AND TERRESTRIAL ANIMALS, SOIL MICROORGANISMS, AND VEGETATION;
5. SEDIMENT WILL BE REMOVED FROM EROSION CONTROLS ONCE IT HAS REACHED 1/3 OF THE EXPOSED HEIGHT OF THE CONTROL; AND
6. ONCE THE SITE IS STABILIZED AFTER CONSTRUCTION, TEMPORARY EROSION CONTROL MEASURES WILL BE REMOVED.

B. EMERGENCY EROSION CONTROLS. THE FOLLOWING MATERIALS FOR EMERGENCY EROSION CONTROL WILL BE AVAILABLE AT THE WORK SITE:

1. A SUPPLY OF SEDIMENT CONTROL MATERIALS; AND
2. AN OIL-ABSORBING FLOATING BOOM WHENEVER SURFACE WATER IS PRESENT.

10. DUST ABATEMENT

A. THE PROJECT SPONSOR WILL DETERMINE THE APPROPRIATE DUST CONTROL MEASURES BY CONSIDERING SOIL TYPE, EQUIPMENT USAGE, PREVAILING WIND DIRECTION, AND THE EFFECTS CAUSED BY OTHER EROSION AND SEDIMENT CONTROL MEASURES.

B. WORK WILL BE SEQUENCED AND SCHEDULED TO REDUCE EXPOSED BARE SOIL SUBJECT TO WIND EROSION.

C. DUST-ABATEMENT ADDITIVES AND STABILIZATION CHEMICALS (TYPICALLY MAGNESIUM CHLORIDE, CALCIUM CHLORIDE SALTS, OR LIGNINSULFONATE) WILL NOT BE APPLIED WITHIN 25 FEET OF WATER OR A STREAM CHANNEL AND WILL BE APPLIED SO AS TO MINIMIZE THE LIKELIHOOD THAT THEY WILL ENTER STREAMS. APPLICATIONS OF LIGNINSULFONATE WILL BE LIMITED TO A MAXIMUM RATE OF 0.5 GALLONS PER SQUARE YARD OF ROAD SURFACE, ASSUMING MIXED 50:50 WITH WATER.

D. APPLICATION OF DUST ABATEMENT CHEMICALS WILL BE AVOIDED DURING OR JUST BEFORE WET WEATHER, AND AT STREAM CROSSINGS OR OTHER AREAS THAT COULD RESULT IN UNFILTERED DELIVERY OF THE DUST ABATEMENT MATERIALS TO A WATERBODY (TYPICALLY THESE WOULD BE AREAS WITHIN 25 FEET OF A WATERBODY OR STREAM CHANNEL; DISTANCES MAY BE GREATER WHERE VEGETATION IS SPARSE OR SLOPES ARE STEEP).

E. SPILL CONTAINMENT EQUIPMENT WILL BE AVAILABLE DURING APPLICATION OF DUST ABATEMENT CHEMICALS.

F. PETROLEUM-BASED PRODUCTS WILL NOT BE USED FOR DUST ABATEMENT.

11. SPILL PREVENTION, CONTROL, AND COUNTER MEASURES

A. A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.

B. WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.

C. SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.

D. WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.

E. ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.

F. PUMPS USED ADJACENT TO WATER SHALL USE SPILL CONTAINMENT SYSTEMS.

12. INVASIVE SPECIES CONTROL

A. PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.

B. WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.

C. WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES UNLESS DECONTAMINATION PROCEDURES HAVE BEEN APPROVED BY THE EC LEAD.

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LOWER CHIWAWA ASSESSMENT UNIT
PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS,JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

GENERAL CONSERVATION MEASURES (1 OF 3)

SHEET 4

SHEET 4 OF 21

LAST SAVED DATE
2025-08-26
LAST SAVED BY
CMCCONNELL

CAD SYSTEM
AUTOCAD 24.3 (LMS TECH)
CAD FILENAME
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WORK AREA ISOLATION AND FISH SALVAGE

1. WORK AREA ISOLATION

A. ANY WORK AREA WITHIN THE WETTED CHANNEL WILL BE ISOLATED FROM THE ACTIVE STREAM WHENEVER ESA-LISTED FISH ARE REASONABLY CERTAIN TO BE PRESENT, OR IF THE WORK AREA IS LESS THAN 300-FEET UPSTREAM FROM KNOWN SPAWNING HABITATS.

B. WORK AREA ISOLATION AND FISH SALVAGE ACTIVITIES WILL COMPLY WITH THE IN-WATER WORK WINDOW.

C. DESIGN PLANS WILL INCLUDE ALL ISOLATION ELEMENTS AND AREAS (COFFER DAMS, PUMPS, DISCHARGE AREAS, FISH SCREENS, FISH RELEASE AREAS, ETC.).

D. WORK AREA ISOLATION AND FISH CAPTURE ACTIVITIES WILL OCCUR DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS AND DEATH OF SPECIES PRESENT.

2. FISH SALVAGE

A. MONITORING AND RECORDING WILL TAKE PLACE FOR DURATION OF SALVAGE. THE SALVAGE REPORT WILL BE COMMUNICATED TO AGENCIES VIA THE PROJECT COMPLETION FORM (PCF).

B. SALVAGE ACTIVITIES SHOULD TAKE PLACE DURING CONDITIONS TO MINIMIZE STRESS TO FISH SPECIES, TYPICALLY PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES WHICH OCCUR IN THE MORNING VERSUS LATE IN THE DAY.

C. SALVAGE OPERATIONS WILL FOLLOW THE ORDERING, METHODS, AND CONSERVATION MEASURES SPECIFIED BELOW:

1. SLOWLY REDUCE WATER FROM THE WORK AREA TO ALLOW SOME FISH TO LEAVE VOLITIONALLY.
2. BLOCK NETS WILL BE INSTALLED AT UPSTREAM AND DOWNSTREAM LOCATIONS AND MAINTAINED IN A SECURED POSITION TO EXCLUDE FISH FROM ENTERING THE PROJECT AREA.
3. BLOCK NETS WILL BE SECURED TO THE STREAM CHANNEL BED AND BANKS UNTIL FISH CAPTURE AND TRANSPORT ACTIVITIES ARE COMPLETE. BLOCK NETS MAY BE LEFT IN PLACE FOR THE DURATION OF THE PROJECT TO EXCLUDE FISH AS LONG AS PASSAGE REQUIREMENTS ARE MET.
4. NETS WILL BE MONITORED HOURLY DURING IN-STREAM DISTURBANCE.
5. IF BLOCK NETS REMAIN IN PLACE MORE THAN ONE DAY, THE NETS WILL BE MONITORED AT LEAST DAILY TO ENSURE THEY ARE SECURED AND FREE OF ORGANIC ACCUMULATION. IF BULL TROUT ARE PRESENT, NETS ARE TO BE CHECKED EVERY 4 HOURS FOR FISH IMPINGEMENT.
6. CAPTURE FISH THROUGH SEINING AND RELOCATE TO STREAMS.
7. WHILE DEWATERING, ANY REMAINING FISH WILL BE COLLECTED BY HAND OR DIP NETS.
8. SEINES WITH A MESH SIZE TO ENSURE CAPTURE OF THE RESIDING ESA-LISTED FISH WILL BE USED.
9. MINNOW TRAPS WILL BE LEFT IN PLACE OVERNIGHT AND USED IN CONJUNCTION WITH SEINING.
10. ELECTROFISH TO CAPTURE AND RELOCATED FISH NOT CAUGHT DURING SEINING PER ELECTROFISH CONSERVATION MEASURES.
11. CONTINUE TO SLOWLY DEWATER STREAM REACH.
12. COLLECT ANY REMAINING FISH IN COLD-WATER BUCKETS AND RELOCATED TO THE STREAM.
13. LIMIT THE TIME FISH ARE IN A TRANSPORT BUCKET.
14. MINIMIZE PREDATION BY TRANSPORTING COMPARABLE SIZES IN BUCKETS.
15. BUCKET WATER TO BE CHANGED EVERY 15 MINUTES OR AERATED.
16. BUCKETS WILL BE KEPT IN SHADED AREAS OR COVERED.
17. DEAD FISH WILL NOT BE STORED IN TRANSPORT BUCKETS, BUT WILL BE LEFT ON THE STREAM BANK TO AVOID MORTALITY COUNTING ERRORS.

D. SALVAGE GUIDELINES FOR BULL TROUT, LAMPREY, MUSSELS, AND NATIVE FISH

1. CONDUCT SITE SURVEY TO ESTIMATE SALVAGE NUMBERS.
2. PRE-SELECT SITE(S) FOR RELEASE AND/OR MUSSEL BED RELOCATION.
3. SALVAGE OF BULL TROUT WILL NOT TAKE PLACE WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.
4. IF DRAWDOWN LESS THAN 48 HOURS, SALVAGE OF LAMPREY AND MUSSELS MAY NOT BE NECESSARY IF TEMPERATURES SUPPORT SURVIVAL IN SEDIMENTS.
5. SALVAGE MUSSELS BY HAND, LOCATING BY SNORKELING OR WADING.
6. SALVAGE LAMPREY BY ELECTROFISHING (SEE ELECTROFISHING FOR LARVAL LAMPREY SETTINGS AND LARVAL LAMPREY DRY SHOCKING SETTINGS).
7. SALVAGE BONY FISH AFTER LAMPREY WITH NETS OR ELECTROFISHING (SEE ELECTROFISHING FOR APPROPRIATE SETTINGS).
8. REGULARLY INSPECT DEWATERED SITE SINCE LAMPREY LIKELY TO EMERGE AFTER DEWATERING AND MUSSELS MAY BECOME VISIBLE.
9. MUSSELS MAY BE TRANSFERRED IN COOLERS.
10. MUSSELS WILL BE PLACED INDIVIDUALLY TO ENSURE ABILITY TO BURROW INTO NEW HABITAT.

3. ELECTROFISHING

A. INITIAL SITE SURVEY AND INITIAL SETTINGS

1. IDENTIFY SPAWNING ADULTS AND ACTIVE REDDS TO AVOID.
2. RECORD WATER TEMPERATURE. ELECTROFISHING WILL NOT OCCUR WHEN WATER TEMPERATURES ARE ABOVE 18 DEGREES CELSIUS.
3. IF POSSIBLE, A BLOCK NET WILL BE PLACED DOWNSTREAM AND CHECKED REGULARLY TO CAPTURE STUNNED FISH THAT DRIFT DOWNSTREAM.
4. INITIAL SETTINGS WILL BE 100 VOLTS, PULSE WIDTH OF 500 MICRO SECONDS, AND PULSE RATE OF 30 HERTZ.
5. RECORDS FOR CONDUCTIVITY, WATER TEMPERATURE, AIR TEMPERATURE, ELECTROFISHING SETTINGS, ELECTROFISHER MODEL, ELECTROFISHER CALIBRATION, FISH CONDITIONS, FISH MORTALITIES, AND TOTAL CAPTURE RATES WILL BE INCLUDED IN THE SALVAGE LOG BOOK.

B. ELECTROFISHING TECHNIQUE

1. SAMPLING WILL BEGIN USING STRAIGHT DC. POWER WILL REMAIN ON UNTIL THE FISH IS NETTED WHEN USING STRAIGHT DC GRADUALLY INCREASE VOLTAGE WHILE REMAINING BELOW MAXIMUM LEVELS.
2. MAXIMUM VOLTAGE WILL BE 1100 VOLTS WHEN CONDUCTIVITY IS <100 MILLISECONDS, 800 VOLTS WHEN CONDUCTIVITY IS BETWEEN 100 AND 300 MILLISECONDS, AND 400 VOLTS WHEN CONDUCTIVITY IS >300 MILLISECONDS.
3. IF FISH CAPTURE IS NOT SUCCESSFUL USING STRAIGHT DC, THE ELECTROFISHER WILL BE SET TO INITIAL VOLTAGE FOR PDC. VOLTAGE, PULSE WIDTH, AND PULSE FREQUENCY WILL BE GRADUALLY INCREASED WITHIN MAXIMUM VALUES UNTIL CAPTURE IS SUCCESSFUL.
4. MAXIMUM PULSE WIDTH IS 5 MILLISECONDS. MAXIMUM PULSE RATE IS 70 HERTZ
5. ELECTROFISHING WILL NOT OCCUR IN ONE AREA FOR AN EXTENDED PERIOD.
6. THE ANODE WILL NOT INTENTIONALLY COME INTO CONTACT WITH FISH. THE ZONE FOR POTENTIAL INJURY OF 0.5 M FROM THE ANODE WILL BE AVOIDED.
7. SETTINGS WILL BE LOWERED IN SHALLOWER WATER SINCE VOLTAGE GRADIENTS LIKELY TO INCREASE.
8. ELECTROFISHING WILL NOT OCCUR IN TURBID WATER WHERE VISIBILITY IS POOR (I.E. UNABLE TO SEE THE BED OF THE STREAM).
9. OPERATIONS WILL IMMEDIATELY STOP IF MORTALITY OR OBVIOUS FISH INJURY IS OBSERVED. ELECTROFISHING SETTINGS WILL BE REEVALUATED.

C. SAMPLE PROCESSING

1. FISH SHALL BE SORTED BY SIZE TO AVOID PREDATION DURING CONTAINMENT.
2. SAMPLERS WILL REGULARLY CHECK CONDITIONS OF FISH HOLDING CONTAINERS, AIR PUMPS, WATER TRANSFERS, ETC.
3. FISH WILL BE OBSERVED FOR GENERAL CONDITIONS AND INJURIES
4. EACH FISH WILL BE COMPLETELY REVIVED BEFORE RELEASE. ESA-LISTED SPECIES WILL BE PRIORITIZED FOR SUCCESSFUL RELEASE.

D. BULL TROUT ELECTROFISHING

1. ELECTROFISHING FOR BULL TROUT WILL ONLY OCCUR FROM MAY 1 TO JULY 31. NO ELECTROFISHING WILL OCCUR IN ANY BULL TROUT OCCUPIED HABITAT AFTER AUGUST 15. IN FMO HABITATS ELECTROFISHING MAY OCCUR ANY TIME.
2. ELECTROFISHING OF BULL TROUT WILL NOT OCCUR WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.

E. LARVAL LAMPREY ELECTROFISHING

1. PERMISSION FROM EC LEAD WILL BE OBTAINED IF LARVAL LAMPREY ELECTROFISHER IS NOT ONE OF FOLLOWING PRE-APPROVED MODELS: ABP-2 "WISCONSIN", SMITH-ROOT LR-24, OR SMITH-ROOT APEX BACKPACK.
2. LARVAL LAMPREY SAMPLING WILL INCORPORATE 2-STAGE METHOD: "TICKLE" AND "STUN".
3. FIRST STAGE: USE 125 VOLT DC WITH A 25 PERCENT DUTY CYCLE APPLIED AT A SLOW RATE OF 3 PULSES PER SECOND. IF TEMPERATURES ARE BELOW 10 DEGREES CELSIUS, VOLTAGE MAY BE INCREASED GRADUALLY (NOT TO EXCEED 200 VOLTS). BURSTED PULSES (THREE SLOW AND ONE SKIPPED) RECOMMENDED TO INCREASE EMERGENCE.
4. SECOND STAGE (OPTIONAL FOR EXPERIENCED NETTERS): IMMEDIATELY AFTER LAMPREY EMERGE, USE A FAST PULSE SETTING OF 30 PULSES PER SECOND.
5. USE DIP NETS FOR VISIBLE LAMPREY. SIENES AND FINE MESH NET SWEEPS MAY BE USED IN POOR VISIBILITY.
6. SAMPLING WILL OCCUR SLOWLY (>60 SECONDS PER METER) STARTING AT UPSTREAM AND WORKING DOWNSTREAM.
7. MULTIPLE SWEEPS TO OCCUR WITH 15 MINUTES BETWEEN SWEEPS.
8. POST-DRAWDOWN "DRY-SHOCKING" WILL BE APPLIED IF LARVAL LAMPREY CONTINUE TO EMERGE. ANODES TO BE PLACED ONE METER APART TO SAMPLE ONE SQUARE METER AT A TIME FOR AT LEAST 60 SECONDS. FOR TEMPERATURES LESS THAN 10 DEGREES CELSIUS, MAXIMUM VOLTAGE MAY BE GRADUALLY INCREASED TO 400 VOLTS (DRY-SHOCKING ONLY).

4. DEWATERING

C. DEWATERING WILL OCCUR AT A RATE SLOW ENOUGH TO ALLOW SPECIES TO NATURALLY MIGRATE OUT OF THE WORK AREA.

D. WHERE A GRAVITY FEED DIVERSION IS NOT POSSIBLE, A PUMP MAY BE USED. PUMPS WILL BE INSTALLED TO AVOID REPETIVE DEWATERING AND REWATERING.

E. WHEN FISH ARE PRESENT, PUMPS WILL BE SCREENED IN ACCORDANCE WITH NMFS FISH SCREEN CRITERIA. NMFS ENGINEERING REVIEW AND APPROVAL WILL BE OBTAINED FOR PUMPS EXCEEDING 3 CUBIC FEET PER SECOND.

F. DISSIPATION OF FLOW ENERGY AT THE BYPASS OUTFLOW WILL BE PROVIDED TO PREVENT DAMAGE TO THE STREAM CHANNEL AND RIPARIAN VEGETATION.

G. SEEPAGE WATER WILL BE PUMPED TO A TEMPORARY STORAGE AND TREATMENT SITE OF INTO UPLAND AREAS TO ALLOW WATER TO PERCOLATE THROUGH SOIL AND VEGETATION PRIOR TO REENTERING THE STREAM CHANNEL.

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PROJECT AREA D
60% DESIGN

Preliminary
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ACCEPTED

BOISE, ID AUGUST 2025

GENERAL CONSERVATION MEASURES (2 OF 3)

SHEET 5

SHEET 5 OF 21

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CONSTRUCTION AND POST CONSTRUCTION CONSERVATION MEASURES.

1. FISH PASSAGE

A. FISH PASSAGE WILL BE PROVIDED FOR ADULT AND JUVENILE FISH LIKELY TO BE PRESENT DURING CONSTRUCTION UNLESS PASSAGE DID NOT EXIST BEFORE CONSTRUCTION, THE STREAM IS NATURALLY IMPASSABLE, OR PASSAGE WILL NEGATIVELY IMPACT ESA-LISTED SPECIES OR THEIR HABITAT.

B. FISH PASSAGE ALTERNATIVES WILL BE APPROVED UNDER ADVISEMENT BY THE NMFS HABITAT BIOLOGIST.

2. CONSTRUCTION AND DISCHARGE WATER

A. SURFACE WATER MAY BE DIVERTED TO MEET CONSTRUCTION NEEDS ONLY IF DEVELOPED SOURCES ARE UNAVAILABLE OR INADEQUATE.

B. DIVERSIONS WILL NOT EXCEED 10% OF THE AVAILABLE FLOW.

C. CONSTRUCTION DISCHARGE WATER WILL BE COLLECTED AND TREATED TO REMOVE DEBRIS, NUTRIENTS, SEDIMENT, PETROLEUM HYDROCARBONS, METALS, AND OTHER POLLUTANTS.

3. TIME AND EXTENT OF DISTURBANCE

A. EARTHWORK REQUIRING IN-STREAM MECHANIZED EQUIPMENT (INCLUDING DRILLING, EXCAVATION, DREDGING, FILLING, AND COMPACTING) WILL BE COMPLETED AS QUICKLY AS POSSIBLE.

B. MECHANIZED EQUIPMENT WILL WORK FROM TOP OF BANK UNLESS WORK FROM ANOTHER LOCATION WILL RESULT IN LESS HABITAT DISTURBANCE (TURBIDITY, VEGETATION DISTURBANCE, ETC.).

4. CESSATION OF WORK

A. PROJECT OPERATIONS WILL CEASE WHEN HIGH FLOW CONDITIONS MAY RESULT IN INUNDATION OF THE PROJECT AREA (FLOOD EFFORTS TO DECREASE DAMAGES TO NATURAL RESOURCES PERMITTED).

B. WATER QUALITY LEVELS EXCEEDED. SEE CWA SECTION 401 WATER QUALITY CERTIFICATION AND TURBIDITY MEASURES.

5. SITE RESTORATION

A. DISTURBED AREAS, STREAM BANKS, SOILS, AND VEGETATION WILL BE CLEANED UP AND RESTORED TO IMPROVED OR PRE-PROJECT CONDITIONS.

B. PROJECT-RELATED WASTE WILL BE REMOVED.

C. TEMPORARY ACCESS ROADS AND STAGING WILL BE DECOMPACTED AND RESTORED. SOILS WILL BE LOOSENED IF NEEDED FOR REVEGETATION OR WATER INFILTRATION.

D. THE PROJECT SPONSOR WILL RETAIN THE RIGHT OF REASONABLE ACCESS TO THE SITE TO MONITOR AND MAINTAIN THE SITE OVER THE LIFE OF THE PROJECT.

6. REVEGETATION

A. PLANTING AND SEEDING WILL OCCUR PRIOR TO OR AT THE BEGINNING OF THE FIRST GROWING SEASON AFTER CONSTRUCTION.

B. A MIX OF NATIVE SPECIES (INVASIVE SPECIES NOT ALLOWED) APPROPRIATE TO THE SITE WILL BE USED TO REESTABLISH VEGETATION, PROVIDE SHADE, AND REDUCE EROSION. REESTABLISHED VEGETATION SHOULD BE AT LEAST 70% OF PRE-PROJECT CONDITIONS WITHIN THREE YEARS.

C. VEGETATION SUCH AS WILLOWS, SEDGES, OR RUSH MATS WILL BE SALVAGED FROM DISTURBED OR ABANDONED AREAS TO BE REPLANTED.

D. SHORT-TERM STABILIZATION MEASURE MAY INCLUDE THE USE OF NON-NATIVE STERILE SEED MIX (WHEN NATIVE NOT AVAILABLE), WEED-FREE CERTIFIED STRAW, OR OTHER SIMILAR TECHNIQUES.

E. SURFACE FERTILIZER WILL NOT BE APPLIED WITHIN 50 FEET OF ANY STREAM, WATE BODY, OR WETLAND.

F. FENCING WILL BE INSTALLED AS NECESSARY TO PREVENT ACCESS TO REVEGETATED SITES BY LIVESTOCK OR UNAUTHORIZED PERSONS.

G. INVASIVE PLANTS WILL BE REMOVED OR CONTROLLED UNTIL NATIVE PLANT SPECIES ARE WELL ESTABLISHED (TYPICALLY THREE YEARS POST-CONSTRUCTION).

7. SITE ACCESS AND IMPLEMENTATION MONITORING

A. THE PROJECT SPONSOR WILL PROVIDE CONSTRUCTION MONITORING DURING IMPLEMENTATION TO ENSURE ALL CONSERVATION MEASURES ARE ADEQUATELY FOLLOWED, EFFECTS TO LISTED SPECIES ARE NOT GREATER THAN PREDICTED, AND INCIDENTAL TAKE LIMITATIONS ARE NOT EXCEEDED.

B. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL SUBMIT THE PROJECT COMPLETION FORM (PCF) WITHIN 30 DAYS OF PROJECT COMPLETION.

8. CWA SECTION 401 WATER QUALITY CERTIFICATION

A. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL COMPLETE AND RECORD WATER QUALITY OBSERVATIONS (SEE TURBIDITY MONITORING) TO ENSURE IN-WATER WORK IS NOT DEGRADING WATER QUALITY.

B. DURING CONSTRUCTION, WATER QUALITY PROVISIONS PROVIDED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY, WASHINGTON DEPARTMENT OF ECOLOGY.

STAGED REWATERING PLAN

A. WHEN REINTRODUCING WATER TO DEWATERED AREAS AND NEWLY CONSTRUCTED CHANNELS, A STAGED REWATERING PLAN WILL BE APPLIED.

B. THE FOLLOWING WILL BE APPLIED TO ALL REWATERING EFFORTS. COMPLEX REWATERING EFFORTS MAY REQUIRE ADDITIONAL NOTES OR A DEDICATED SHEET IN THE CONSTRUCTION DETAILS.

1. TURBIDITY MONITORING PROTOCOL WILL BE APPLIED TO REWATERING EFFORTS.
2. PRE-WASH THE AREA BEFORE REWATERING. TURBID WASH WATER WILL BE DETAINED AND PUMPED TO THE FLOODPLAIN OR SEDIMENT CAPTURE AREAS RATHER THAN DISCHARGING TO FISH-BEARING STREAMS.
3. INSTALL SEINE NETS AT UPSTREAM END TO PREVENT FISH FROM MOVING DOWNSTREAM UNTIL 2/3 OF TOTAL FLOW IS RESTORED TO THE CHANNEL.
4. STARTING IN EARLY MORNING INTRODUCE 1/3 OF NEW CHANNEL FLOW OVER PERIOD OF 1-2 HOURS.
5. INTRODUCE SECOND THIRD OF FLOW OVER NEXT 1 TO 2 HOURS AND BEGIN FISH SALVAGE OF BYPASS CHANNEL IF FISH ARE PRESENT.
6. REMOVE UPSTREAM SEINE NETS ONCE 2/3 FLOW IN REWATERED CHANNEL AND DOWNSTREAM TURBIDITY IS WITHIN ACCEPTABLE RANGE (LESS THAN 40 NTU OR LESS THAN 10% BACKGROUND).
7. INTRODUCE FINAL THIRD OF FLOW ONCE FISH SALVAGE EFFORTS ARE COMPLETE AND DOWNSTREAM TURBIDITY VERIFIED TO BE WITHIN ACCEPTABLE RANGE.
8. INSTALL PLUG TO BLOCK FLOW INTO OLD CHANNEL OR BYPASS. REMOVE ANY REMAINING SEINE NETS.
9. IN LAMPREY SYSTEMS, LAMPREY SALVAGE AND DRY SHOCKING MAY BE NECESSARY.

TURBIDITY MONITORING

A. RECORD THE READING, LOCATION, AND TIME FOR THE BACKGROUND READING APPROXIMATELY 100 FEET UPSTREAM OF THE PROJECT AREA USING A RECENTLY CALIBRATED TURBIDIMETER OR VIA VISUAL OBSERVATION (SEE THE HIP HANDBOOK TURBIDITY MONITORING SECTION FOR A VISUAL OBSERVATION KEY).

B. RECORD THE TURBIDITY READING, LOCATION, AND TIME AT THE MEASUREMENT COMPLIANCE LOCATION POINT.

1. 50 FEET DOWNSTREAM FOR STREAMS LESS THAN 30 FEET WIDE.
2. 100 FEET DOWNSTREAM FOR STREAMS BETWEEN 30 AND 100 FEET WIDE.
3. 200 FEET DOWNSTREAM FOR STREAMS GREATER THAN 100 FEET WIDE.
4. 300 FEET FROM THE DISCHARGE POINT OR NONPOINT SOURCE FOR LOCATIONS SUBJECT TO TIDAL OR COASTAL SCOUR.

C. TURBIDITY SHALL BE MEASURED (BACKGROUND LOCATION AND COMPLIANCE POINTS) EVERY 4 HOURS WHILE WORK IS BEING IMPLEMENTED.

D. IF THERE IS A VISIBLE DIFFERENCE BETWEEN A COMPLIANCE POINT AND THE BACKGROUND, THE EXCEEDANCE WILL BE NOTED IN THE PROJECT COMPLETION FORM (PCF). ADJUSTMENTS OR CORRECTIVE MEASURES WILL BE TAKEN IN ORDER TO REDUCE TURBIDITY.

E. IF EXCEEDANCES OCCUR FOR MORE THAN TWO CONSECUTIVE MONITORING INTERVALS (AFTER 8 HOURS), THE ACTIVITY WILL STOP UNTIL THE TURBIDITY LEVEL RETURNS TO BACKGROUND. THE EC LEAD WILL BE NOTIFIED OF ALL EXCEEDANCES AND CORRECTIVE ACTIONS AT PROJECT COMPLETION.

F. IF TURBIDITY CONTROLS (COFFER DAMS, WADDLES, FENCING, ETC.) ARE DETERMINED INEFFECTIVE, CREWS WILL BE MOBILIZED TO MODIFY AS NECESSARY. OCCURRENCES WILL BE DOCUMENTED IN THE PROJECT COMPLETION FORM (PCF).

G. FINAL TURBIDITY READINGS, EXCEEDANCES, AND CONTROL FAILURES WILL BE SUBMITTED TO THE EC LEAD USING THE PROJECT COMPLETION FORM (PCF).

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GENERAL CONSERVATION MEASURES (3 OF 3)

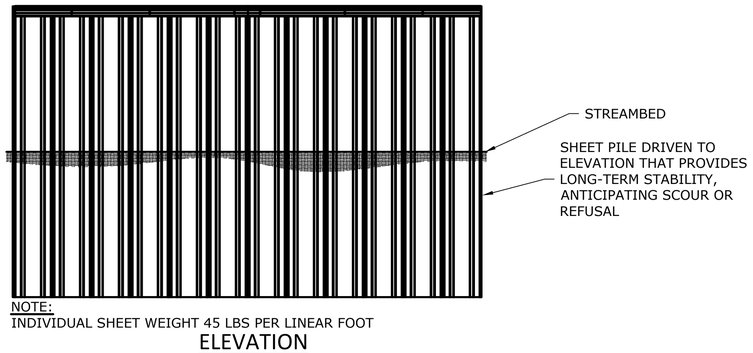
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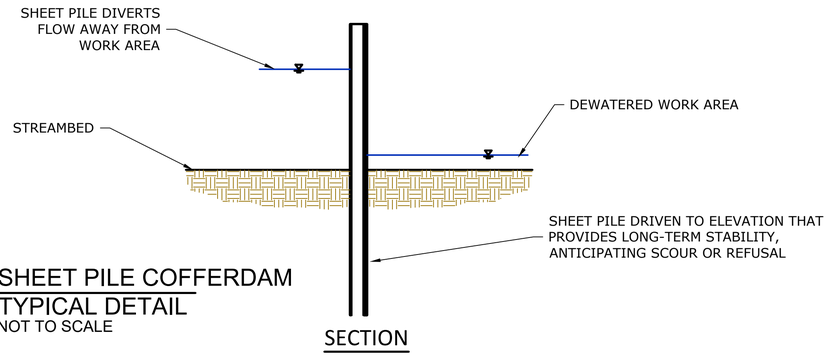
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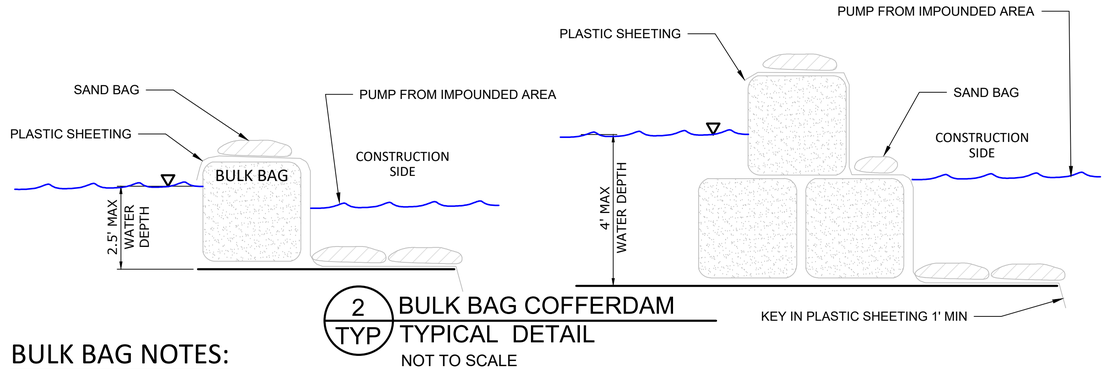
NOTE:
INDIVIDUAL SHEET WEIGHT 45 LBS PER LINEAR FOOT

ELEVATION



1 TYP SHEET PILE COFFERDAM TYPICAL DETAIL
NOT TO SCALE

SECTION



2 TYP BULK BAG COFFERDAM TYPICAL DETAIL
NOT TO SCALE

BULK BAG NOTES:

1. BULK BAG COFFERDAM SHALL BE CONSTRUCTED OF SEVERAL UNITS OF BULK BAGS FILLED WITH WASHED GRAVEL, AND ABUTTED SIDE BY SIDE TO CREATE A ROW THAT ISOLATES THE CONSTRUCTION SITE.
2. IF WATER DEPTH EXCEEDS 85% OF THE BULK BAG HEIGHT, AN ADDITIONAL TOP ROW OF BULK BAGS SHALL BE INSTALLED, SUPPORTED BY TWO BOTTOM ROWS OF BULK BAGS. BULK BAG COFFERDAM SHALL BE SEALED BY COVERING THE COFFERDAM WITH PLASTIC SHEETING HELD IN PLACE BY STANDARD SANDBAGS PLACED IN ROWS ON TOP OF COFFERDAM, AND AT TOE OF COFFERDAM.
3. THE PLASTIC SHEETING SHALL BE DRAPED ALONG THE CHANNEL BOTTOM ON BOTH SIDES OF THE COFFERDAM WITH OUTWARD EDGE OF SHEETING MINIMUM 4-FEET FROM TOE OF COFFERDAM. THE DRAPED PORTION OF PLASTIC SHEETING SHALL BE PINNED TO THE CHANNEL BED BY MINIMUM TWO ROWS OF STANDARD SANDBAGS.
4. THE CONSTRUCTION SIDE EDGE OF PLASTIC SHEETING SHALL BE TOED INTO THE CHANNEL BED MINIMUM 1-FT. TOEING IN THE OUTWARD EDGE OF PLASTIC SHEETING SHALL OCCUR AFTER THE COFFERDAM IS CLOSED TO PREVENT TURBIDITY RELEASE TO THE WATERWAY.
5. THE TERMINAL ENDS OF BULK BAG COFFERDAM, WHERE IT CONNECTS TO CHANNEL BANK OR HIGH GROUND, SHALL BE SEALED WITH PLASTIC SHEETING AND STANDARD SANDBAGS.
6. BULK BAGS SHALL BE CUBE-SHAPED POLYPROPYLENE WOVEN FABRIC BAGS WITH FULLY OPEN TOP, FLAT BOTTOM, FOUR LOOPS, MINIMUM 2-TON WEIGHT CAPACITY, MINIMUM 5:1 SAFETY FACTOR.
7. PLASTIC SHEETING SHALL BE MINIMUM 6-MIL THICKNESS. ROLL LENGTH SHALL BE LONG ENOUGH TO ENSURE THAT ENTIRE LENGTH OF COFFERDAM WILL BE COVERED WITHOUT A SEAM. MINIMUM 12-FT WIDE ROLL SHALL BE USED FOR SINGLE LAYER BULK BAG COFFERDAM. MINIMUM 16-FT WIDE ROLL SHALL BE USED FOR 2-LAYER STACKED BULK BAG COFFERDAM.
8. BULK BAG COFFERDAM SHALL BE COMPLETELY REMOVED AFTER CONSTRUCTION IS COMPLETED AND TURBIDITY HAS BEEN REMOVED.
9. ALTERNATE COFFERDAM MATERIALS AND CONFIGURATIONS MAY BE ALLOWED BUT SHALL NOT BE IMPLEMENTED WITHOUT REVIEW AND APPROVAL BY THE OWNER'S REPRESENTATIVE. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS AND/OR VENDOR CUT SHEETS FOR SUBSTITUTIONS.

TEMPORARY COFFERDAM NOTES:

1. TEMPORARY SHEET PILE IS A PRE-APPROVED METHOD OF ISOLATING CONSTRUCTION WATER FROM THE WATERWAY. SHEET PILE COFFERDAM IS THE PREFERRED ISOLATION METHOD. ALTERNATIVE METHODS PROPOSED BY THE CONTRACTOR MAY BE UTILIZED WITH APPROVAL BY THE OWNER.
2. CONTRACTOR SHALL PROVIDE PUMPING SUFFICIENT FOR A NET INFLOW TO THE WORK AREA, AND DISCHARGE TURBID WATER TO UPLAND FLOODPLAIN.
3. COFFERDAM SHALL BE COMPLETELY REMOVED AFTER CONSTRUCTION IS COMPLETED AND TURBIDITY HAS BEEN REMOVED.

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TYPICAL SEDIMENT CONTOL DETAIL

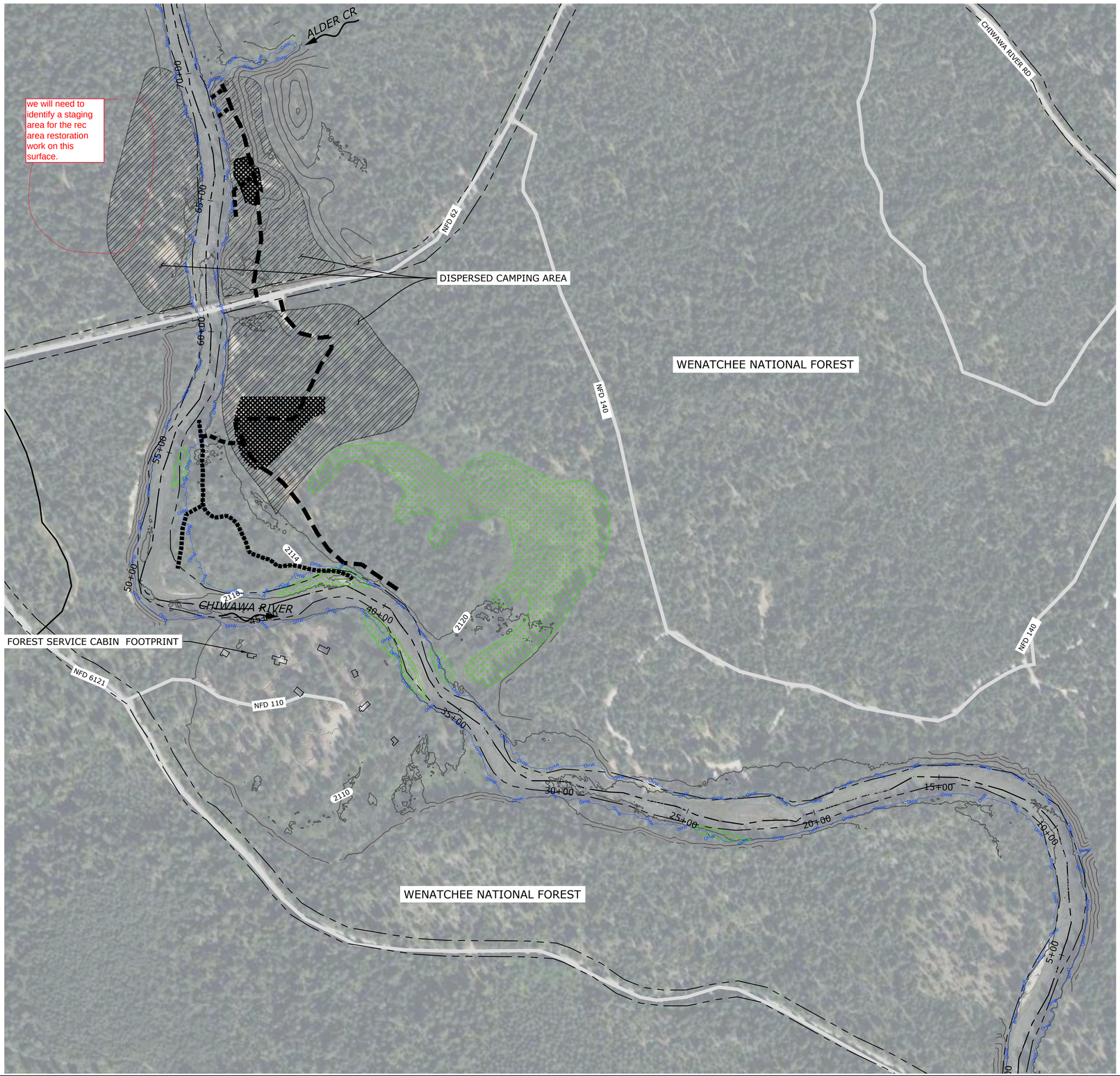
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NOTES:

1. ALL TEMPORARY ACCESS ROUTES SHALL AVOID EXISTING MATURE TREES WHERE FEASIBLE.
2. PARCEL BOUNDARY INFORMATION IS APPROXIMATE
3. DEPICTED ACCESS ROUTES ARE APPROXIMATE AND WILL NEED TO BE COORDINATED WITH LANDOWNERS.

LEGEND

- EXISTING CONTOURS (1')
- EXISTING CONTOURS (5')
- TAXLOTS
- EXISTING ACCESS
- TEMPORARY ACCESS
- ALIGNMENT (000+00)
- DISPERSED CAMPING AREA
- STAGING AREA
- WETLANDS (INTER-FLUVE 2023)
- OHW — ORDINARY HIGH WATER

0 100' 200'

PLAN SCALE IN FEET
(AS SHOWN ON
22" X 34" SHEET)

N

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EXISTING CONDITIONS, ACCESS AND STAGING

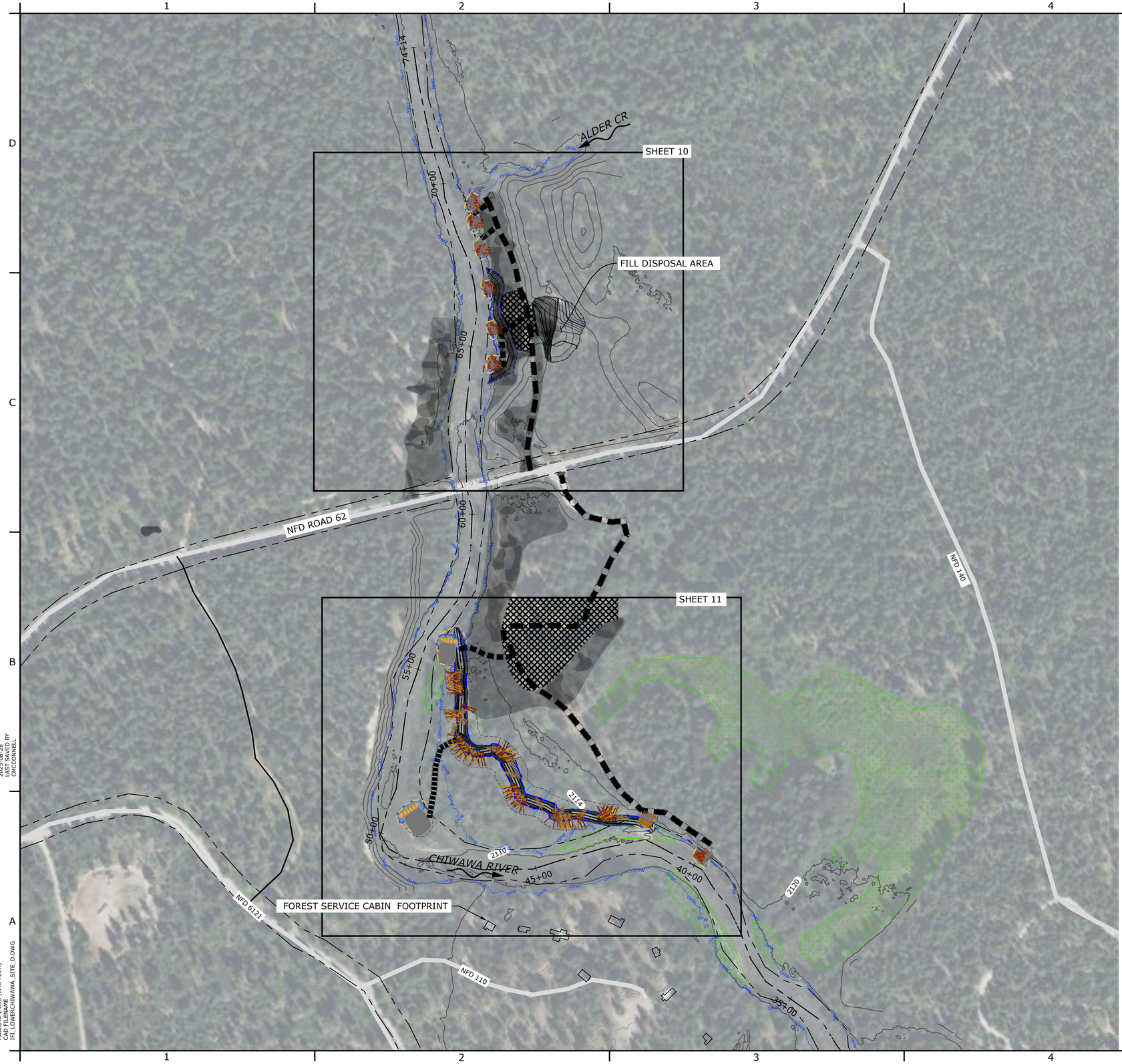
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NOTES:

1. LARGE WOOD LAYOUT, LOCATIONS, AND ORIENTATIONS ARE APPROXIMATE AND WILL VARY DEPENDING ON SITE CONDITIONS AND THE DIMENSIONS OF WOOD RECEIVED.
2. LARGE WOOD PLACEMENTS SHALL UTILIZE EXISTING BOULDERS IN THE CHANNEL TO THE EXTENT PRACTICABLE.
3. ALL TEMPORARY ACCESS ROUTES SHALL AVOID EXISTING MATURE TREES WHERE FEASIBLE.
4. PARCEL BOUNDARY INFORMATION IS APPROXIMATE
5. DEPICTED ACCESS ROUTES ARE APPROXIMATE AND WILL NEED TO BE COORDINATED WITH LANDOWNERS.
6. SIDE CHANNEL CONNECTIONS WERE TARGETED FOR ENGAGEMENT AT BASEFLOWS (SEPTEMBER AVERAGE FLOW) WHERE FEASIBLE BASED ON HYDRAULIC MODEL RESULTS.
7. RECREATIONAL DESIGN FOR DECOMMISSIONED CAMPGROUND AREAS TO BE COMPLETED BY OTHERS.

LEGEND

- EXISTING CONTOURS (2')
- EXISTING CONTOURS (10')
- PROPOSED CONTOURS (1')
- TAXLOTS
- EXISTING ACCESS
- TEMPORARY ACCESS
- LIMITS OF DISTURBANCE
- TEMPORARY COFFERDAM
- ALIGNMENT
- 000+00 — LARGE WOOD STRUCTURE (TYPE VARIES)
- WETLANDS (INTER-FLUVE 2023)
- STAGING AREA
- OHW — ORDINARY HIGH WATER
- RECREATION IMPROVEMENTS

0 150' 300'

PLAN SCALE IN FEET (AS SHOWN ON 22" X 34" SHEET)

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SITE OVERVIEW AND SHEET INDEX

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3. ALL TEMPORARY ACCESS ROUTES SHALL AVOID EXISTING MATURE TREES WHERE FEASIBLE.
4. PARCEL BOUNDARY INFORMATION IS APPROXIMATE
5. DEPICTED ACCESS ROUTES ARE APPROXIMATE AND WILL NEED TO BE COORDINATED WITH LANDOWNERS.
6. RECREATIONAL DESIGN FOR DECOMMISSIONED CAMPGROUND AREAS TO BE COMPLETED BY OTHERS IN FUTURE PROJECT PHASES.

LEGEND

- EXISTING CONTOURS (2')
- EXISTING CONTOURS (10')
- PROPOSED CONTOUR (1')
- TAXLOTS
- EXISTING ACCESS
- TEMPORARY ACCESS
- LIMITS OF DISTURBANCE
- TEMPORARY COFFERDAM
- ALIGNMENT (000+00)
- LARGE WOOD STRUCTURE (TYPE VARIES)
- STAGING AREA
- ORDINARY HIGH WATER (OHW)
- RECREATION IMPROVEMENTS
- SAVE OR REMOVE TREE (## / ##)

0 50' 100'

PLAN SCALE IN FEET
(AS SHOWN ON
22" X 34" SHEET)

N

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COLUMBIA PACIFIC NORTHWEST REGION
FCRPS HABITAT IMPROVEMENT PROGRAM

LOWER CHIWAWA ASSESSMENT UNIT PROJECT DEVELOPMENT

60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

PROPOSED CONDITIONS
(1 OF 2)

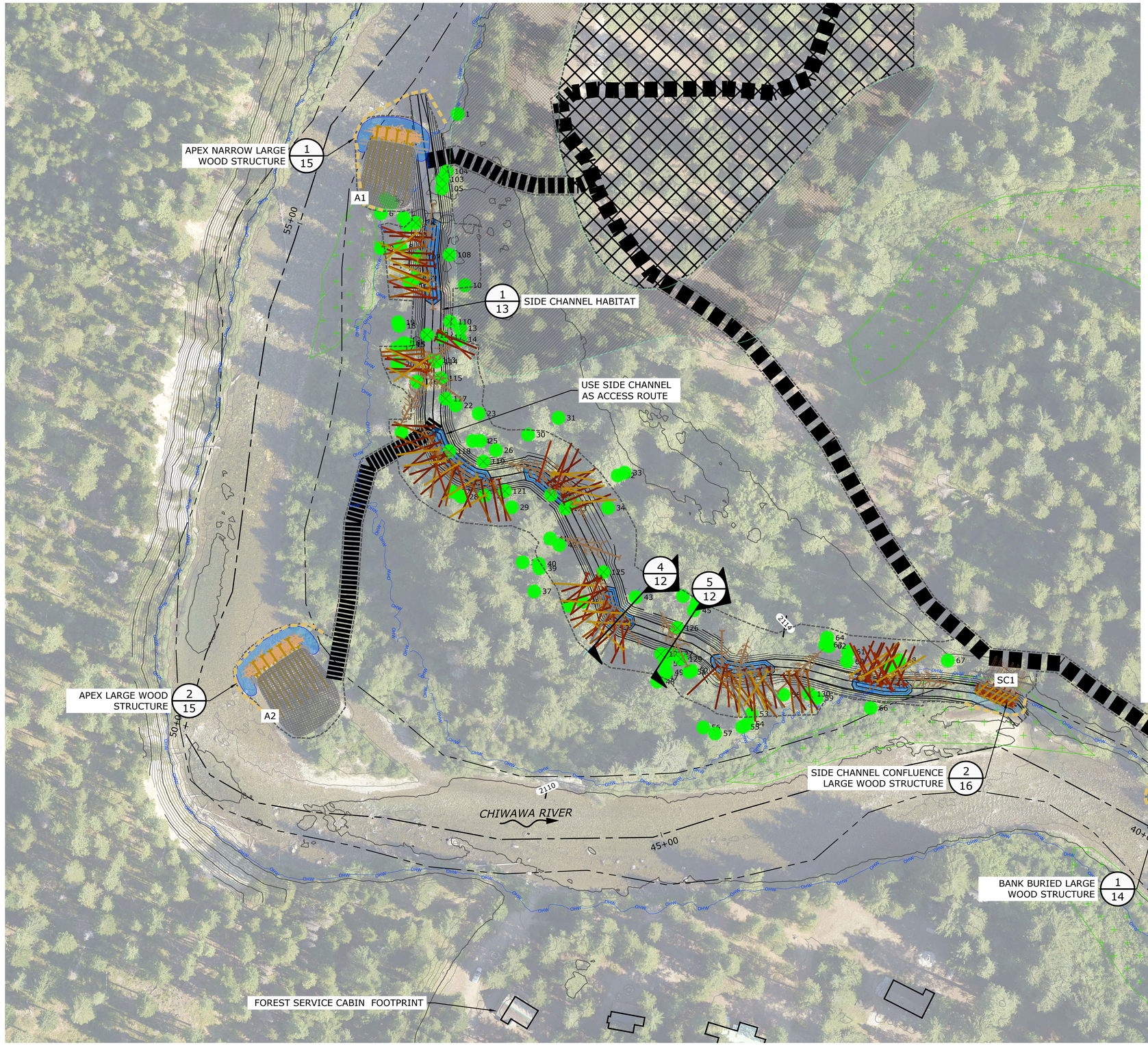
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CONTROLLED



NOTES:

1. LARGE WOOD LAYOUT, LOCATIONS, AND ORIENTATIONS ARE APPROXIMATE AND WILL VARY DEPENDING ON SITE CONDITIONS AND THE DIMENSIONS OF WOOD RECEIVED.
2. LARGE WOOD PLACEMENTS SHALL UTILIZE EXISTING BOULDERS IN THE CHANNEL TO THE EXTENT PRACTICABLE.
3. ALL TEMPORARY ACCESS ROUTES SHALL AVOID EXISTING MATURE TREES WHERE FEASIBLE.
4. PARCEL BOUNDARY INFORMATION IS APPROXIMATE
5. DEPICTED ACCESS ROUTES ARE APPROXIMATE AND WILL NEED TO BE COORDINATED WITH LANDOWNERS.
6. SIDE CHANNEL CONNECTIONS WERE TARGETED FOR ENGAGEMENT AT BASEFLOWS (SEPTEMBER AVERAGE FLOW) WHERE FEASIBLE BASED ON PRELIMINARY HYDRAULIC MODEL RESULTS.
7. RECREATIONAL DESIGN FOR DECOMMISSIONED CAMPGROUND AREAS TO BE COMPLETED BY OTHERS.

LEGEND

- EXISTING CONTOURS (2')
- EXISTING CONTOURS (10')
- PROPOSED CONTOUR (1')
- TAXLOTS
- EXISTING ACCESS
- TEMPORARY ACCESS
- LIMITS OF DISTURBANCE
- TEMPORARY COFFERDAM
- ALIGNMENT (000+00)
- LARGE WOOD STRUCTURE (TYPE VARIES)
- POTENTIAL STAGING AREA
- ORDINARY HIGH WATER (OHW)
- RECREATION IMPROVEMENTS
- SAVE OR REMOVE TREE (## / ##)

0 50' 100'

PLAN SCALE IN FEET
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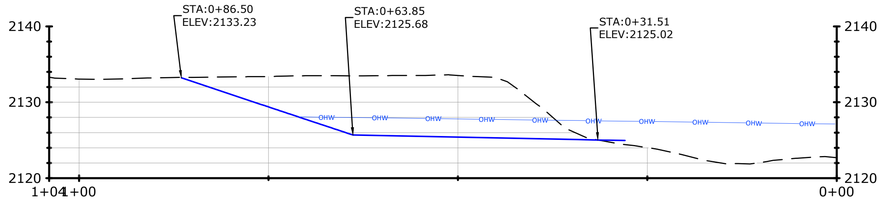
PROPOSED CONDITIONS (2 OF 2)

SHEET 11

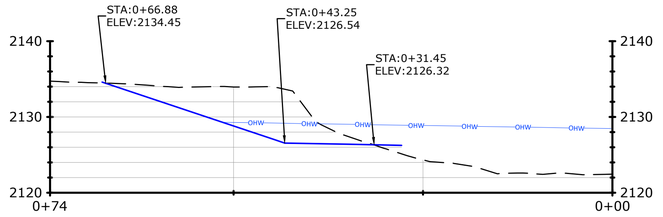
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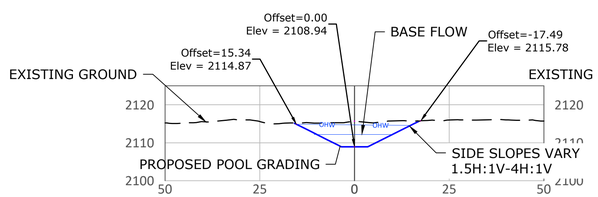


1/12 BENCH GRADING SECTION
1"=10'

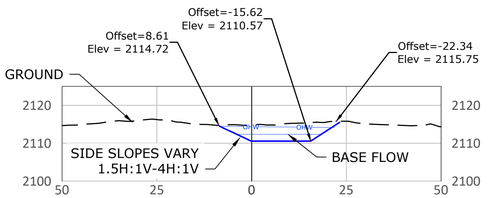


2/12 BENCH GRADING SECTION
1"=10'

3/12 SIDE CHANNEL PROFILE
1"=50'H 1"=20'V



4/12 TYPICAL SIDE CHANNEL CROSS SECTION
1"=20'



5/12 TYPICAL SIDE CHANNEL CROSS SECTION
1"=20'

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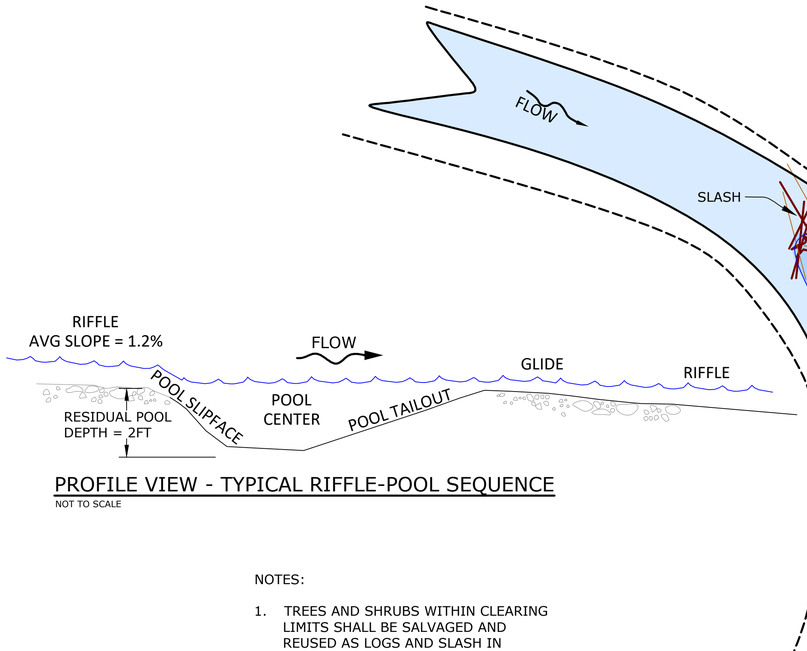
PROFILES AND CROSS SECTIONS

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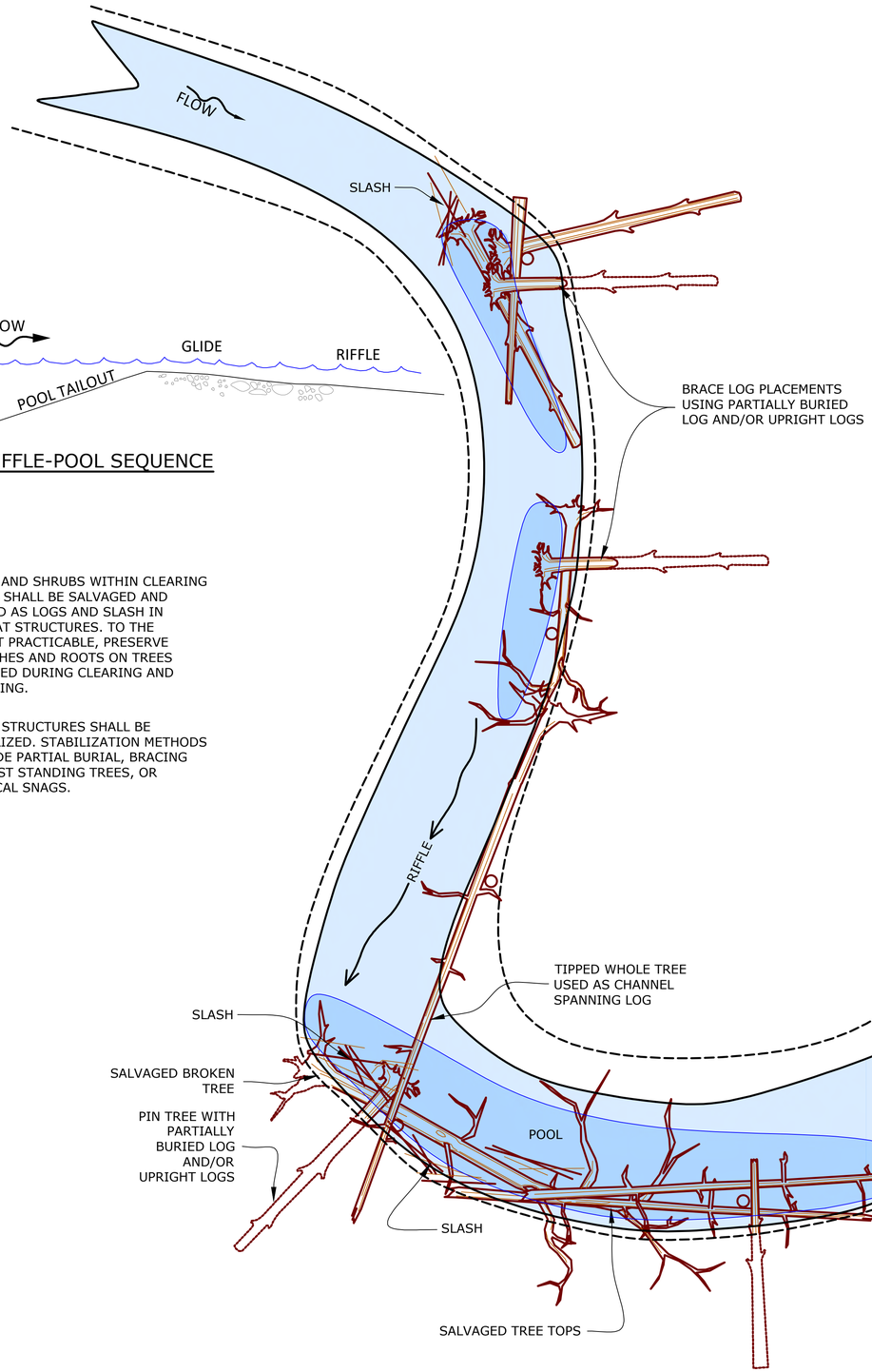


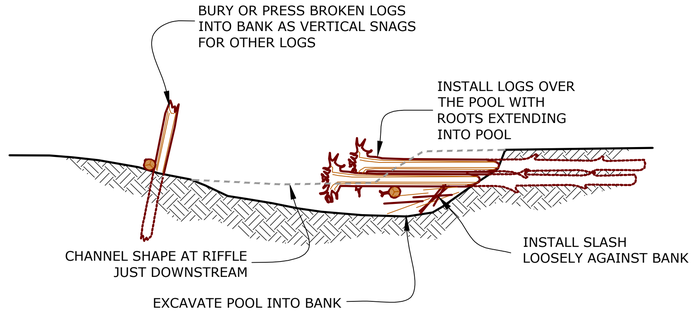
PROFILE VIEW - TYPICAL RIFFLE-POOL SEQUENCE
NOT TO SCALE

NOTES:

1. TREES AND SHRUBS WITHIN CLEARING LIMITS SHALL BE SALVAGED AND REUSED AS LOGS AND SLASH IN HABITAT STRUCTURES. TO THE EXTENT PRACTICABLE, PRESERVE BRANCHES AND ROOTS ON TREES REMOVED DURING CLEARING AND GRUBBING.

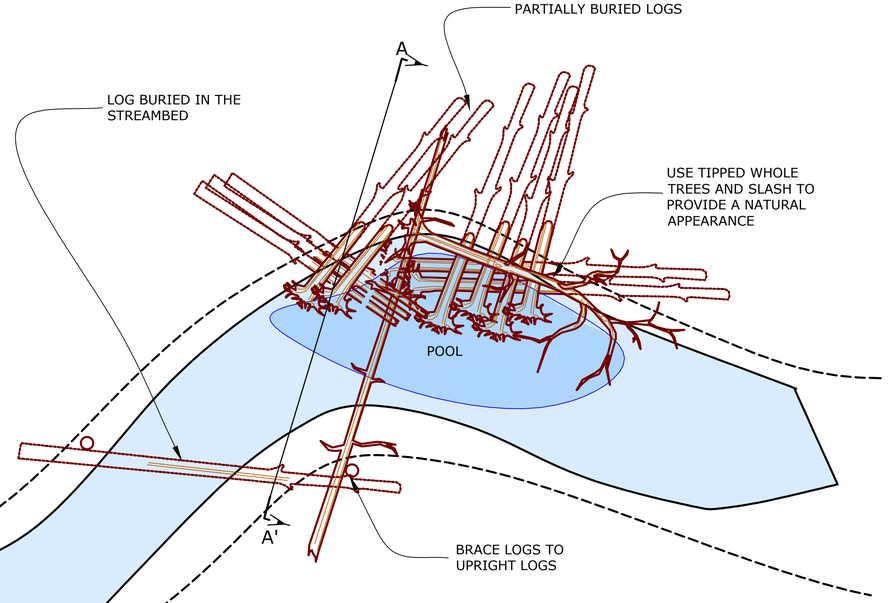
2. WOOD STRUCTURES SHALL BE STABILIZED. STABILIZATION METHODS INCLUDE PARTIAL BURIAL, BRACING AGAINST STANDING TREES, OR VERTICAL SNAGS.





SECTION VIEW A-A'

WOOD CONFIGURATION AND POOL ENHANCEMENT
NOT TO SCALE



PLAN VIEW - TYPICAL SIDE CHANNEL
NOT TO SCALE

1/13 TYPICAL SIDE CHANNEL HABITAT
NOT TO SCALE

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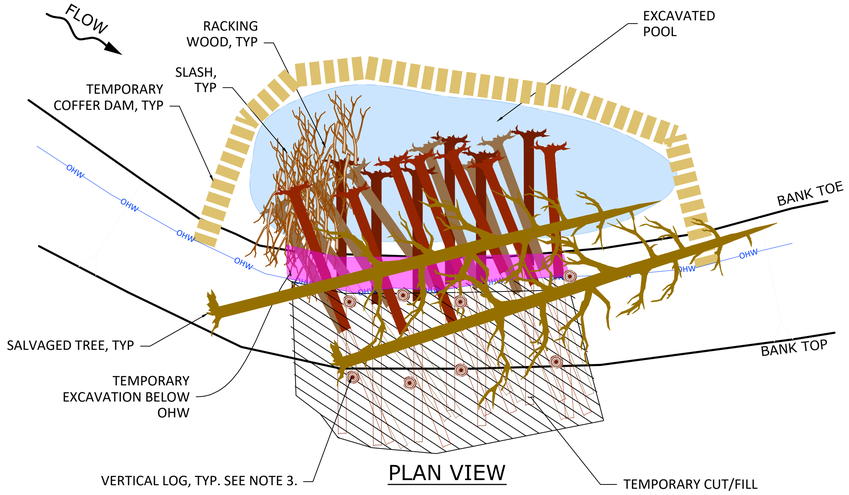
TYPICAL DETAILS
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SHEET 13

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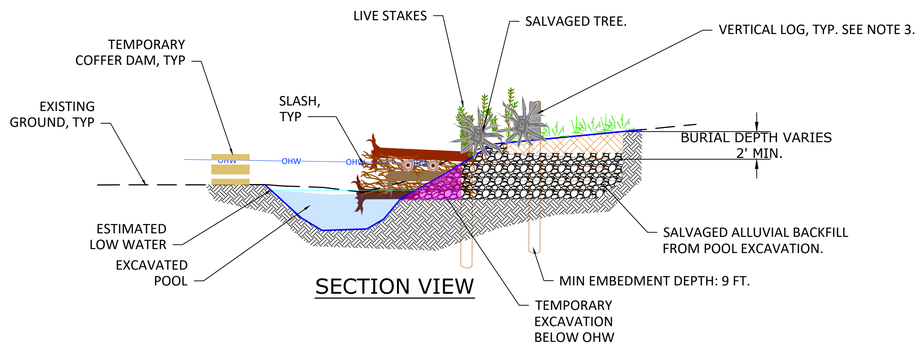
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PLAN VIEW

NOTES:

1. THE DEPICTED LARGE WOOD DETAILS ARE TYPICAL REPRESENTATIONS. THE EXACT LAYOUT, ORIENTATION, AND CONFIGURATION OF LARGE WOOD MATERIAL IS SUBJECT TO CHANGE BASED ON SITE SPECIFIC CONDITIONS AND THE LARGE WOOD MATERIAL RECEIVED..
2. WHOLE TREES AND SLASH SHALL BE SALVAGED AND INCORPORATED INTO THE LARGE WOOD STRUCTURES IN ACCORDANCE WITH THE SPECIFICATIONS.
3. VERTICAL LOGS SHALL BE INSTALLED IN A PORTION OF THE BANK-BURIED LW STRUCTURES AS DEPICTED ON SHEET 17. EACH VERTICAL LOG SHALL HAVE A MINIMUM OF ONE (1) BOLTED CONNECTION TO A TOP LAYER ROOTWAD LOG PER THE DETAILS ON SHEET 17.
4. THE MINIMUM BURIAL DEPTHS DEPICTED ON SHEET 17 SHALL BE MEASURED AS THE DISTANCE BETWEEN THE TOP OF THE TOP LAYER LOG AND FINISHED GRADE, AT THE MIDPOINT OF BURIED PORTION OF THE LOG.
5. ROOTWAD LOGS SHALL BE EMBEDDED A MINIMUM OF 60% OF THE TOTAL LOG LENGTH INTO THE BANK.



SECTION VIEW

1/14 TYPICAL DETAIL – BANK–BURIED LARGE WOOD STRUCTURE
NOT TO SCALE

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	UNITS	QTY	LAYER 1	LAYER 2	LAYER 3
ROOTWAD LOGS (18" DBH, 40' LENGTH)	EA	20	6	7	7
PILES (16" DBH, 25' LENGTH)	EA	8			
SALVAGED WHOLE TREES	EA	2			
LIVE STAKES	EA	28			
POOL EXCAVATION	CY	100			

NOTES:

1. PILES OR BOULDER BALLAST MAY BE USED IN INSTANCES WHERE MINIMUM BURIAL DEPTH CANNOT BE ACHIEVED.



TYPICAL CONSTRUCTED BANK-BURIED LARGE WOOD STRUCTURE

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TYPICAL DETAILS
(2 OF 5)

SHEET 14

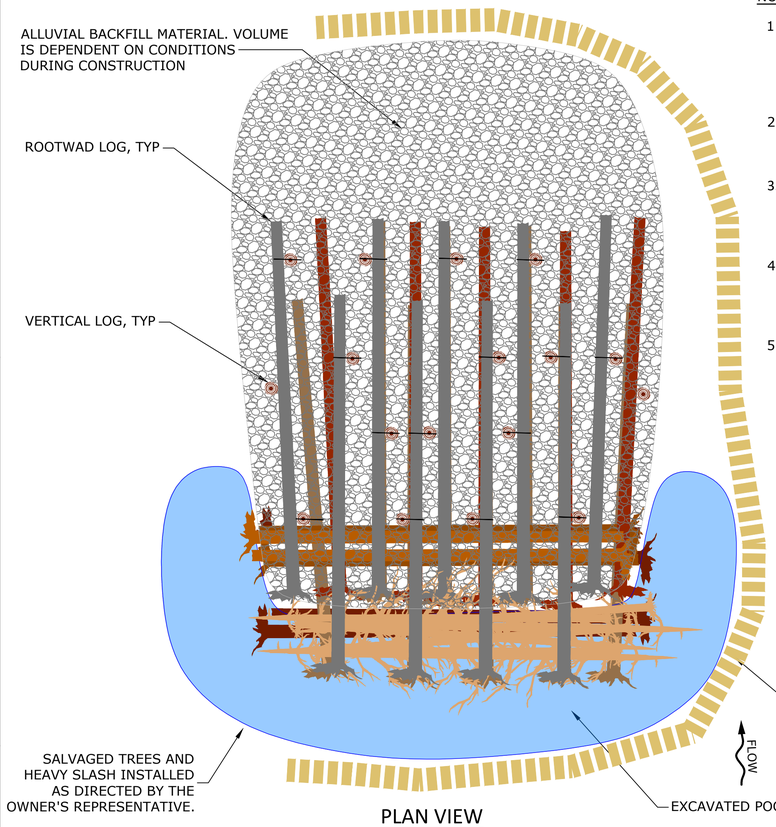
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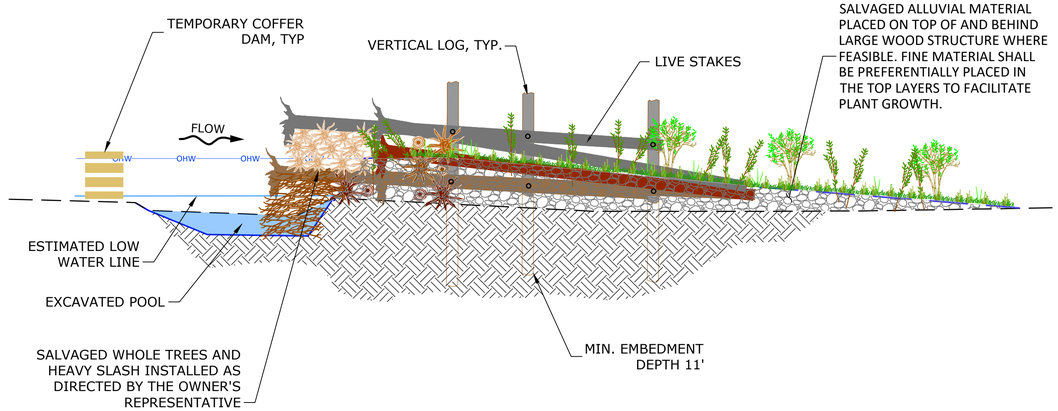
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5. ROOTWAD LOGS SHALL BE EMBEDDED A MINIMUM OF 60% OF THE TOTAL LOG LENGTH INTO THE BANK.



PLAN VIEW

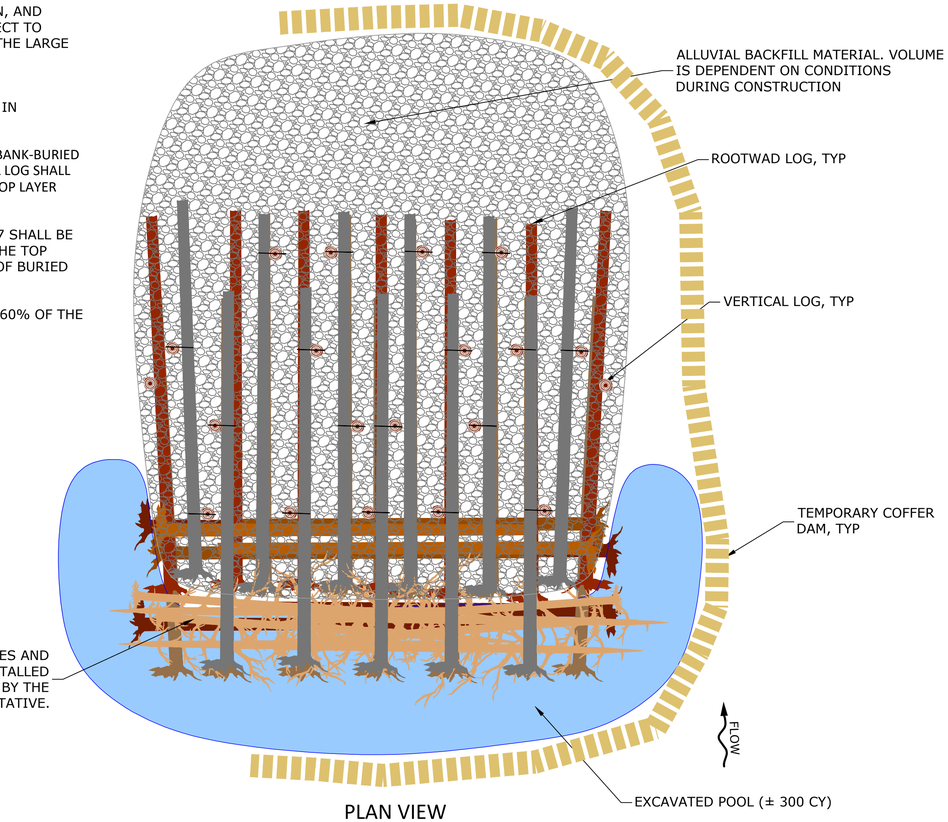
MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	UNITS	QTY	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER 5	LAYER 6
ROOTWAD LOGS (18" DBH, 40' LENGTH)	EA	30	4	8	2	5	2	9
PILES (16" DBH, 25' LENGTH)	EA	17						
SALVAGED WHOLE TREES	EA	6						
LIVE STAKES	EA	47						
POOL EXCAVATION	CY	225						



SECTION VIEW

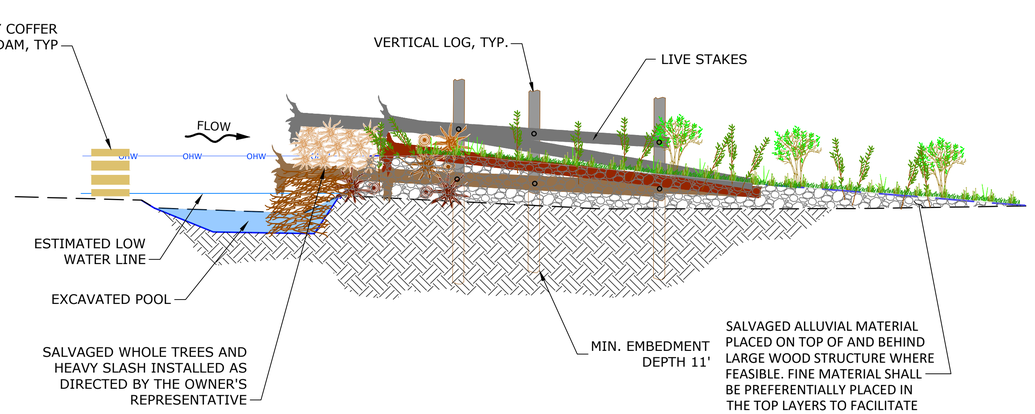
1/15 TYPICAL DETAIL – APEX–NARROW LARGE WOOD STRUCTURE
NOT TO SCALE



PLAN VIEW

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	UNITS	QTY	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER 5	LAYER 6
ROOTWAD LOGS (18" DBH, 40' LENGTH)	EA	37	4	11	2	7	2	11
PILES (16" DBH, 25' LENGTH)	EA	20						
SALVAGED WHOLE TREES	EA	8						
LIVE STAKES	EA	57						
POOL EXCAVATION	CY	300						



SECTION VIEW

2/15 TYPICAL DETAIL – APEX LARGE WOOD STRUCTURE
NOT TO SCALE

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PROJECT AREA D
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Preliminary
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LS, PB
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BOISE, ID AUGUST 2025

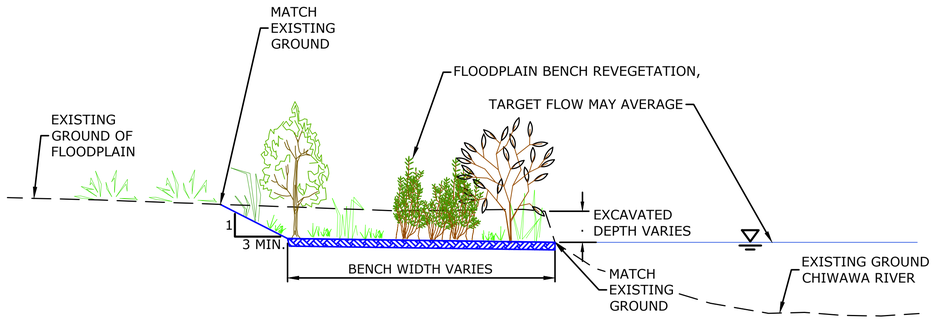
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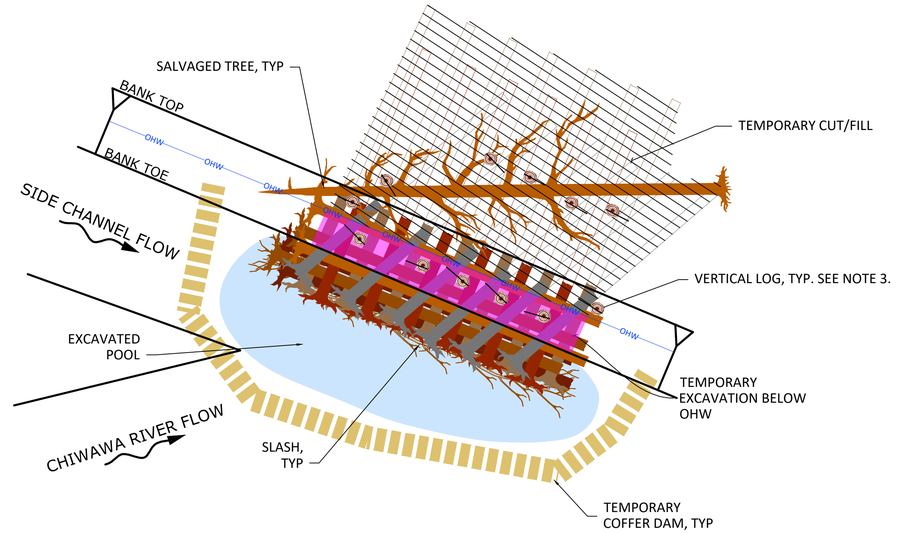
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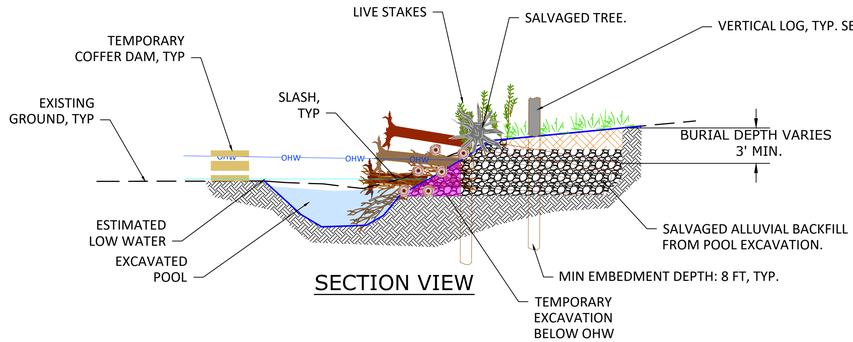
1/16 TYPICAL DETAIL – RIPARIAN BANK TREATMENT
NOT TO SCALE

NOTES:

1. CONTRACTOR SHALL SCRAPE AND DISPOSE OF THE EXISTING VEGETATION WITHIN THE PROPOSED GRADING LIMITS AND THEN STRIP AND STOCKPILE THE UNDERLYING SOIL LAYER TO AN AVERAGE MINIMUM DEPTH OF 10 INCHES.
2. EXCAVATE THE FLOODPLAIN BENCH TO THE TARGET ELEVATION.
3. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE ONCE MASS GRADING IS COMPLETE SO A GRADING INSPECTION CAN OCCUR BEFORE AMENDING THE SOILS TO CREATE A SUITABLE GROWING MEDIUM.
4. AMEND THE FLATTER PORTION OF THE FLOODPLAIN BENCH WITH SALVAGED TOPSOIL BY OVER-EXCAVATING THE BENCH TO A DEPTH OF 8 INCHES AND THEN SPREADING STOCKPILED TOPSOIL TO A DEPTH OF 8 INCHES, UNLESS DIRECTED OTHERWISE BY THE OWNER'S REPRESENTATIVE.
5. AGAIN, NOTIFY THE OWNER'S REPRESENTATIVE FOR A GRADING INSPECTION OF THE FINISHED SURFACE.



PLAN VIEW



SECTION VIEW

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	UNITS	QTY	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER 5	LAYER 6
ROOTWAD LOGS (18" DBH, 40' LENGTH)	EA	25	2	7	2	6	2	6
PILES (16" DBH, 25' LENGTH)	EA	12						
SALVAGED WHOLE TREES	EA	5						
LIVE STAKES	EA	37						
POOL EXCAVATION	CY	300						

2/16 TYPICAL DETAIL – SIDE CHANNEL CONFLUENCE
NOT TO SCALE

NOTES:

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5. ROOTWAD LOGS SHALL BE EMBEDDED A MINIMUM OF 60% OF THE TOTAL LOG LENGTH INTO THE BANK.

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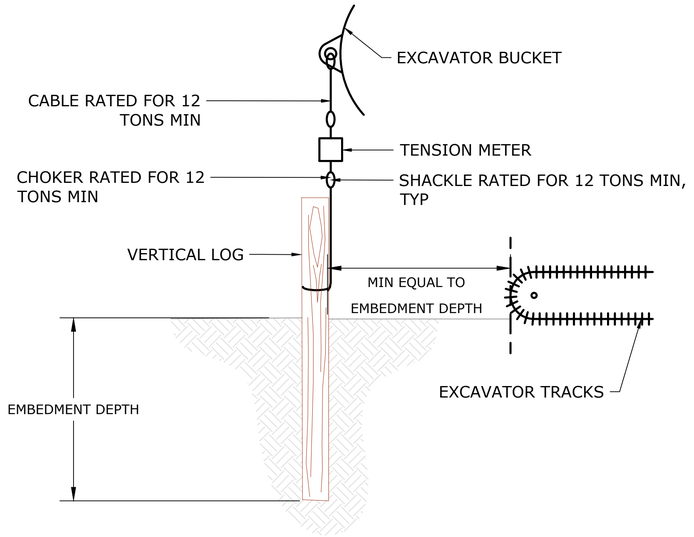
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SHEET 16

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1/17 TYPICAL DETAIL – VERTICAL LOG TESTING
NOT TO SCALE

NOTES:

VERTICAL LOGS

ALL VERTICAL LOGS SHALL BE INSTALLED USING VIBRATORY PILE DRIVING EQUIPMENT. INSTALLATION BY EXCAVATION, HAMMERING, OR VIBRATORY PLATE COMPACTOR SHALL NOT BE ALLOWED.

RIGGING

RIGGING FOR VERTICAL LOG TESTING SHALL CONFORM TO THE TENSION SCALE MANUFACTURER'S RECOMMENDATIONS.

CHOKERS, CABLES AND SHACKLES SHALL HAVE MINIMUM WORKING LOAD RATING OF 12 TONS. FITTINGS SHALL BE SIZED ACCORDINGLY

TESTING

TESTING OF VERTICAL LOGS SHALL BE PERFORMED IN THE PRESENCE OF THE OWNER'S REPRESENTATIVE.

EACH VERTICAL LOG TEST SHALL HAVE UPWARD LOAD GRADUALLY INCREASED AND AS CLOSELY ALIGNED TO AXIS OF VERTICAL LOG AS POSSIBLE. RECORD THE VERTICAL LOG DIAMETER, EMBEDMENT DEPTH AND MAXIMUM FORCE REQUIRED TO MOVE THE VERTICAL LOG . UP TO A TOTAL OF THREE LOADINGS MAY BE REQUIRED AT EACH EMBEDMENT DEPTH.

PROOF TESTS SHALL BE MADE AT UP TO FOUR EMBEDMENT DEPTHS TO BE DETERMINED IN THE FIELD. AS A GUIDELINE TEST EMBEDMENT DEPTHS MAY INCLUDE 10 FT, 12 FT, 14 FT AND 16 FT.

EXCAVATOR CONDUCTING PULL OUT LOADING SHALL BE POSITIONED NO CLOSER THAN EMBEDMENT DEPTH OF VERTICAL LOG IF POSSIBLE. IF A CLOSER POSITIONING IS REQUIRED, EXCAVATOR SHALL BE NO CLOSER THAN THAT REQUIRED TO GENERATE DESIRED LOADING WITH DISTANCE FROM VERTICAL LOG NOTED IN THE TEST RECORD. EQUIPMENT GROUND PRESSURE MAY BE REDUCED BY POSITIONING THE EXCAVATOR ACROSS HORIZONTAL LOGS, WITH DISTANCE FROM VERTICAL LOG, LOG NUMBERS AND LENGTH NOTED IN THE TEST RECORD.

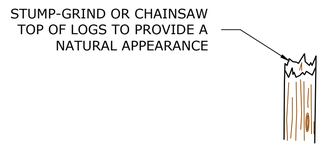
PULL OUT RESISTANCE READING SHALL BE COMPARED AGAINST EXCAVATOR MAX LIFT OFFSET TABLE.

10% OF PRODUCTION VERTICAL LOGS SHALL BE PROOF TESTED TO REQUIRED LOAD. IF RESULTS VARY MORE THAN 50% THEN IT SHOULD BE ANTICIPATED THAT UP TO 25% OF THE PRODUCTION VERTICAL LOGS SHALL BE PROOF TESTED. IF THE VERTICAL LOG EMBEDMENT DEPTH DOES NOT MEET MINIMUM, OWNER'S REPRESENTATIVE MAY REQUEST ADDITIONAL PULLOUT TESTING.

CONSTRUCTED DRIVEN VERTICAL LOG EMBEDMENT DEPTH SPECIFIED IN THE DRAWINGS MAY BE REDUCED OR INCREASED, PENDING PULL OUT TEST RESULTS, AT NO ADDITIONAL COST.

VIBRATORY DRIVEN VERTICAL LOGS SHALL INCLUDE REPOSITIONING AND MODIFICATIONS OF LOG TIP AS NEEDED FOR DRIVING AS INCIDENTAL TO THE LARGE WOOD STRUCTURE.

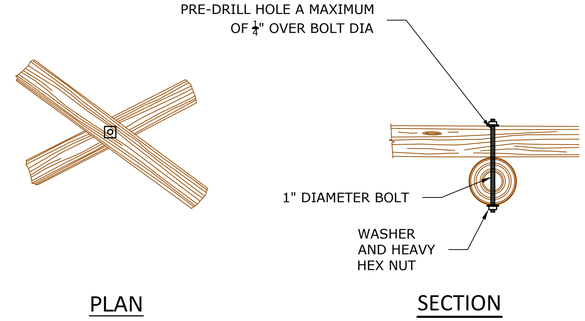
IN THE EVENT THAT 20 MINUTES OF FULL FORCE VIBRATORY DRIVING EFFORT FAILS TO EMBED LOGS TO A SUFFICIENT DEPTH TO PROVIDE 6,000 LB OF RESISTANCE TO PULLOUT, ENGINEER SHALL DETERMINE IF VERTICAL LOGS SHALL BE REPLACED OR SUPPLEMENTED WITH ADDITIONAL BURIAL DEPTH.



2/17 ROUGHENED TOP TYPICAL DETAIL
NOT TO SCALE

NOTES:

1. VISIBLE ENDS OF VERTICAL LOGS SHALL BE ROUGHENED WITH A CHAINSAW, STUMP-GRINDER, OR OTHER SIMILAR METHOD PROVIDED THAT THE ROUGHENING DOES NOT COMPROMISE THE STRUCTURAL INTEGRITY OF THE LOG.
2. UNDER NO CIRCUMSTANCES MAY THE CONTRACTOR ATTEMPT TO BREAK THE TOPS OFF OF INSTALLED VERTICAL LOGS.
3. ANY VERTICAL LOGS DAMAGED OR BROKEN AT DURING ROUGHENING SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER.



3/17 TYPICAL DETAIL – BOLTED CONNECTION
NOT TO SCALE

NOTES:

1. BOLTS, WASHERS, AND NUTS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
2. DRILL 1-1/4" HOLE THROUGH LOGS.
3. INSERT 1" DIAMETER THREADBAR.
4. INSTALL WASHERS OVER EACH END OF THE BOLT. THREAD NUTS ONTO EACH END OF THE BOLT AND TIGHTEN THE NUT UNTIL UNDERLYING WOOD BEGINS TO CRUSH.
8. IF END OF BOLT EXTENDS MORE THAN 2 INCHES BEYOND THE TIGHTENED NUT, CUT OFF EXCESS BOLT NO CLOSER THAN 1 INCH FROM THE NUT.
9. PEEN END OF BOLT OR CHISEL THREADS SO NUT CANNOT BE BACKED OFF.
10. FILE OR GRIND OFF SHARP EDGES ON BOLT END.

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FCRPS HABITAT IMPROVEMENT PROGRAM

LOWER CHIWAWA ASSESSMENT UNIT
PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS, PB
ACCEPTED

BOISE, ID AUGUST 2025

TYPICAL DETAILS
(5 OF 5)

SHEET 17

SHEET 17 OF 21

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CONTROLLED



LEGEND

- OHW — ORDINARY HIGH WATER LINE
- LIMITS OF DISTURBANCE
- LARGE WOOD STRUCTURE
- LIVE STAKE CUTTINGS
- RIPARIAN PLANTING
- TRANSITIONAL/UPLAND
- SEED ONLY
- EXISTING WETLANDS
- POTENTIAL STAGING AREA
- RECREATION IMPROVEMENTS

0 100' 200'

PLAN SCALE IN FEET
(AS SHOWN ON
22" X 34" SHEET)

N

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CM
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LS JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

REVEGETATION PLAN

SHEET 18

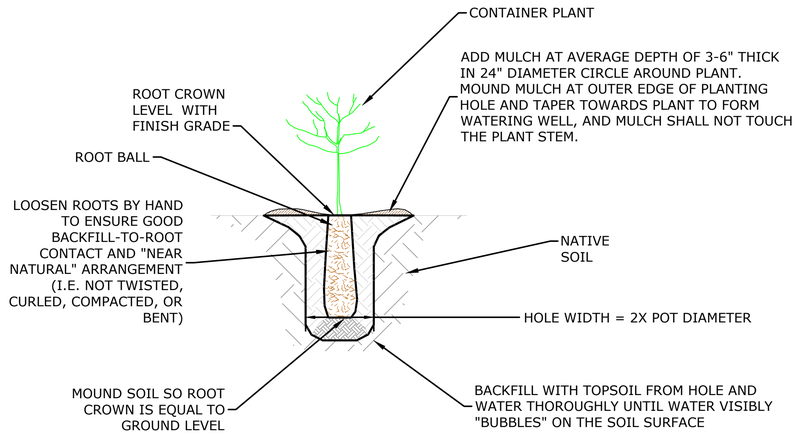
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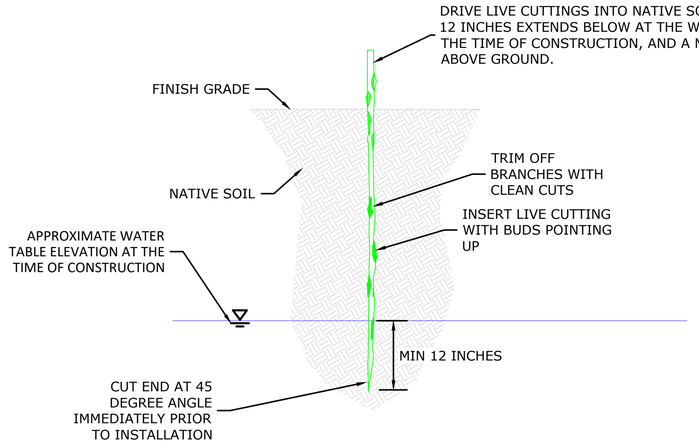
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3/21 TYPICAL DETAIL – POTTED PLANT
NOT TO SCALE

POTTED PLANT NOTES:

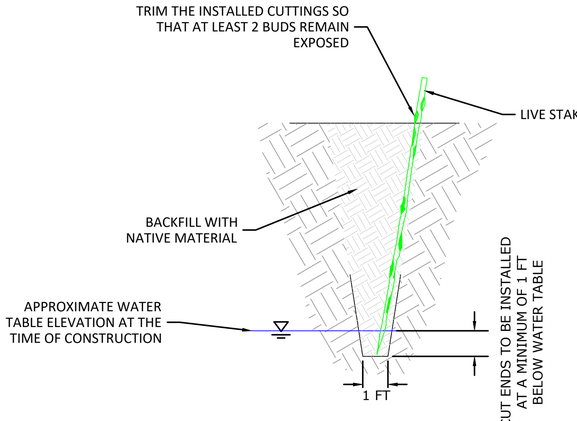
1. POTTED PLANTS TO BE INSTALLED BY LANDSCAPE CONTRACTOR



2/21 TYPICAL DETAIL – LIVE STAKE CUTTING
NOT TO SCALE

LIVE STAKE CUTTING NOTES:

1. CONTRACTOR IS ONLY RESPONSIBLE FOR LIVE STAKE CUTTINGS IN THE IMMEDIATE VICINITY OF THE LARGE WOOD STRUCTURES. LIVE CUTTINGS TO BE PROVIDED BY OWNER.
2. ALL OTHER LIVE STAKES TO BE INSTALLED BY LANDSCAPE CONTRACTOR (NOT IN CONTRACT)
3. DEVELOP PILOT HOLE TO 1 FT BELOW WATER TABLE DEPTH. PUMP WATER INTO HOLE. INSTALL LIVE CUTTINGS WITH CUT ENDS DOWN.
4. CONTINUE TO PUMP WATER INTO HOLE AND COMPACT SOIL BACKFILL IN LIFTS TO IMPROVE STEM TO SOIL CONTACT.
5. WATER IN FINISHED CUTTING UNTIL WATER VISIBLY "BUBBLES" ON SURFACE.



SECTION

1/21 TYPICAL DETAIL – LIVE STAKE CUTTING TRENCH
NOT TO SCALE

LIVE STAKE CUTTING TRENCH NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR EXCAVATING, PLACING THE LIVE CUTTINGS, BACKFILLING, AND COMPACTING THE TRENCHES. LIVE CUTTINGS TO BE PROVIDED BY OWNER.
2. ALL LIVE STAKE CUTTINGS TO BE CUT TO A POINT IMMEDIATELY PRIOR TO INSTALLATION.
3. EXCAVATE TRENCH TO 1 FT BELOW WATER TABLE DEPTH. PUMP WATER INTO TRENCH. INSTALL LIVE STAKE CUTTINGS WITH CUT ENDS IN TOE OF TRENCH.
4. COMPACT BACKFILL IN 12 INCH LIFTS TO IMPROVE STEM TO SOIL CONTACT
5. PUMP WATER INTO THE TRENCH WHILE BACKFILLING EACH LIFT UNTIL WATER VISIBILY "BUBBLES" ON SURFACE

RE-VEGETATION TABLES

RIPARIAN LIVE PLANTS - 0.15 ACRES

COMMON NAME	SCIENTIFIC NAME	TYPE	STOCK	SIZE	SPACING	QUANTITY	WETLAND
Scoulers Willow	*Salix scouleriana*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	4 ft o.c.	75	FAC
Sitka Willow	*Salix sitchensis*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	4 ft o.c.	75	FACW
Douglas Spirea	*Spirea douglassi*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	4 ft o.c.	75	FACW
Redosier Dogwood	*Cornus sericea*	Shrub	Tubling	40 in^3	4 ft o.c.	75	FACW
Thimbleberry	*Rubus parviflorus*	Shrub	Tubling	40 in^3	4 ft o.c.	75	FAC
Pacific Willow	*Salix lasiandra*	Tree	Live Stake	4 - 6 ft, 0.5-1.25" diameter	10 ft o.c.	35	FACW
Red Alder	*Alnus rubra*	Tree	Tubling	40 in^3	10 ft o.c.	35	FAC

TRANSITIONAL / UPLAND - 0.20 ACRES

COMMON NAME	SCIENTIFIC NAME	TYPE	STOCK	SIZE	SPACING	QUANTITY	WETLAND
Vine Maple	*Acer circinatum*	Shrub	Tubling	40 in^3	4 ft o.c.	105	FAC
Nootka Rose	*Rosa nutkana*	Shrub	Tubling	40 in^3	4 ft o.c.	105	FACU
Thimbleberry	*Rubus parviflorus*	Shrub	Tubling	40 in^3	4 ft o.c.	105	FAC
Blue Elderberry	*Sambucus cerulea*	Shrub	Tubling	40 in^3	4 ft o.c.	105	FACU
Common Snowberry	*Symphoricarpos albus*	Shrub	Tubling	40 in^3	4 ft o.c.	105	FACU
Grand Fir	*Abies grandis*	Tree	Tubling	40 in^3	10 ft o.c.	30	FACU
Bigleaf Maple	*Acer macrophyllum*	Tree	Tubling	40 in^3	10 ft o.c.	30	FAC
Red Alder	*Alnus rubra*	Tree	Tubling	40 in^3	10 ft o.c.	30	FAC

LIVE STAKES FOR LARGE WOOD STRUCTURES

COMMON NAME	SCIENTIFIC NAME	TYPE	STOCK	SIZE	QUANTITY	WETLAND
Scoulers Willow	*Salix scouleriana*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	112	FAC
Sitka Willow	*Salix sitchensis*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	112	FACW
Douglas Spirea	*Spirea douglassi*	Shrub	Live Stake	4 - 6 ft, 0.5-1.25" diameter	113	FACW

SEED MIX - 1.4 ACRES (25 LBS / ACRE)

COMMON NAME	SCIENTIFIC NAME (BIOTYPE NAME)	PERCENT OF MIX
Blue Wildrye	*Elymus glaucus (OkaWenSE)*	40%
Alaska Brome	*Bromus sitchensis (OkaWenSE)*	36%
Bluegrass	*Poa secunda (OkaWenSE)*	16%
Slender Hairgrass	*Descampsia elongata (OkaWenSE)*	4%
Idaho Fescue	*Festuca idahoensis (Entiat Chelan)*	4%

NOTE:
PLANT MATERIALS MUST BE LOCALLY ADAPTED NATIVE BIOTYPE STOCK (PESHASTIN - LEAVENWORTH) AS PER THE USFS DIRECTIVE.

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BOISE, ID AUGUST 2025

REVEGETATION DETAILS

SHEET 19

SHEET 19 OF 21

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INTRODUCTION

THE CONTRACTOR SHALL ATTEND A PRE-CONSTRUCTION MEETING WITH THE OWNER AND OWNER'S REPRESENTATIVE PRIOR TO BEGINNING CONSTRUCTION.

THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION'S STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION 2025 (WSDOT STANDARD SPECIFICATIONS) SHALL APPLY UNLESS OTHERWISE NOTED IN THE FOLLOWING PROVISIONS. IN CASE OF A CONFLICT BETWEEN THE REGULATORY STANDARDS OR SPECIFICATIONS, THE MORE STRINGENT WILL PREVAIL. THE "CONTRACTING AGENCY" OR "OWNER" SHALL BE THE CONFEDERATED TRIBES AND BANDS OF THE YAKAMA NATION. ADDITIONAL SPECIFICATIONS IN THE FOLLOWING CONTRACT SECTIONS ARE INCLUDED FOR ITEMS NOT COVERED BY THE WSDOT STANDARD SPECIFICATIONS.

SECTIONS 1-02, 1-03, AND 1-08 (EXCEPT 1-08.6, 1-08.7, 1-08.8) OF THE STANDARD SPECIFICATIONS DO NOT APPLY.

THE IN-WATER WORK WINDOW IS JULY 1 - JULY 31, 2027. HIGH WATER IN THE RIVER IS EXPECTED THROUGH MID-JULY. WORK MAY OCCUR OUTSIDE OF WATER BEFORE OR AFTER THE IN-WATER WORK WINDOW. WORK SHALL BE ONLY 7AM TO 7PM, 6 DAYS PER WEEK (MON-SAT).

IN A CASE OF A CONFLICT BETWEEN THE REGULATORY STANDARDS OR SPECIFICATIONS, LOCAL REGULATIONS, OR OTHER CONTRACT DOCUMENTATION, THE MORE STRINGENT WILL PREVAIL, UNLESS SPECIFIED IN WRITING BY THE OWNER.

ALL EXCAVATION ACTIVITY WILL BE MONITORED BY A CULTURAL RESOURCE SPECIALIST. IF YOUR WORK BRINGS YOU INTO CONTACT WITH ANY OF THE FOLLOWING CULTURAL RESOURCES:

- NATIVE AMERICAN CULTURAL ARTIFACTS (EXAMPLE: FLAKES, ARROWHEADS, STONE TOOLS, BONE TOOLS, POTTERY, ETC.)
- HISTORIC ERA ARTIFACTS (EXAMPLE: BUILDING FOUNDATIONS, HOMESTEADS, SHIPWRECKS, MINING CAMPS, ETC.)
- HUMAN SKELETAL REMAINS AND BONE FRAGMENTS

YOU MUST IMMEDIATELY DISCONTINUE ALL GROUND-DISTURBING ACTIVITY. DO NOT TOUCH OR MOVE THE OBJECTS AND MAINTAIN THE CONFIDENTIALITY OF THE SITE. FOLLOW THE PROCEDURES LISTED IN THE FOREST SERVICE INADVERTENT DISCOVERY PROCEDURE AND AWAIT FURTHER DIRECTION FROM THE ARCHEOLOGIST AND FOREST SERVICE'S CULTURAL RESOURCES STAFF..

ITEM 001 - MOBILIZATION/DEMOBILIZATION

DESCRIPTION

THIS ITEM SHALL CONSIST OF PREPARATION WORK AND OPERATIONS PERFORMED BY THE CONTRACTOR IN ACCORDANCE WITH APPLICABLE CHELAN COUNTY ROAD REQUIREMENTS, USFS ROAD REQUIREMENTS, THE PROVISIONS OF SECTION 1-09.7 OF THE WASHINGTON DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS (STANDARD SPECIFICATIONS), AND AS AMENDED BY THESE SPECIAL PROVISIONS.

1. PRIOR TO ENTERING THE SITE, ALL EQUIPMENT SHALL BE POWER WASHED, BECOME FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE. IF EQUIPMENT LEAVES THE SITE AND RETURNS, IT SHALL BE REWASHED AND INSPECTED PRIOR TO ACCESSING THE SITE.
2. TEMPORARY SITE ACCESS SHALL BE ALONG ACCESS ROUTES AND STAGING AREAS SHOWN IN THE DRAWINGS. THESE ARE APPROXIMATE. ACTUAL DISTURBANCE LIMITS WILL BE STAKED AND FLAGGED IN THE FIELD BY THE OWNER. DESIGNATED DISTURBANCE LIMITS SHALL BE STRICTLY ADHERED TO AND NO LARGE TREES WILL BE IMPACTED WITHOUT PERMISSION FROM THE OWNER.
3. TEMPORARY TRAFFIC CONTROL REQUIREMENTS SHALL INCLUDE MEASURES PER SECTION 1-10 OF THE STANDARD SPECIFICATIONS AND ANY APPLICABLE LOCAL OR REGIONAL REGULATIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN AND COMPLY WITH APPLICABLE LOCAL AND STATE PERMITS.
4. PRIOR TO DEMOBILIZATION, ALL DISTURBED GROUND SHALL BE GRADED SMOOTH TO BLEND WITH EXISTING TOPOGRAPHY, AND IF DIRECTED BY THE OWNER, RIPPED TO A DEPTH OF 18 INCHES TO DECOMPACT SOILS.
   a. ALL DISTURBED ROAD SURFACES SHALL BE RESTORED TO PRE-PROJECT CONDITIONS OR BETTER, UNLESS OTHERWISE DIRECTED BY THE OWNER.
   b. EXCESS SLASH MATERIAL SHALL BE PLACED ALONG THE DECOMMISSIONED ACCESS ROUTES FOR THE REVEGETATION CONTRACTOR TO INSTALL FOR FURTHER EROSION CONTROL.
   c. SALVAGED BOULDERS AND/OR TREES SHALL BE PLACED IN FRONT OF ACCESS POINTS FROM EXISTING ROADS TO PREVENT MOTORIZED VEHICLE ACCESS, AS DIRECTED BY THE OWNER.

MEASUREMENT AND PAYMENT

MOBILIZATION/DEMOBILIZATION SHALL BE MEASURED AND PAID FOR BY LUMP SUM. ANY NECESSARY TRAFFIC CONTROL SHALL BE CONSISDERED INCIDENTAL TO MOBILIZATION. PARTIAL PAYMENTS WILL BE MADE IN ACCORDANCE WITH SECTION 1-09.9 OF THE STANDARD SPECIFICATIONS. PAYMENT SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EQUIPMENT, LABOR, TOOLS, MATERIALS, AND INCIDENTALS NECESSARY TO COMPLETE THIS WORK AS SPECIFIED.

ITEM 002- EROSION, POLLUTION, AND SEDIMENT CONTROL

DESCRIPTION

THIS WORK SHALL PROVIDE FOR PREPARATION, IMPLEMENTATION, AND REMOVAL OF A TEMPORARY EROSION SEDIMENT CONTROL (TESC) PLAN AND FOR THE PREPARATION AND IMPLEMENTATION OF A SPILL PREVENTION CONTROL AND COUNTERMEASURE (SPCC) PLAN IN ACCORDANCE WITH SECTION 1-07.15 OF THE STANDARD SPECIFICATIONS, AND AS AMENDED BY THESE SPECIAL PROVISIONS.

1. THE CONTRACTOR SHALL SUBMIT A TESC FOR THE PROJECT TO THE OWNER FOR APPROVAL. THE TESC MUST SATISFY THE REQUIREMENTS OF THE WASHINGTON DEPARTMENT OF ECOLOGY NPDES STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY AND ALL OTHER APPLICABLE PERMITS. THE TESC INCLUDED IN THE DRAWINGS AND DESCRIBED HEREIN IS INTENDED TO PROVIDE A BASELINE FOR SEDIMENT AND EROSION CONTROL AND DOES NOT ENSURE THAT THE STANDARDS ESTABLISHED BY ANY APPLICABLE PERMITS WILL BE MET. THE CONTRACTOR MAY USE THESE MEASURES OR ALTERNATIVE MEASURES OF THEIR OWN DESIGN TO ENSURE SATISFACTORY PERFORMANCE AND THAT THE EROSION CONTROL REQUIREMENTS OF ALL APPLICABLE PERMITS ARE MET. THE CONTRACTOR SHALL BE NAMED AS THE PERMIT HOLDER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING, INSPECTING AND FILING REPORTS, MAINTAINING, REPLACING, AND REMOVING TESC AND SPCC MEASURES. THE PLAN SHALL INCLUDE THE NAME, ADDRESS AND 24-HOUR CONTACT NUMBER OF THE PERSON RESPONSIBLE FOR EROSION PREVENTION AND SEDIMENT CONTROL MEASURES.
2. A SPILL CONTAINMENT KIT SHALL BE ON SITE AND CREWS SHALL BE TRAINED IN ITS USE
3. BIODEGRADABLE HYDRAULIC FLUID SHALL BE INSTALLED INTO EACH PIECE OF HEAVY MACHINERY WORKING WITHIN 50 FEET OF THE RIVER

MEASUREMENT

"EROSIONS, POLLUTION, AND SEDIMENT CONTROL," WILL BE MEASURED BY LUMP SUM.

PAYMENT

PAYMENT SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EQUIPMENT, LABOR, TOOLS, MATERIALS, AND INCIDENTALS NECESSARY TO COMPLETE THIS WORK AS SPECIFIED. PAYMENT WILL BE MADE IN ACCORDANCE WITH SECTION 1-04.1 FOR THE FOLLOWING BID ITEMS: "EROSIONS, POLLUTION, AND SEDIMENT CONTROL" PER LUMP SUM.

ITEM 003- CLEARING, GRUBBING, AND TREE SALVAGE

DESCRIPTION

THIS ITEM CONSISTS OF CLEARING, GRUBBING, AND TREE SALVAGE FOR CONSTRUCTION AS SHOWN ON THE DRAWINGS, INCLUDING THOSE AREAS REQUIRED FOR TEMPORARY ACCESS ROUTES AND IN ACCORDANCE WITH SECTION 2-01 OF THE STANDARD SPECIFICATIONS, AND AS AMENDED BY THESE SPECIAL PROVISIONS.

1. AREAS FOR CLEARING AND GRUBBING ARE SHOWN IN THE DRAWINGS. ADJUSTMENTS TO ALIGNMENTS AND EXTENTS MAY BE ADJUSTED BY THE OWNER TO REDUCE DAMAGE TO THE ENVIRONMENT. THE FINAL AREAS WILL BE FLAGGED IN THE FIELD BY THE OWNER PRIOR TO CLEARING AND GRUBBING WORK. CLEARING AND GRUBBING SHALL NOT OCCUR OUTSIDE OF THE DESIGNATED LIMITS.
2. INCLUDED IN THIS ITEM ARE THE REMOVAL AND SALVAGE OF TREES, SHRUBS, AND SLASH FOR INCORPORATION INTO LARGE WOOD STRUCTURES. SALVAGED TREES, SHRUBS, AND SLASH SHALL BE INSTALLED AS WOODY MATERIAL DURING CONSTRUCTION.
3. TO THE MAXIMUM PRACTICABLE EXTENT, THE CONTRACTOR SHALL REMOVE OWNER-IDENTIFIED SALVAGED TREES GREATER THAN 12" DBH BY EXCAVATING TO LOOSEN SOIL AROUND EACH ROOTWAD AND THEN PUSH OVER THE TREES IN ORDER TO SALVAGE LOGS WITH INTACT AND ATTACHED ROOTS. SALVAGED TREES MAY BE TEMPORARILY STOCKPILED OUTSIDE OF THE CLEARING LIMITS BUT WITHIN REACH OF THE EXCAVATOR DURING LARGE WOOD STRUCTURE CONSTRUCTION. THE MAXIMUM DIAMETER OF SALVAGED TREES WILL BE 25" DBH.
4. VEGETATION PROTECTION AND RESTORATION PER SECTION 1-07.16(2) SHALL BE INCIDENTAL TO CLEARING AND GRUBBING. ALL TREES NOT MARKED FOR REMOVAL SHALL BE PRESERVED AND UNDISTURBED. CONSTRUCTION ACTIVITY SHALL NOT DEBARK OR DAMAGE LIVE TREES. KEEP OUT OF DRIP LINE OF ALL TREES OUTSIDE OF CLEARING LIMITS. WITH PRIOR APPROVAL BY THE OWNER, TREES MAY BE LIMBED TO FACILITATE EQUIPMENT MOVEMENT AND SITE SAFETY.

MEASUREMENT

"CLEARING, GRUBBING, AND TREE SALVAGE," INCLUDING THE ABOVE AMENDMENTS, WILL BE MEASURED BY LUMP SUM.

MEASUREMENT AND COMPENSATION FOR THE INSTALLATION OF SALVAGED TREES AND SLASH IS DESCRIBED UNDER ITEMS 005 THOROUGH 008 "LARGE WOOD STRUCTURES" AND PAID UNDER THAT ITEM. NO ADDITIONAL COMPENSATION WILL BE ALLOWED.

PAYMENT

PAYMENT WILL BE MADE IN ACCORDANCE WITH SECTION 1-09.9 FOR THE FOLLOWING BID ITEMS: "CLEARING, GRUBBING, AND TREE SALVAGE" PER LUMP SUM.

DRAFT

ITEM 004- DIVERSION AND DEWATERING

DESCRIPTION

THIS ITEM INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:

1. INSTALLING, MAINTAINING, AND REMOVING MEASURES TO ISOLATE IN-WATER WORK AREAS FROM FLOWING SURFACE WATER AND TO PREVENT TURBIDITY FROM ENTERING THE RIVER.
2. DEWATERING AND CONTROLLING TURBIDITY WITHIN CONSTRUCTION AREAS ISOLATED FROM THE RIVER BY COFFERDAMS.
3. FURNISHING, MONITORING, OPERATING, MAINTAINING, AND REMOVING PUMPS.
4. COORDINATING WITH THE OWNER FOR FISH SALVAGE AND RELOCATION ACTIVITIES
5. INSTALLATION OF WATER CONTROL BMPS.

MATERIALS

1. WORK AREA ISOLATION
   a. COFFERDAMS CONSTRUCTED OF SHEET PILE INSTALLED BY VIBRATORY DRIVER IS A PRE-APPROVED METHOD OF WORK AREA ISOLATION.
   b. SANDBAGS SHALL BE FILLED WITH PEA GRAVEL OR STREAM GRAVEL. USING SAND WILL NOT BE ALLOWED.
2. PUMPING
   a. THE CONTRACTOR SHALL PROVIDE SUFFICIENT SIZE AND NUMBERS OF PUMPS TO DEWATER ISOLATED WORK AREAS AND CONTROL TURBIDITY FOR THE PROJECT AND ENCOUNTERED FLOWS AND GROUNDWATER CONDITIONS.
   b. THE CONTRACTOR SHALL PROVIDE A MINIMUM OF TWO 3" TRASH PUMPS, OR AS NECESSARY TO PROVIDE COMBINED PUMPING CAPACITY GREATER THAN 400 GPM, ASSUMING 20 FEET OF VERTICAL LIFT AND 300 FEET OF DISCHARGE HOSE.
   i. IF AN ALTERNATE COFFERDAM METHOD IS UTILIZED, THE PUMPING REQUIREMENTS SHALL BE INCREASED TO A MINIMUM OF TWO 4" TRASH PUMPS, OR AS NECESSARY TO PROVIDE COMBINED PUMPING CAPACITY GREATER THAN 800 GPM.
   c. IF NEEDED, THE CONTRACTOR SHALL PROVIDE ADDITIONAL PUMPS OR PUMPING CAPACITY AT NO ADDITIONAL COST TO THE OWNER.
3. FISH SALVAGE
   a. THE WORK INCLUDES COORDINATING WITH THE OWNER FOR FISH SALVAGE AND RELOCATION ACTIVITIES. EXCAVATION OR LOG PLACEMENT SHALL NOT OCCUR UNTIL THE OWNER COMPLETES FISH SALVAGE. THE CONTRACTOR SHALL PROVIDE SUFFICIENT ADVANCE NOTICE TO THE OWNER BEFORE EACH COFFERDAM INSTALLATION DATE. THE CONTRACTOR SHALL PROVIDE OWNER ACCESS TO COFFERDAMS AND SUPPORTING STAFF FOR OWNER'S DEFISHING. THE CONTRACTOR IS ADVISED THAT FISH RESCUE WILL NOT OCCUR ON SATURDAYS OR SUNDAYS AND MAY TAKE SEVERAL HOURS PER COFFERDAM.

CONSTRUCTION REQUIREMENTS

1. COFFERDAMS
   a. THE CONTRACTOR SHALL ISOLATE THE WORK AREA FROM THE RIVER BY INSTALLING COFFERDAM PER THE DRAWINGS. NO TURBIDITY FROM CONSTRUCTION ACTIVITIES SHALL ENTER THE RIVER.
   b. SHEET PILE INSTALLED BY VIBRATORY DRIVER IS A PRE-APPROVED METHOD. DRIVING SHEET PILE BY IMPACT HAMMER IS NOT ACCEPTABLE.
      b.a. THE CONTRACTOR MAY PROPOSE A DIFFERENT METHOD THAT PROVIDES EQUAL OR BETTER ISOLATION OF THE WORK AREA FROM THE FLOW. IF A DIFFERENT METHOD IS PROPOSED, THE CONTRACTOR SHALL SUBMIT DRAWINGS SHOWING DETAILS OF PROPOSED METHODS FOR PROVIDING TEMPORARY ISOLATION OF SURFACE WATER DURING CONSTRUCTION ACTIVITIES.
      b.b. REVIEW AND APPROVAL OF ANY ALTERNATE COFFERDAM PLAN SHALL NOT RELIEVE THE CONTRACTOR FROM FULL RESPONSIBILITY FOR THE ADEQUACY OF COFFERDAM WORK. IF THE PROPOSED PLAN IS NOT SUCCESSFUL AT PROPERLY ISOLATING THE WORK AREA ACTIVITIES MUST IMMEDIATELY SHUT DOWN UNTIL A NEW PLAN IS EXECUTED THAT ISOLATES AND PREVENTS TURBIDITY FROM LEAVING THE CONSTRUCTION SITE.
   c. COFFERDAMS SHALL BE SUITABLY OFFSET FROM WORK AREA SO AS TO NOT INTERFERE WITH LOG PLACEMENT OR LIMIT SCOUR POOL EXCAVATION SHOWN IN THE DRAWINGS.
2. PUMPING
   a. EACH WATER INTAKE SHALL HAVE A FISH SCREEN INSTALLED, OPERATED AND MAINTAINED ACCORDING TO NMFS' FISH SCREEN CRITERIA (NMFS 1997; NMFS 2008). NO PUMPING CAN OCCUR UNTIL FISH SCREEN HAS BEEN APPROVED BY OWNER PRIOR TO INSTALLATION.
   b. PUMPS SHALL BE PLACED WITHIN A CONTAINER TO CONTAIN FUEL OR OIL SPILLS. OIL ABSORBENT DIAPERS SHALL BE STORED AT EACH PUMP.
   c. THE CONTRACTOR SHALL PROVIDE ENVIRONMENTAL PROTECTION MEASURES SUCH AS STRAW BALES, PERFORATED PIPE FOR DISCHARGE FLOW DISTRIBUTORS, GEOTEXTILES, FILTER BAGS, OR OTHER MEANS OF CONTROLLING DISCHARGE WATER AND TURBIDITY. NO TURBIDITY SHALL BE ALLOWED TO ENTER SURFACE WATERS OR WETLANDS.
   d. TO HELP PREVENT TURBIDITY FROM LEAKING THROUGH COFFERDAMS, THE CONTRACTOR SHALL OPERATE PUMP(S) TO LOWER THE WATER SURFACE WITHIN THE ISOLATED AREA AND DISCHARGE TO AN INFILTRATION AREA.
3. FISH SALVAGE
   a. THIS WORK INCLUDES COORDINATING WITH THE OWNER FOR FISH SALVAGE AND RELOCATION ACTIVITIES. EXCAVATION OR LOG PLACEMENT SHALL NOT OCCUR UNTIL THE OWNER COMPLETES FISH SALVAGE. THE CONTRACTOR SHALL PROVIDE SUFFICIENT ADVANCE NOTICE TO THE OWNER BEFORE EACH COFFERDAM INSTALLATION DATE.
   b. THE CONTRACTOR SHALL PROVIDE OWNER ACCESS TO COFFERDAMS AND SUPPORTING STAFF FOR OWNER'S DEFISHING. THE CONTRACTOR IS ADVISED THAT FISH RESCUE WILL NOT OCCUR ON SATURDAYS OR SUNDAYS AND MAY TAKE SEVERAL HOURS PER COFFERDAM.
4. ENVIRONMENTAL PROTECTION MEASURES
   a. TURBIDITY MONITORING AND CORRECTION SHALL BE IN ACCORDANCE WITH ALL PERMIT CONDITIONS AND THE GENERAL CONSERVATION MEASURES ON SHEET 5.

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LOWER CHIWAWA ASSESSMENT UNIT
PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS,JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

SPECIFICATIONS (1 OF 2)

SHEET 20

SHEET 20 OF 21

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ITEM 004 - DIVERSION AND DEWATERING (CONTINUED)

MEASUREMENT AND PAYMENT

"DIVERSION AND DEWATERING," INCLUDING THE ABOVE AMENDMENTS TO THE ITEM WILL BE MEASURED BY LUMP SUM. PAYMENT SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EQUIPMENT, LABOR, TOOLS, MATERIALS, AND INCIDENTALS NECESSARY TO COMPLETE THIS WORK AND MEET PERFORMANCE CRITERIA AS SPECIFIED FOR THE ENTIRETY OF THE PROJECT.

PAYMENT WILL BE MADE IN ACCORDANCE WITH SECTION 1-04.1 FOR THE FOLLOWING BID ITEMS: "DIVERSION AND DEWATERING" PER LUMP SUM.

ITEMS 005 - 008 LARGE WOOD STRUCTURES

DESCRIPTION

1. "LARGE WOOD STRUCTURES" INCLUDE:
   ITEM 005 - BANK-BURIED STRUCTURES B1 THROUGH B7
   ITEM 006 - APEX NARROW LW STRUCTURE A1
   ITEM 007 - APEX LW STRUCTURE A2
   ITEM 008 - SIDE CHANNEL CONFLUENCE LW STRUCTURE SC1

2. THE WORK COVERED UNDER THIS ITEM INCLUDES ALL WORK ASSOCIATED WITH ON-SITE HAULING, HANDLING, AND INSTALLATION OF LARGE WOOD MATERIAL (LWM), SALVAGED TREES, AND SLASH TO CONSTRUCT THE LARGE WOOD STRUCTURES SHOWN ON THE DRAWINGS.

3. THIS ITEM ALSO INCLUDES EXCAVATION OF HABITAT POOLS, EXCAVATION FOR LOG PLACEMENT, TEMPORARY STOCKPILING, BACKFILL TO PARTIALLY BURY LWM, AND SHAPING BANKS ADJACENT TO LWM PLACEMENTS. WORK AREA ISOLATION IS REQUIRED AT DESIGNATED "LARGE WOOD STRUCTURES" SHOWN IN THE DRAWINGS, IN ACCORDANCE WITH ITEM 004 "DIVERSION AND DEWATERING".

4. LARGE WOOD STRUCTURES SHALL BE CONSTRUCTED OF LARGE WOOD MATERIAL (LWM), EXCAVATION AND BACKFILL, SLASH, SALVAGED TREE TOPS, SLAVAGED TREES, AND BOLTED CONNECTIONS APPLY TO LARGE WOOD STRUCTURES AS SHOWN ON THE DRAWINGS.

MATERIALS

LARGE WOOD MATERIAL (LWM)

1. LWM IS SUPPLIED BY THE OWNER AND WILL BE DECKED AT THE STAGING AREA SHOWN ON THE DRAWINGS.
2. LWM WILL HAVE THE FOLLOWING CHARACTERISTICS:
   a. ROOTWAD LOGS WITH ROOTWADS: 40' LONG AND 18"-24" DBH.
   b. VERTICAL LOGS: 25' LONG AND 16" DBH.

SALVAGED TREE

3. SALVAGED TREE INCLUDES OWNER-IDENTIFIED TREES RANGING BETWEEN 12" AND 38" DBH REMOVED FROM ACCESS ROUTES, STAGING/STOCKPILE AREAS, AND EXCAVATION AREAS.

SLASH

4. SLASH WILL BE CREATED AND SALVAGED FROM THE DEVELOPMENT OF ACCESS ROUTES AND EXCAVATION AREAS. SALVAGED SLASH MATIERAL INCLUDES: SHRUBS, TREES <12" DBH AND TREE TOPS REMOVED FROM ACCESS ROUTES AND EXCAVATION AREAS.

BOLTED CONNECTIONS

5. PRE-APPROVED MATERIALS FOR BOLTED CONNECTIONS ARE AS FOLLOWS:
   a. BOLTS
   a.a. BOLTS SHALL BE A MINIMUM OF 1" DIAMETER NON-GLAVANIZED ASTM A615 GRADE 75 STEEL THREADBAR (EQUIVALENT TO A #8 SIZE BAR) OR,
   a.b. BOLTS SHALL BE A MINIMUM OF 1" DIAMETER NON-GALVANIZED FULLY THREADED ROD (FTR) MEETING THE REQUIREMENTS OF ASTM F1554, GRADE 55 STEEL.
   b. WASHERS AND NUTS
   b.a. WASHERS SHALL BE SQUARE PLATE, 3/16" X 3" X 3" MINIMUM, OR ROUND WITH A DIAMETER OF 3.5"
   b.b. NUTS SHALL BE DOMED OR HEAVY HEX WITH MATERIAL PROPERTIES EQUIVALENT TO OR STRONGER THAN THE BOLTS.

CONSTRUCTION REQUIREMENTS

1. LOCATIONS FOR PLACEMENT AND DETAILS OF CONSTRUCTION FOR EACH STRUCTURE TYPE ARE SHOWN IN THE DRAWINGS. FINAL LOCATION AND INSTALLATION WILL DEPEND UPON THE SIZE, SHAPE AND QUANTITY OF MATERIAL DELIVERED OR SALVAGED. INSTALLATION OF LWM SHALL BE UNDERSTOOD TO REQUIRE A "FIT IN THE FIELD" APPROACH AS DIRECTED BY THE OWNER. LWM SHALL BE STABILIZED BY PARTIAL BURIAL, BRACING AGAINST VERTICAL LOGS AND BRACING AGAINST EXISTING TREES OR BOULDERS AS SHOWN IN THE DRAWINGS.

2. CONSTRUCTION OF VERTICAL LOGS SHALL INCLUDE ON-SITE MOVEMENT AND INSTALLATION OF VERTICAL LOGS AT DESIGNATED SITES SHOWN IN THE DRAWINGS. VERTICAL LOGS SHALL BE PER THE APPROXIMATE NUMBERS AND QUANTITIES INDICATED ON THE DRAWINGS. SPECIFIC LOCATIONS SHALL BE DETERMINED IN THE FIELD AND AS DIRECTED BY THE OWNER'S REPRESENTATIVE. THE REQUIRED EMBEDMENT DEPTH IS INDICATED ON THE DRAWINGS.

3. VERTICAL LOGS SHALL BE INSTALLED BY VIBRATORY PILE DRIVER MEETING OR EXCEEDING THE FOLLOWING CHARACTERISTICS:
   i. MINIMUM OF 800 KN (80 TONS) OF CENTRIFUGAL FORCE.
   j. SIDE GRIP WITH MINIMUM 16" SPACE BETWEEN ENDS OF JAWS SO THAT 16" DIAMETER LOG WILL FIT INTO THE JAWS WITHOUT NEEDING TO SLIDE THE GRIP OVER THE END AND DOWN THE LOG.
   k. PRE-APPROVED PILE DRIVERS INCLUDE: MOVAX SP-80, GRIZZLY MG90, OR EQUIVALENT.

4. THE CHANNEL SUBSTRATE IS KNOWN TO CONTAIN LARGE BOULDERS AND THE PREFERRED METHOD OF INSTALLING VERTICAL LOGS BY VIBRATORY PILE DRIVER MAY NOT BE FEASIBLE IN ALL LOCATIONS. IN THE EVENT THAT INSTALLATION BY VIBRATORY PILE DRIVER IS DETERMINED INFEASIBLE, INSTALLATION OF VERTICAL LOGS BY EXCAVATION MAY ALSO BE REQUIRED AS DESCRIBED IN THE DRAWINGS ON SHEET ##.
   a. INSTALLATION OF VERTICAL LOGS BY EXCAVATION WILL REQUIRE ADDITIONAL BOLTED CONNECTIONS, AS INDICATED IN THE DRAWINGS ON SHEET ##.

5. SLASH SHALL BE INCORPORATED INTO LARGE WOOD STRUCTURES AS SHOWN IN THE DRAWINGS AND AS DIRECTED BY THE OWNER. SLASH WILL BE STACKED AND RACKED AGAINST INSTALLED LWM AND VERTICAL LOGS TO EMULATE NATURAL ACCUMULATIONS OF WOOD MATERIAL.

6. SALVAGED TREE: ANY TREES CLEARED FOR ACCESS OR ALREADY DOWNED TREES IMMEDIATELY ADJACENT TO CONSTRUCTION SITE AND REQUIRING MOVEMENT FOR SITE ACCESS MAY BE INCORPORATED INTO A LARGE WOOD STRUCTURE, AS DIRECTED BY THE OWNER. SALVAGED TREE TOPS MAY BE USED AS SLASH. AT A MINIMUM, THE NUMBER OF SALVAGED TREES INDICATED ON THE DRAWINGS SHALL BE INCORPORATED INTO EACH OF THE LARGE WOOD STRUCTURES.

7. WHERE PARTIAL BURIAL OF LWM IS REQUIRED, EXCAVATE TO SUBGRADE AND STOCKPILE MATERIAL WITHIN THE DESIGNATED DISTURBANCE AREA. SORT MATERIALS BY GENERAL SIZES, SEPARATING PILES FOR COARSE AND FINE MATERIAL. BACKFILL THE LWM AS EACH LAYER IS INSTALLED. USE COARSE FILL ALONG EXTERIOR OF FILL ZONE AND ALONG WATERWARD EDGE, AND FINER MATERIALS WITHIN INTERIOR OF FILL ZONE. WHERE POOL EXCAVATION IS INCLUDED, EXCAVATED MATERIAL SHALL BE SALVAGED AND PLACED AS BACKFILL IN LWM STRUCTURE. A CULTURAL STAFF PERSON WILL BE PRESENT ON SITE DURING ALL EXCAVATION ACTIVITIES.

8. BOLTED CONNECTIONS SHALL BE INSTALLED FOR LARGE WOOD STRUCTURES CONTAINING VERTICAL LOGS. BOLTED CONNECTIONS SHALL BE INSTALLED PER DRAWINGS.

9. AT PROJECT COMPLETION, CONTRACTOR SHALL RESTORE THE LWM STAGING AREA BY REMOVING DEBRIS AND GRADING SMOOTH AND BLENDING TO EXISTING TOPOGRAPHY, AS DIRECTED BY THE OWNER.

QUALITY CONTROL

1. AT EACH LARGE WOOD STRUCTURE SITE CONTAINING VERTICAL LOGS, VERTICAL LOGS SHALL BE TESTED FOR PULLOUT RESISTANCE IN ACCORDANCE WITH THE DETAILS ON SHEET 17.
2. THE CONTRACTOR SHALL PROVIDE THE TENSION LINK, METER, AND ASSOCIATED HARDWARE (RATED 12 TON).
3. A MINIMUM PULLOUT RESISTANCE AT THE MINIMUM EMBEDMENT DEPTH OF 10,000 LB IS REQUIRED. IF THESE CRITERIA ARE NOT MET, THE FOLLOWING ADDITIONAL STABILITY MEASURES SHALL BE IMPLEMENTED:
   3.1. INCREASING THE NUMBER OF VERTICAL LOGS REQUIRING TESTING IN ACCORDANCE WITH THE DETAILS ON SHEET 17.
   3.2. ADDING ADDITIONAL BOLTED CONNECTIONS IN ACCORDANCE WITH THE REQUIREMENTS FOR VERTICAL LOGS INSTALLED BY EXCAVATION SHOWN ON SHEET 17.

MEASUREMENT AND PAYMENT

MEASUREMENT AND PAYMENT SHALL BE MADE AS A LUMP SUM PER EACH STRUCTURE FOR:

ITEM 005 - BANK-BURIED STRUCTURES B1 THROUGH B7
ITEM 006 - APEX NARROW LW STRUCTURE A1
ITEM 007 - APEX LW STRUCTURE A2
ITEM 008 - SIDE CHANNEL CONFLUENCE LW STRUCTURE SC1

THE CONTRACT PRICE FOR "LARGE WOOD STRUCTURE" SHALL BE FULL COMPENSATION FOR ALL COSTS INCURRED FOR EQUIPMENT, MATERIALS AND LABOR FOR HANDLING, LOADING AND HAULING LWM FROM STOCKPILE AREAS, EXCAVATING TO SUBGRADE, SELECTIVE HANDLING OF EXCAVATED MATERIALS AND BACKFILL, INSTALLING AND SECURING LWM, VERTICAL LOGS, SLASH AND SALVAGED TREES AND INSTALLING LIVE STAKES AS OUTLINED IN THE DRAWINGS. QUALITY CONTROL TESTING, EARTHWORK, AND INSTALLING SLASH AND SALVAGED TREES SHALL BE INCIDENTAL TO "LARGE WOOD STRUCTURES".

ITEM 009 EARTHWORKS

EARTHWORKS SHALL CONSIST OF EXCAVATING, LOADING AND HAULING SPOILS TO SPECIFIED ON-SITE DISPOSAL AREA AND GRADING TO BLEND TO EXISTING CONTOURS. SPECIFIC LOCATION AND GRADING SHALL BE AS INDICATED IN PLANS.

1. OWNER'S REPRESENTATIVE WILL FLAG IN THE FIELD THE ALIGNMENT OF SIDE CHANNELS FOR EXCAVATION. CONTRACTOR SHALL PROVIDE SURVEY EQUIPMENT AND CONDUCT STAKEOUT AND SURVEY TO DETERMINE ELEVATIONS. EXISTING ELEVATION CONTROL POINTS ARE LOCATED NEARBY.
2. PORTIONS OF WORK MAY BE IN WATER. THE CONTRACTOR IS ADVISED THAT GROUNDWATER MAY BE ENCOUNTERED THROUGHOUT EXCAVATION AREAS. PUMPING AND TESC SHALL BE IMPLEMENTED AS NECESSARY.
3. THIS ITEM INCLUDES HAULING OF MATERIAL EXCAVATED TO DESIGNATED DISPOSAL AREAS. EXCAVATED MATERIAL MAY BE REQUIRED AS SALVAGED BACKFILL IN STRUCTURES.
4. THIS ITEM INCLUDES DETAIL GRADING TO SHAPE THE CHANNEL AS SHOWN IN THE PLANS, SCOUR POOLS SHALL BE OVER-EXCAVATED INTO THE STREAM BED AS DESIGNATED IN THE PLANS AND DETAILS.
5. NO WORK SHALL OCCUR OUTSIDE OF THE LIMITS OF DISTURBANCE SHOWN IN THE PLANS UNLESS AUTHORIZED BY THE OWNER.

MEASUREMENT AND PAYMENT

EARTHWORKS WILL BE MEASURED BY CUBIC YARDS OF EXCAVATION AND PLACEMENT. MEASUREMENTS SHALL BE IN PLACE QUANTITY BY COMPARISON OF PRE-PROJECT (EXISTING) TOPOGRAPHY, SUBGRADE AND DESIGN (FINISHED GRADE) TOPOGRAPHY.

MEASUREMENT AND PAYMENT

EXCAVATION, HAUL, DISPOSAL, GRADING OF DISPOSED SPOILS, FORMING OF CHANNEL FEATURES; NO ADDITIONAL COMPENSATION WILL BE MADE FOR EXCAVATED MATERIAL THAT IS OVER EXCAVATED OR STOCKPILED, RE-EXCAVATED, AND MOVED AGAIN.

PAYMENT SHALL BE CONSIDERED FULL COMPENSATION FOR ALL EQUIPMENT, LABOR, TOOLS, ATERIALS, AND INCIDENTALS NECESSARY TO COMPLETE THIS WORK AS SPECIFIED.

DRAFT

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PROJECT AREA D
60% DESIGN

Preliminary
Not for Construction

CM
DRAWN

LS,JB,CS
ACCEPTED

BOISE, ID AUGUST 2025

SPECIFICATIONS (2 OF 2)

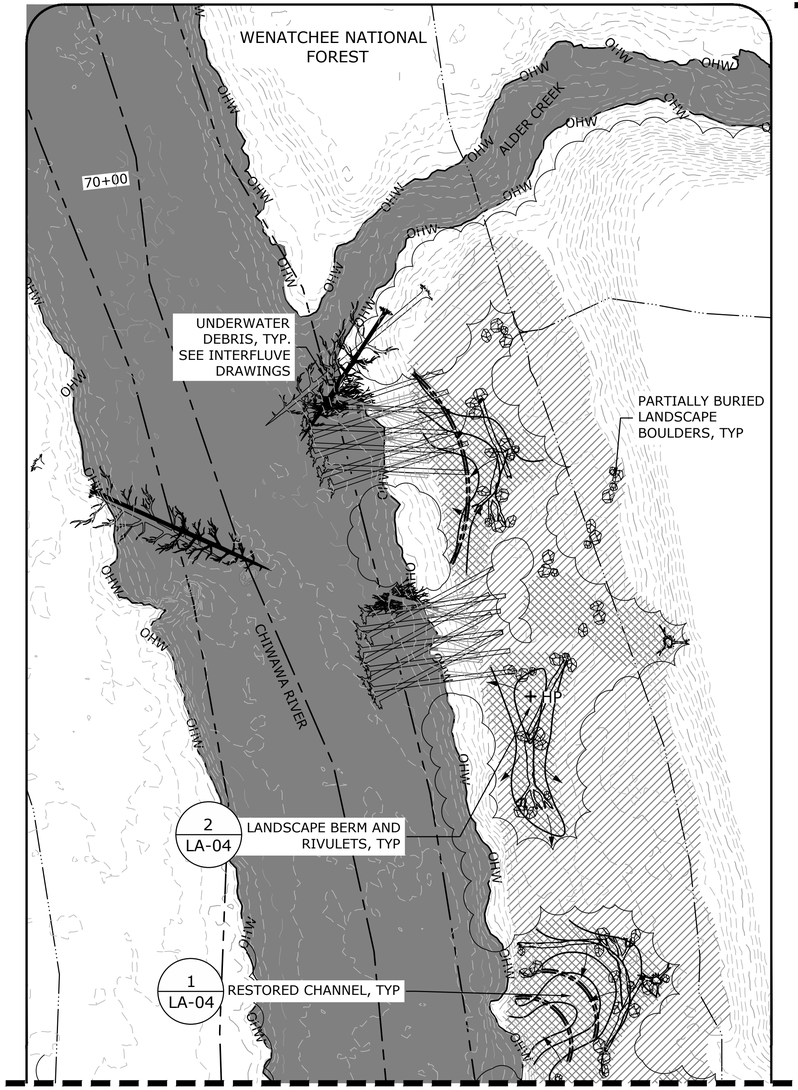
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SHEET 21 OF 21

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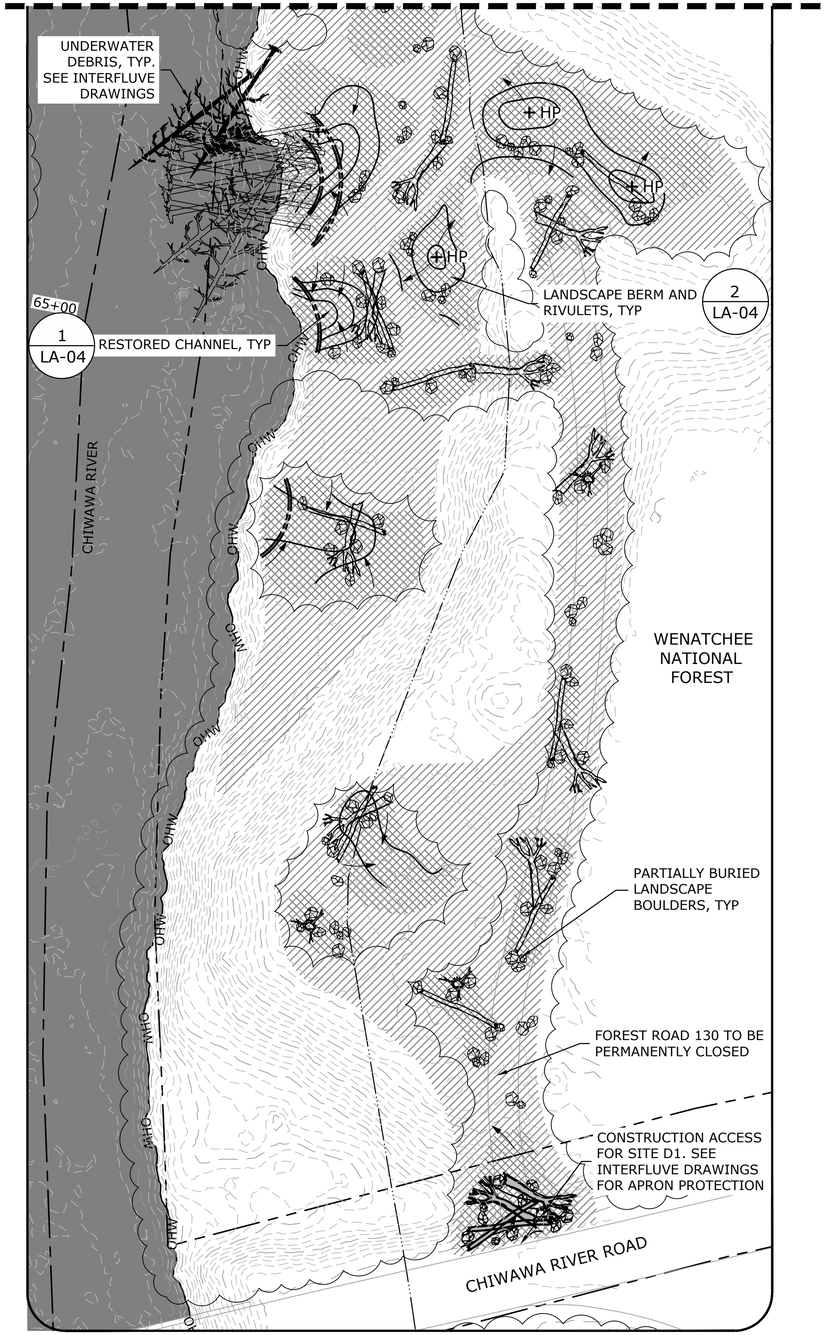
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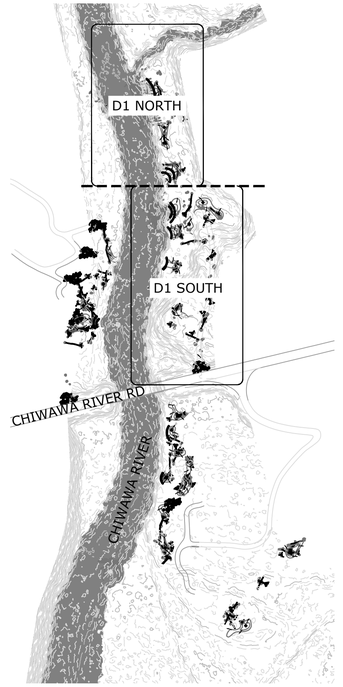


D1 SOUTH

LANDSCAPE LEGEND

- NATIVE RESTORATION MIX 1
- NATIVE RESTORATION MIX 2
- 150' ROAD SETBACK
- 150' WETLAND BUFFER
- 100' STREAM BUFFER
- EXISTING CONTOURS (5')
- EXISTING CONTOURS (1')
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- RIVER ALIGNMENT
- OHW — ORDINARY HIGH WATER
- WILLOW FASCINES FOR EROSION CONTROL
- SLOPE DIRECTION OF REGRADED AREAS
- +HP — HIGH POINT OF BERMS
- RECLAIMED LOGS AND ON-SITE WOODY DEBRIS
- FALLEN LOG AND ROOTWAD BARRIER (3 / LA-04)

KEY MAP



0 30' 60'

PLAN SCALE IN FEET (AS SHOWN ON 22" X 34" SHEET)

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LOWER CHIWAWA RIVER RESTORATION

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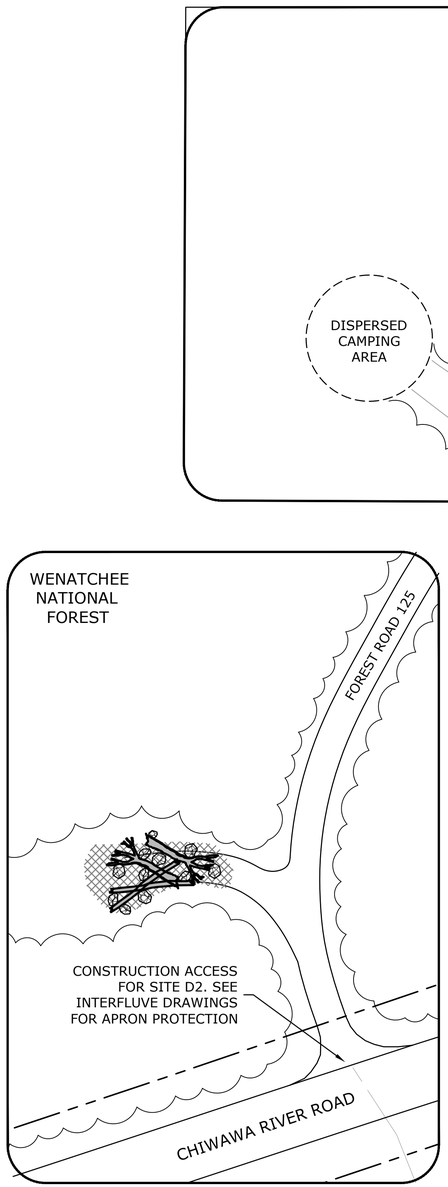
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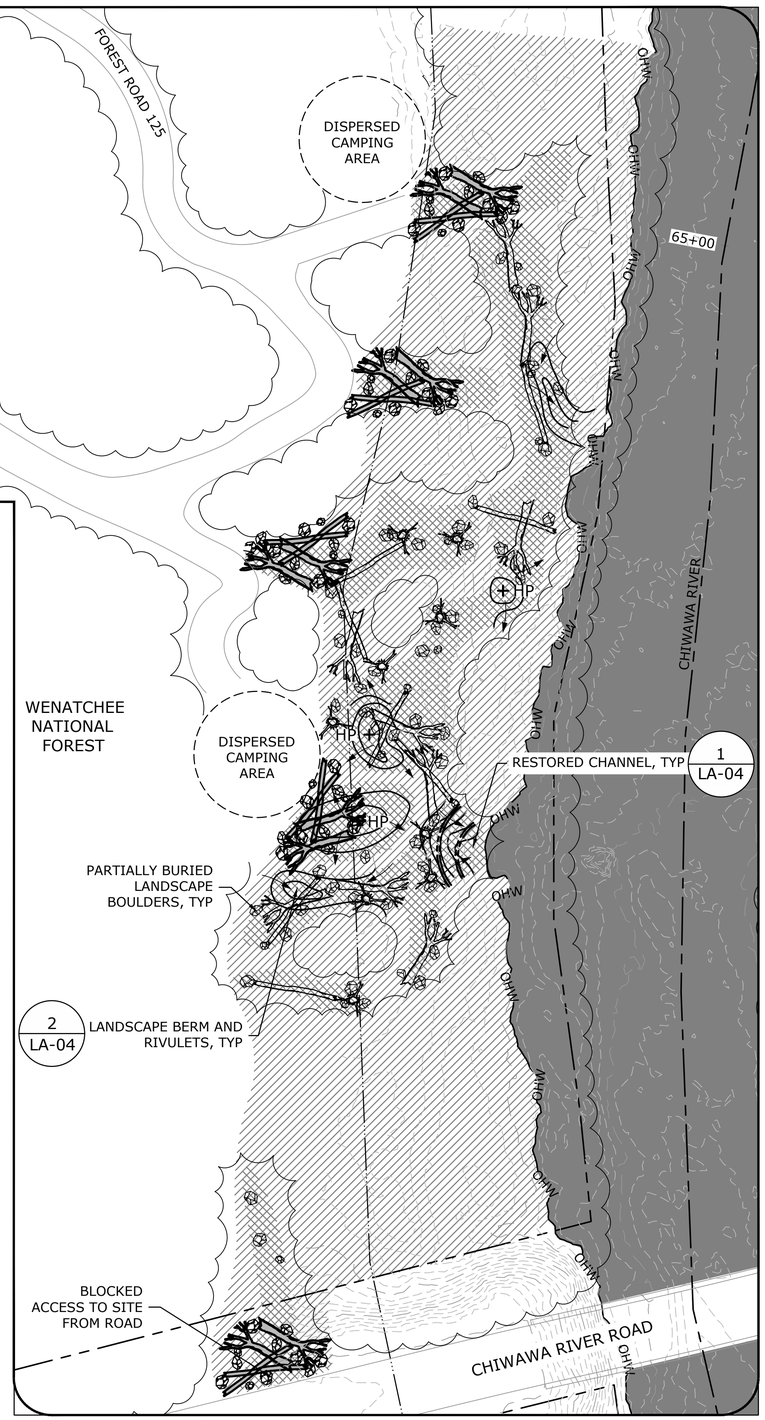
AREA D-1
RECOMMENDATIONS

LA-01

1 OF 4



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D2 - EAST

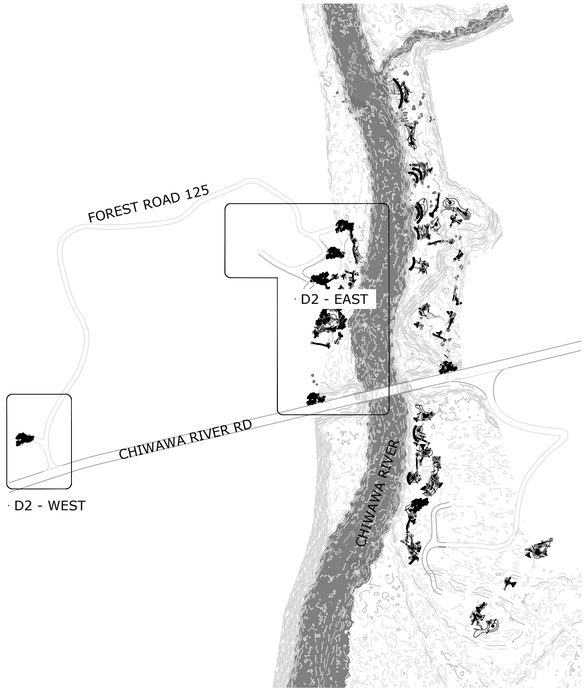
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KEY MAP



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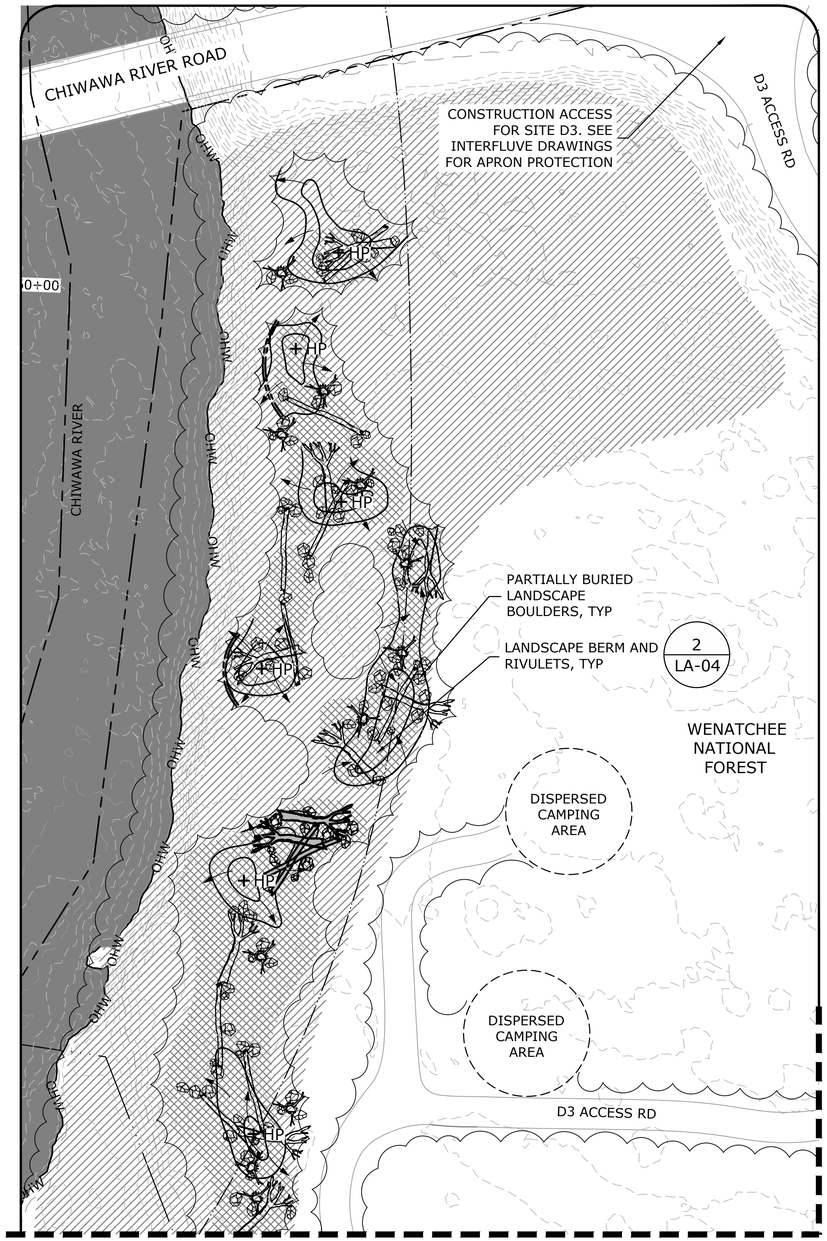
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LA-02
2 OF 4

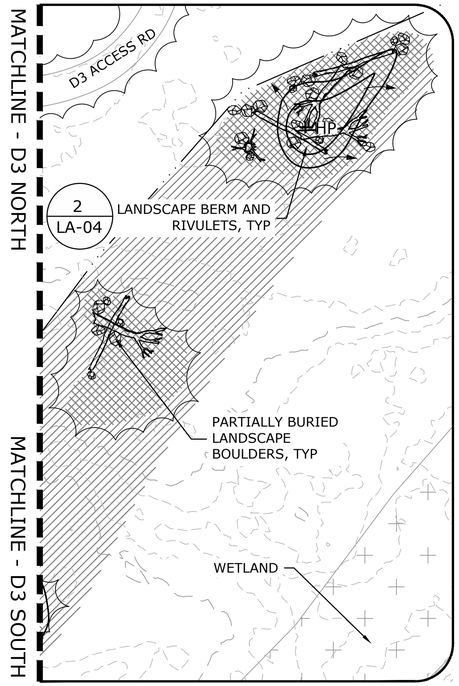
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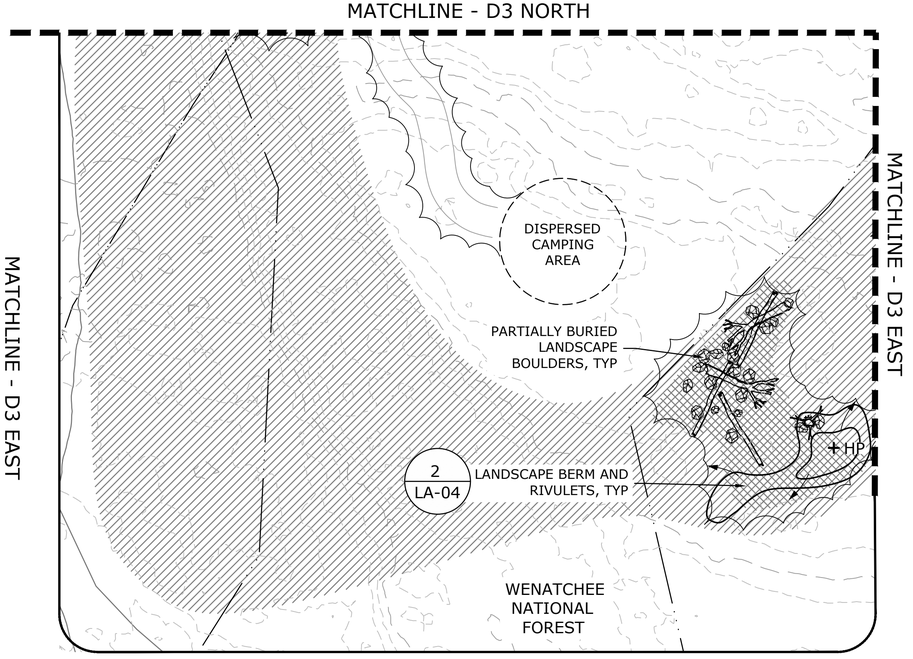
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LANDSCAPE LEGEND

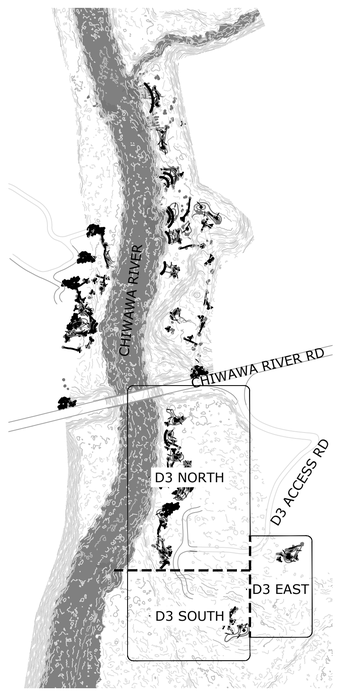
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MATCHLINE - D3 NORTH



D3 SOUTH

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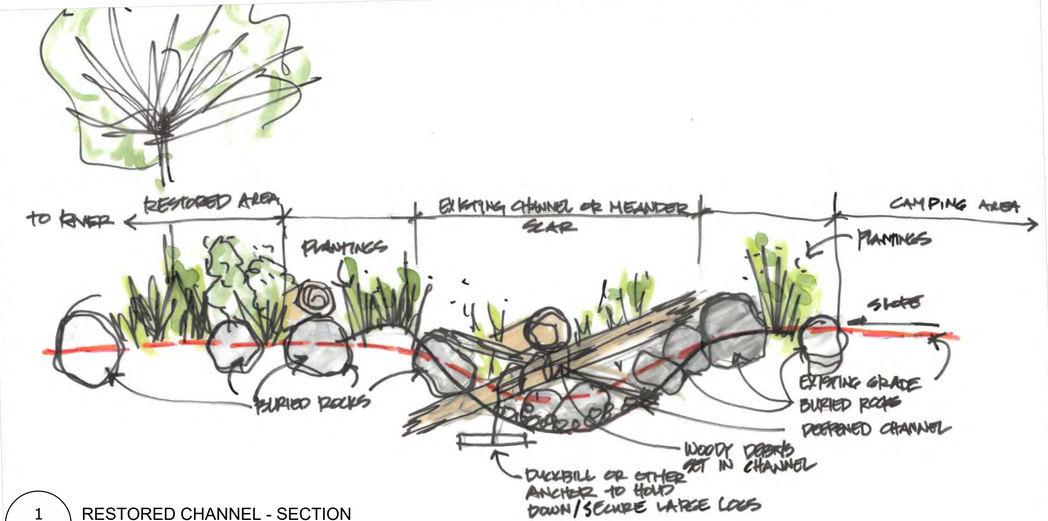
WENATCHEE, WA SEPTEMBER 2024

AREA D-3 RECOMMENDATIONS

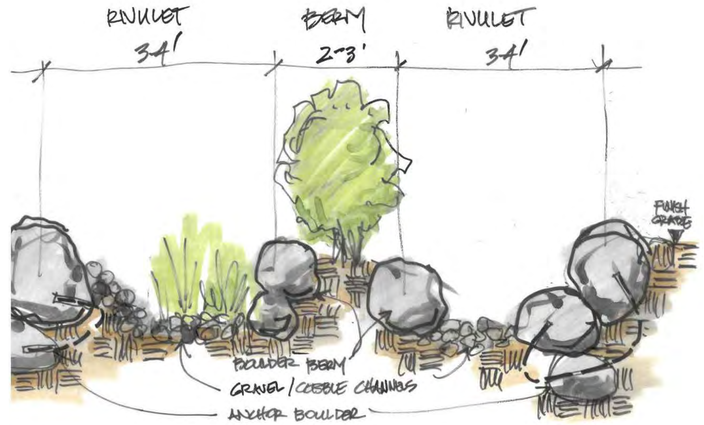
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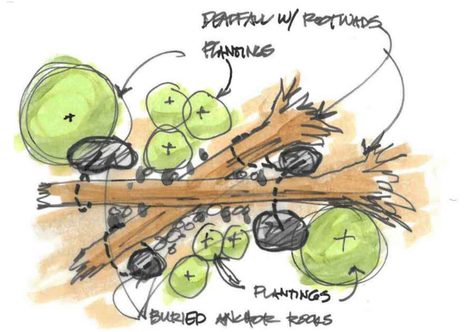
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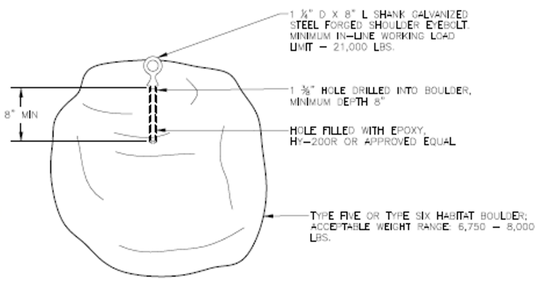
1 LA-04 RESTORED CHANNEL - SECTION



2 LA-04 LANDSCAPE BERM AND RIVULETS - SECTION



3 LA-04 DEADFALL ANCHORING TO BOULDERS - PLAN VIEW



DEADFALL ANCHORING TO BOULDERS - SECTION

LANDSCAPE NOTES:

SITE CLEARING AND EROSION CONTROL

CAREFULLY REMOVE INVASIVE PLANT SPECIES, INCLUDING ROOTS, TO PREVENT RE-ESTABLISHMENT. FOLLOW APPROVED METHODS FOR INVASIVE SPECIES REMOVAL, SUCH AS HAND-PULLING OR TARGETED HERBICIDE APPLICATION BY A CERTIFIED APPLICATOR.

CLEAR DEAD OR DOWNED NON-NATIVE PLANT MATERIAL, LITTER, AND DEBRIS FROM THE RESTORATION AREA. RETAIN NATIVE WOODY DEBRIS AND DEADFALL THAT CAN PROVIDE HABITAT, STABILIZE SOIL AND CREATE BARRIERS FOR VEHICULAR MOVEMENT THROUGH THE SITE(S).

INSTALL TEMPORARY EROSION CONTROL MEASURES, SUCH AS SILT FENCES, COIR LOGS, OR STRAW WATTLES, ALONG SLOPES, STREAMS, AND SENSITIVE AREAS PRIOR TO ANY SOIL DISTURBANCE TO PREVENT SEDIMENT RUNOFF.

SEE INTERFLUVE'S PLANS, NOTES, AND SPECIFICATIONS FOR INSTALLING COIR LOGS OR FASCINES ALONG STREAMBANKS TO STABILIZE SOIL AND REDUCE EROSION POTENTIAL.

FOR STEEPER SLOPES, USE A COMBINATION OF COIR LOGS AND LIVE STAKING (E.G., WILLOW STAKES) TO ESTABLISH NATURAL STABILIZATION AND RAPID REVEGETATION. SEE PLANS FOR AREAS.

AVOID WORKING IN THE STREAM DURING SPAWNING SEASON OR SENSITIVE PERIODS FOR AQUATIC WILDLIFE. FOLLOW ALL LOCAL AND STATE REGULATIONS REGARDING IN-STREAM WORK TIMING.

NATIVE PLANT PROTECTION

FLAG AND PROTECT EXISTING NATIVE TREES, SHRUBS, AND ANY AREAS WITH ESTABLISHED NATIVE VEGETATION. LIMIT DISTURBANCE TO THESE AREAS TO PRESERVE NATURAL HABITATS AND SOIL STRUCTURE.

SET UP EXCLUSION ZONES AROUND LARGE TREES OR AREAS WITH SENSITIVE ROOT ZONES TO PREVENT DAMAGE DURING REMOVAL OR GRADING ACTIVITIES.

EQUIPMENT ACCESS AND STAGING

REFER TO INTERFLUVE"S GENERAL NOTES AND SPECIFICATIONS FOR EQUIPMENT ACCESS AND STAGING.

SOIL PREPARATION

LOOSEN COMPACTED SOILS BY SCARIFYING OR TILLING TO A DEPTH OF 6-12 INCHES WHERE FEASIBLE, TYPICALLY OUTSIDE OF EXISTING TREE DRIPLINES, AND ESPECIALLY IN AREAS DESIGNATED FOR PLANTING. AVOID OVER-TILLING TO MINIMIZE DISRUPTION TO SOIL STRUCTURE.

AVOID OPERATING HEAVY EQUIPMENT NEAR ESTABLISHED ROOT ZONES, TYPICALLY UNDERNEATH DRIPLINES.

INCORPORATE ORGANIC MULCH OR COMPOST INTO SOIL IF RECOMMENDED BY SOIL TESTING TO IMPROVE SOIL FERTILITY AND MOISTURE RETENTION.

WEED AND INVASIVE SPECIES MANAGEMENT

CONDUCT A THOROUGH WEED CONTROL PHASE. USE APPROVED HERBICIDES FOR DIFFICULT-TO-REMOVE SPECIES OR REMOVE BY HAND AS APPROPRIATE.

FOR AREAS HEAVILY IMPACTED BY INVASIVE SPECIES, CONSIDER A FALL AND SPRING CONTROL EFFORT BEFORE SEEDING OR PLANTING.

GRADE THE SOIL TO CREATE MICRO-TOPOGRAPHIES THAT MIMIC NATURAL RIPARIAN CONTOURS, INCLUDING SLIGHT DEPRESSIONS TO RETAIN MOISTURE IN PLANTING AREAS.

ENSURE SLOPES ARE STABLE WITH GENTLE TRANSITIONS TO REDUCE EROSION POTENTIAL. AVOID SHARP GRADES OR ABRUPT CHANGES THAT COULD LEAD TO SOIL EROSION.

INSTALL BIODEGRADABLE EROSION CONTROL FABRIC, COIR MATS, OR STRAW BLANKETS ON STEEP SLOPES OR AREAS PRONE TO EROSION, SECURING THEM WITH STAKES OR LANDSCAPE STAPLES. AVOID USING PLASTIC NETTING THAT CAN ENTANGLE WILDLIFE.

LEAVE OPENINGS IN EROSION CONTROL FABRIC FOR PLANTING LOCATIONS, ENSURING GOOD SOIL CONTACT TO PROMOTE SEED GERMINATION AND PLANT ESTABLISHMENT.

SEEDING

TIMING: SEED DURING EARLY FALL OR SPRING TO TAKE ADVANTAGE OF NATURAL RAINFALL. FALL SEEDING IS PREFERRED FOR COOL-SEASON GRASSES AND NATIVE SPECIES.

METHOD: APPLY SEED EVENLY USING A BROADCAST SEEDER, AND LIGHTLY RAKE OR ROLL THE AREA TO ENSURE GOOD SEED-TO-SOIL CONTACT.

MULCHING: SPREAD A THIN LAYER OF WEED-FREE STRAW MULCH (AROUND 2,000 LBS/ACRE) TO RETAIN SOIL MOISTURE AND PROTECT SEED FROM EROSION AND BIRDS.

EROSION CONTROL (IF HYDROSEEDING): IN HIGH EROSION AREAS, CONSIDER HYDROSEEDING WITH A SEED-MULCH-TACKIFIER MIX TO SECURE SEEDS IN PLACE.

FOR RESTORATION MIX #1:

EAST SLOPE CASCADE MIX:

- 20% BLUE WILDRYE
- 20% BLUEBUNCH WHEATGRASS
- 20% IDAHO FESCUE
- 20% MOUNTAIN BROME
- 10% PRAIRIE JUNEGRASS
- 10% SANDBERG BLUEGRASS

FOR RESTORATION MIX #2:

EAST SLOPE CASCADE MIX:

- 35% BLUE WILDRYE
- 30% CALIFORNIA BROME
- 10% PRAIRIE JUNEGRASS
- 20% ROEMER'S FESCUE
- 5% WESTERN MANNAGRASS

PLANTING (SHRUBS, TREES, AND FORBS)

SPACING: PLANT SHRUBS AND TREES IN CLUSTERS TO MIMIC NATURAL RIPARIAN HABITATS. SPACE PLANTS ACCORDING TO SPECIES RECOMMENDATIONS, GENERALLY 3-6 FEET FOR SHRUBS AND 10-15 FEET FOR TREES.

PLANTING DEPTH: DIG PLANTING HOLES TWICE THE WIDTH OF ROOT BALLS AND PLANT AT THE SAME DEPTH AS IN NURSERY POTS. ENSURE ROOTS ARE NOT TWISTED OR CONSTRICTED.

WATERING: WATER DEEPLY AFTER PLANTING TO ENSURE SOIL SETTLES AROUND ROOTS AND PLANTS ESTABLISH PROPERLY. IF FEASIBLE, PROVIDE SUPPLEMENTAL WATER DURING THE FIRST GROWING SEASON IF RAINFALL IS INSUFFICIENT.

POTENTIAL FORBS TO INCLUDE WITH THE RESTORATION MIXES:

- ERIOPHYLLUM LANATUM
- ERIOGONUM NIVEUM
- ACHILLEA MILLEFOLIUM
- LOMATIUM DISSECTUM
- ANAPHALIS MARGARITACEA

MULCHING AND PROTECTION

MULCH: APPLY A 2-3 INCH LAYER OF COARSE BARK MULCH AROUND EACH PLANT TO RETAIN MOISTURE, SUPPRESS WEEDS, AND MODERATE SOIL TEMPERATURE. KEEP MULCH 1-2 INCHES AWAY FROM PLANT STEMS TO PREVENT ROT.

TREE GUARDS AND PLANT PROTECTORS: INSTALL TREE GUARDS OR PLANT PROTECTORS AROUND YOUNG PLANTS TO PREVENT DAMAGE FROM WILDLIFE, IF BROWSING PRESSURE IS HIGH.

BUREAU OF RECLAMATION

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ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

LOWER CHIWAWA RIVER RESTORATION

Draft
Not for Construction

JG
DRAWN

CO
ACCEPTED

WENATCHEE, WA SEPTEMBER 2024

SITE DETAILS & NOTES

LA-04

4 OF 4

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CAD SYSTEM
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Appendix F | CCDNR Lower Chiwawa Area D Recreation Site Management Analysis & Recommendations



CCDNR Lower Chiwawa River Area D

Recreation Site Management Analysis & Recommendations

2023-2024 Technical Memo

Prepared For:
Chelan County Natural Resource Department

Prepared By:
SCJ Alliance

March 2024

SCJ ALLIANCE
CONSULTING SERVICES

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1 Introduction & Purpose

The Chelan County Natural Resource Department (CCNRD) in conjunction with the US Forest Service, Wenatchee River Ranger District (USFS), the Bureau of Reclamation (BOR) and Washington Recreation and Conservation Office (RCO) aims to address identified habitat limitations affecting high- and medium-priority spring Chinook, steelhead, and bull trout life stages in Reach 4 (RM 5.5-7.1) of the Lower Chiwawa River. The Chiwawa River is a tributary to the Wenatchee River in Chelan County, Washington. Covering over 188 square miles in the Cascade Mountains. The project area spans a subset of the Lower Chiwawa River, starting from the confluence of the Chiwawa River with Goose Creek at the downstream end to its confluence with Alder Creek at the upstream end. (Interfluve, 2023)

The holistic project assessment will systematically evaluate various parameters, encompassing holding/maturation, summer rearing, winter rearing, and fry colonization of aquatic life. Additionally, a detailed examination of ecological and habitat aspects, including In-stream Cover (wood), Floodplain Connectivity, Off-channel Side-channels, Temperature (rearing), Riparian Canopy Cover, and Wetland Delineation Boundaries, will be undertaken.

The specific objective of this individual technical memorandum is to methodically inventory, assess, and subsequently present a series of recommendations aimed at optimizing the management of recreation assets within the designated project study area. These efforts are intricately aligned with the overarching restoration goals and objectives of the project, emphasizing a technical and systematic approach to the assessment process.

PROJECT PURPOSE: Inventory dispersed camping use within the study area, assess the impacts of day use, understand current site management guidelines, and understand how these factors impact riparian upland restoration performance associated with current ongoing stream access for recreational camping users. Eventual plans to include preliminary restoration design (60%), and stakeholder consultation.

PROJECT SUMMARY:

Project Name: Lower Chiwawa River Area D Study
Study Applicant: Chelan County Natural Resource Department
Location: 9 miles north of Plain, WA
Legal Description: Sec. 13, T27N, R17E Lat. 47.66329 °, Long. -120.67842°
State: Washington
County: Chelan

SITE DESCRIPTION: The Lower Chiwawa River Area D Project Site is located just upstream of the town of Plain, WA. Area D extends upstream from the river's confluence with Goose Creek at ~RM 6.0 to its confluence with Alder Creek at ~RM 7.25. It includes the river channel and adjacent lands on both sides of the river. (Interfluve WDR, 2023) See Figure 1 for the Project Location Map.



Figure 1- Location Map of Upper Wenatchee Pilot Project Area w/ Lower Area D Boundary

This area is located upstream and downstream of the Chiwawa River Road bridge and includes three areas that are used extensively for dispersed camping within the vicinity of the bridge. One upstream on the river's left (D1), one upstream on the river's right (D2), and one downstream on the river's left (D3). See Figure 2 on the next page.) Additionally, there are several developed campgrounds nearby that

contribute to a wider variety of camping options. See section 6, *Dispersed Camping in the Chiwawa River Valley,* for a full inventory of existing campgrounds and adjacent trailheads.

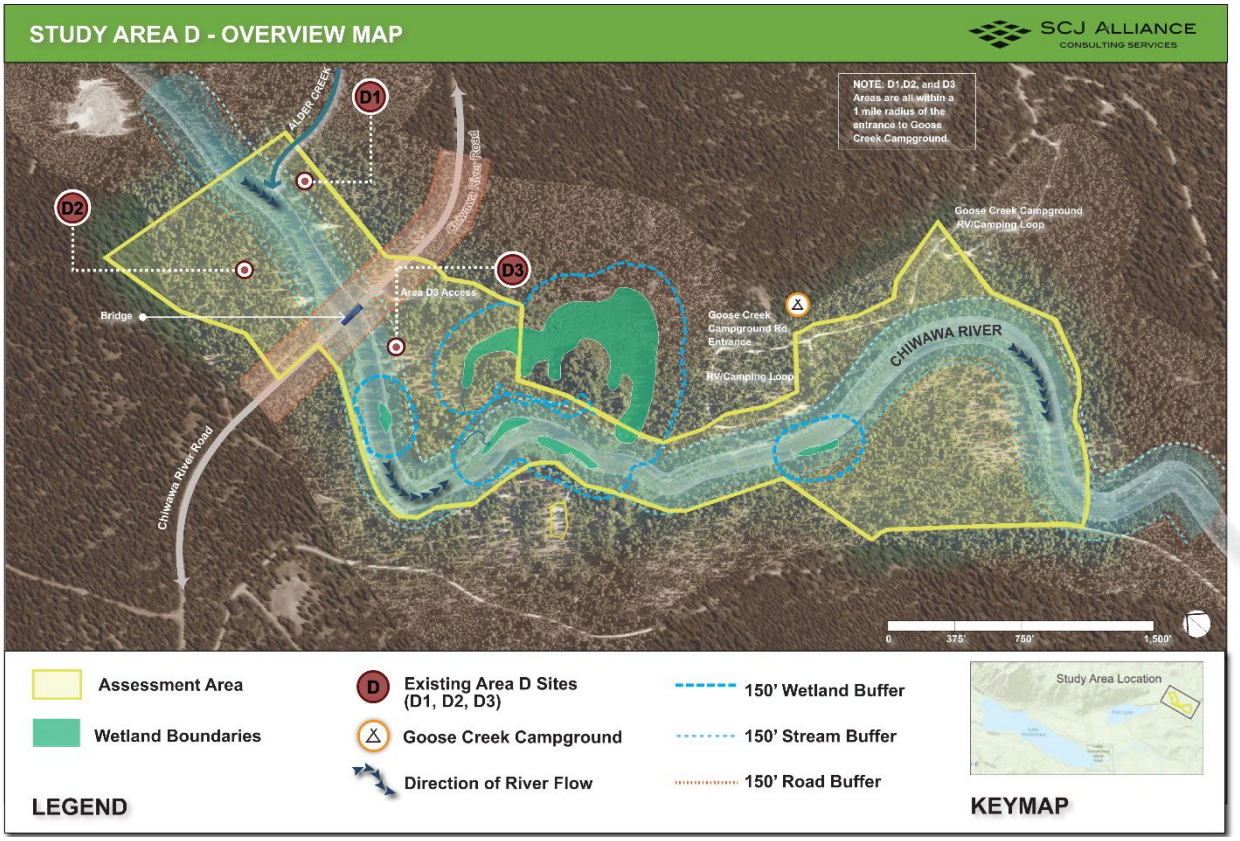


Figure 2 - Study Area D Overview Map



Figure 3 – Representative Photo at Dispersed Campsite D1

2 Project Objectives

The principal objective of this technical memorandum is to conduct a thorough inventory and assessment of the existing recreational uses within the designated study area. This involves a comprehensive comparison of these uses against established recreational guidelines and best practices. Subsequently, the aim is to formulate a structured framework of recommendations for the enhancement of recreational management within the study area to present to the landowner (USFS) as an integral component of restoration focused on improving aquatic, wetland, riparian, and upland habitats in Area D. This process and its results will be incorporated into conceptual and preliminary designs for stream restoration being developed by InterFluve, and will take into consideration the results of a cultural resources survey, a wetland delineation, and adherence to relevant regulations.

The proposed interventions are designed to ameliorate conditions along approximately 1.25 miles of the mainstem channel through the strategic placement of engineered log jams. This initiative further includes the creation of up to 0.25 miles of off-channel habitat, enhancement of cold-water refuge at two tributary confluences, and the consolidation/reduction of dispersed camping. Concurrently, the project entails the decommissioning of approximately 1,000 linear feet of forest roads and the improvement of vegetation within around 25 acres of riparian habitat. This multifaceted approach aims to address various environmental concerns while aligning with the broader restoration goals outlined by CCNRD and project partners.

Additional Project Goals:

- Address dispersed camping, day use, riparian, and upland restoration issues as a key focus, necessitating the formulation of comprehensive recommendations for mitigation and restoration.

- Propose natural-appearing landscape solutions to better direct dispersed camping and day-use flow and patterns. The objective is to limit impacts to acceptable levels while still facilitating recreational access to river shores, viewpoints, and primitive camping facilities.
- Minimize the potential for future impacts on riparian and stream resources arising from recreational use of the area.
- Any disturbed, eroded slopes or decommissioned roads will be restored to a natural native condition, aligning with the broader ecological objectives of the project.

3 Assumptions

This memo was developed using the following assumptions:

- USFS does not have staff to manage the dispersed camping areas. Therefore, the proposed recommendations will need to be addressed by landscape-level modifications.
- Recreation use analysis is anecdotal and utilizes USFS staff knowledge and personal observations. Photos and multiple field visits were gathered by SCJ Alliance during several different time frames, including Memorial Day Weekend, as well as two off-season visits.
- Wetland Delineation Report produced by InterFluve was used to determine revegetation and restoration extents, which may or may not have changed.

4 Ongoing & Historical Restoration Influences for the Upper Wenatchee Watershed

The Upper Wenatchee Pilot Project and the ongoing efforts in the Lower Chiwawa Area D Study Area are intricately connected on a macro scale, influencing watershed quality, fish habitat, and recreation needs across the broader landscape.

Since 2017, the Okanogan-Wenatchee National Forest has collaborated with the North Central Washington Forest Health Collaborative partners to develop the Upper Wenatchee Pilot Project. The primary objectives of this project are to restore watershed health and resiliency. This comprehensive initiative involves the reintroduction of fire to the landscape, enhancing wildlife habitat, and improving watershed function across approximately 74,760 acres. Notably, 62,500 acres of this area fall within forest service lands north of Leavenworth in the Upper Wenatchee watershed.

The Upper Wenatchee Pilot Project operates on a landscape scale, addressing aquatic and terrestrial restoration through a range of treatments. These treatments encompass fuels management, road improvements, vegetation enhancements, and aquatic habitat improvements. The strategic and holistic nature of these interventions speaks to the interconnectedness of ecological components within the watershed.

This broader-scale restoration effort in the Upper Wenatchee watershed is significant for several reasons. Firstly, the restoration of watershed health has cascading effects on downstream areas, potentially influencing water quality and ecological processes. Secondly, improvements in wildlife habitat directly impact the biodiversity and ecological balance of the region. Lastly, the enhancement of watershed function contributes to the overall resilience of the ecosystem, potentially mitigating the impacts of environmental stressors.

In the context of the Lower Chiwawa Area D, these macro-scale restoration efforts play a vital role. Watershed quality improvements upstream can positively affect downstream areas, potentially benefiting fish habitat in the Lower Chiwawa River. Additionally, the focus on landscape-scale restoration aligns with the recreation needs of the area, emphasizing a holistic approach that considers both ecological health, recreation demand, and recreational management opportunities. The interconnectedness of these efforts underscores the importance of considering watershed health, fish habitat, and recreation needs holistically for the overall well-being of the ecosystem (USFS, UWPP 2023)

5 Stakeholders & Team Consultants

Key stakeholders and their roles in the project include: **Table 1 – Stakeholders & Team Consultants**

Name	Type/Role
United States Forest Service (USFS) The principal landowner and manager for the study area (all contained within the Wenatchee National Forest.)	Government Agency / Principal Land Owner / Federal Permits
Chelan County Natural Resource Department (CCNRD) Local partner for project management and oversight	Client Contact
Bureau of Reclamation (BOR) Principal agency working with Chelan County to develop enhancement projects for ESA-listed salmon and trout species in the lower section of the Chiwawa River	Government Agency
Washington Department of Fish & Wildlife Principal agency working with Chelan County to develop enhancement projects for ESA-listed salmon and trout species in the lower section of the Chiwawa River.	Government Agency / State wildlife management, Hydraulic Project Approval permit
Salmon Recovery Funding Board Grant source for project funding	Public Commission
Chelan County Public Works Principal agency responsible for public infrastructure, e.g., County roads and bridges	Government Agency
Our Valley, Our Future Local organization involved in protecting access to back country areas of the County	NGO
InterFluve River Restoration & Water Resources Environmental engineering company	Private Company / Restoration Design Lead
ASM Affiliates Cultural resource consulting firm	Private Company / Cultural resources survey and reporting

6 Dispersed or Primitive Camping

Dispersed camping refers to camping outside of designated campgrounds and campsites. In dispersed camping, individuals set up temporary campsites in natural areas, often in national forests or other public lands, aiming to provide outdoor enthusiasts with a more primitive and secluded experience in natural areas, fostering a personal connection with nature away from the crowds often found in developed campgrounds.

The dispersed camping experience emphasizes seclusion, as dispersed camping areas are intended to be less crowded, creating a peaceful environment for individuals to immerse themselves in nature. Campers have the flexibility to choose sites in natural settings like national forests, encouraging a closer connection with the outdoors. Unlike developed campgrounds, dispersed camping requires higher self-sufficiency, with campers responsible for their supplies and minimizing environmental impact, and does not usually provide amenities such as restrooms, fire rings, or picnic tables.

The freedom to choose camp locations within designated areas contributes to a sense of autonomy and adventure. Leave No Trace ethics are emphasized, promoting responsible outdoor recreation and minimizing impact on the environment.

Dispersed camping also encourages the development of primitive skills, such as setting up tents and practicing low-impact techniques. The primary goal is to facilitate a deeper connection with nature, fostering an appreciation for the environment and wildlife.

6.1 Dispersed Camping Rules

Respecting these rules during camping of any kind in the national forests is a crucial factor for environmental conservation. Abiding by these rules helps minimize human impact, preserve natural habitats, and maintain the overall ecological balance of these sensitive ecosystems that are critical for the environment and the relying wildlife habitat. It also ensures a positive outdoor experience for everyone and helps sustain the beauty and biodiversity of national forests for future generations by fostering a sense of care and placemaking.



Specific rules and regulations for dispersed camping vary depending on the specific district or public land manager. Specific guidelines for the Wenatchee National Forest were neither published nor available for this memo and its status is unknown. However, other districts maintain a set of guidelines referencing United States Department of Agriculture (USDA) regulations relating to dispersed camping activities. Each area has slightly different rules, but some of these rules for Mount Baker-Snoqualmie National Forest (FS.USDA.GOV, DCG -2023) could apply, or be modeled to our study area, including:

- Groups of over 75 people who wish to use the forest, need to obtain a special use permit. There is no fee and permits can be obtained at the nearest District Office.
- You need to be self-contained for dispersed camping. No amenities are provided, such as water, restrooms, or trash cans.
- You may camp in a dispersed area for up to 16 days. After 16 days, you must move at least 5 road miles to camp in another dispersed area. Campers may not spend more than 16 days of any 30-day period in the same dispersed area.
- Keep a Pack-In Pack-Out camp. Follow Leave No Trace guidelines.
- Contact the local Forest Service office to see if any restrictions, especially fire restrictions, are in place. Follow all restrictions.
- Camp on bare soil, if possible, to avoid damage or killing plants and grass.
- Do NOT camp within 150 feet of any stream, wetland or water source, plants near water are especially fragile.
- Do not camp in the middle of a clearing or meadow; try to make your campsite less visible so that other visitors will see a "wild" setting.
- Do not try to level or dig trenches in the ground at your campsite. Pick a tent site that is already level with good drainage.
- Dispersed camping means no bathrooms and no outhouses. That means extra care has to be taken in disposing of human waste. To dispose of feces, dig a hole six (6) inches deep at least 150 feet away from any water source or wetlands. When you are done, fill the hole with the dirt you dug up and take your toilet paper with you to dispose of in a proper waste container. Never defecate or leave toilet paper on top of the ground. It could easily get into the local water source and contaminate it. (FS.USDA.GOV – 2023)
- Dispersed camping is generally NOT allowed in the vicinity of developed recreation areas (within 1 mile) such as managed campgrounds, picnic areas, or trailheads. Doing so would impact the intended experience.
- Do not camp within 150’ of a roadway.
- You may NOT create new roads or accessways to campsites, create new campsites, or clear ground by cutting vegetation.
- You may NOT drive on meadows and must drive on existing access roads in order to get to a site.
- You may NOT block any roads or gates.
- You may NOT create new firepits.

7 Existing Camping Facilities in Study Area D

Presently, numerous developed campgrounds are situated in close proximity to the Area D boundary and along the river, both upstream and downstream (see figures 2 and 5), the Goose Creek Campground and the Lower Chiwawa Trailhead are both positioned within the project footprint, near the downstream end on the left bank of the river. Study Area D is entirely situated on USFS land with many outdoor recreational amenities nearby, including several inactive camping areas that are used as

additional dispersed camping areas. In addition, eight private cabins are situated on leased USFS land near the center of the project area, specifically on the right bank of the river.

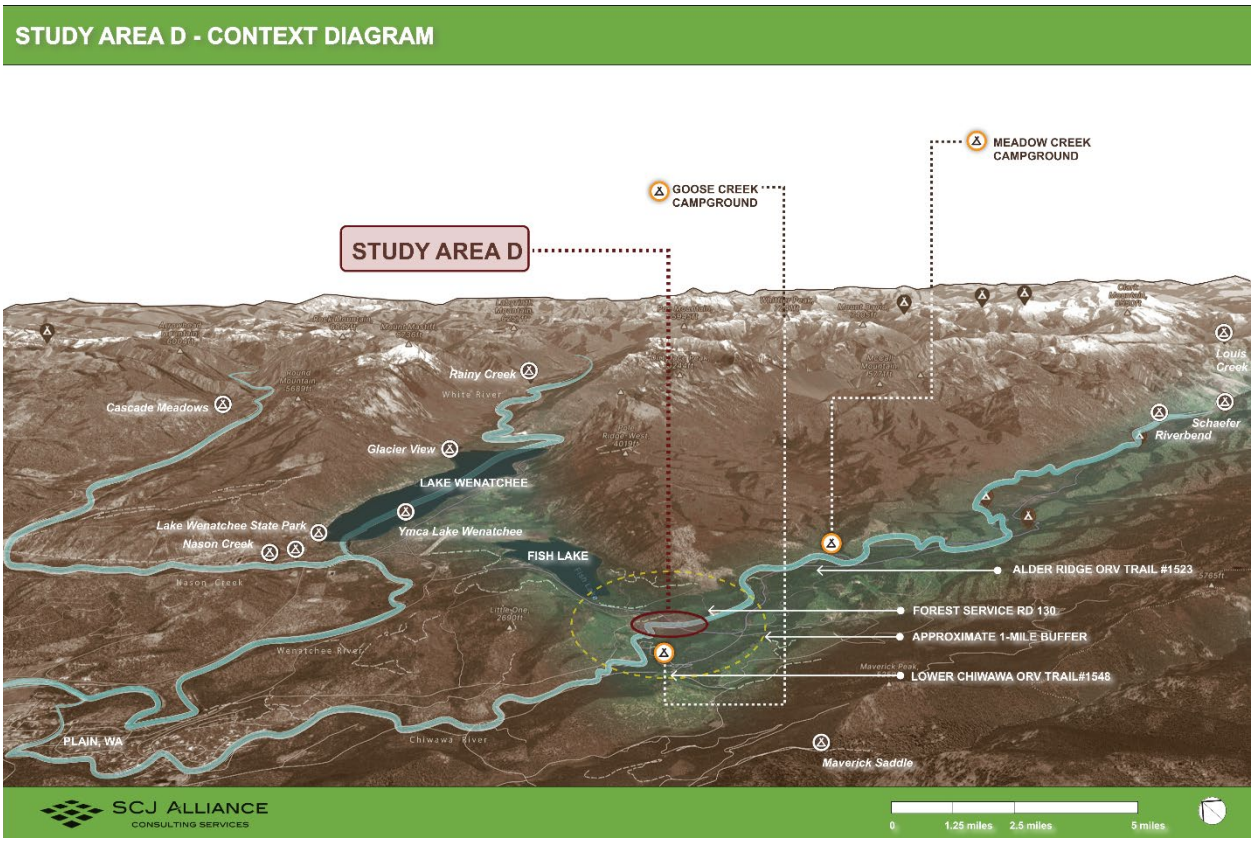


Figure 4 - Study Area D Context Diagram

Noted Camping Areas nearby:

- **Goose Creek Campground-** Goose Creek FS Road 6102 Rd & Lower Chiwawa Rd- located directly adjacent to Study Area D3
- **Meadow Creek Campground-** Meadow Creek FS 6300-211 Rd/ Big Meadow Creek Forest Service 6300 Rd - 3.2 miles north of Area D by via road
- **Grouse Creek Group Campground** – Grouse Creek CG Rd/FS 6200-380 Rd/Chiwawa River Rd- 5.9 miles north of Area D by via road
- **Inactive Campgrounds Nearby:**
    - **Huckleberry Ford (INACTIVE)** - Huckleberry Ford CG Rd/FS 6200-386 Rd/Chiwawa River Rd - 47° 53' 52" N, 120° 42' 57" W – 5.9 miles north of Area D by via road
    - **Alder Creek Horse Camp (INACTIVE) - Chiwawa River Rd/ Alder Creek Tie FS 6200-200 Rd—0.7 miles north of Area D by via road**

Table 2 - Outdoor Recreation Options Nearby

Campground	# of Campsites single	RV's Allowed	# of Campsites double	Vault Toilets	Pit Toilet	Fire Ring	Potable Water
Goose Creek	26	Y	3	3	N	9	Y
Meadow Creek	3	Y		N	1		N
Grouse Creek (Group)	1	Y	1	2	N	?	N
Alder Creek Horse Camp*	1*	Y*		N*	N	N*	N*

* No longer being maintained. Unconfirmed use as a dispersed camping area only.

Marked Trailheads & Forest Service Roads nearby:

- **Lower Chiwawa ORV Trail #1548**- Goose Creek FS Road 6102 Rd & Lower Chiwawa Rd-1.3 miles northwest of Area D by via road
- **Area D3 Access Road –** (referenced often as 'Swallow Caves Campground Rd' on some USGS Maps) - Chiwawa River Rd-0.1 miles southwest of Area D via road
- **Alder Creek Horse Camp Ridge ORV Trail # 1523-** Chiwawa River Rd/ Alder Creek Tie FS 6200-200 Rd—0.7 miles north of Area D by via road

7.1 Dispersed Camping Sites within Area D

Presently, there are three primary areas within the study area that are being used for dispersed camping. Labeled 'D1', 'D2', and 'D3', all are concentrated both North and South of the Chiwawa River Road bridge.

Table 3 - Dispersed Camping Areas

Dispersed Camping Area	Access / Description
D1	Accessed by USFS Road #130 on the left bank of the river just North of Chiwawa River Road and bordered by Alder Creek to the North, topographic constraints limit a narrow band of accessible area available for dispersed camping activities.
D2	Accessed by USFS Road #125 on the right bank of the river just North of Chiwawa River Road, this is a much larger area accessible for campers. Road #125 also provides access to a PIT Array (Passive Integrated Transponder), a monitoring device used to track the movements of fish marked with PIT tags.
D3	Accessed by a gravel and stone access road on the left bank of the river just South of Chiwawa River Road sometimes referred to as 'Swallow Caves Campground Road' on USGS maps, this area is generally flat and situated along the bank of a large river bend.

8 Existing Conditions & Site Analysis

In order to comprehend the utilization patterns of each dispersed site by campers, the planning team undertook a systematic approach aimed at capturing the existing conditions at each location and the manner in which they were being utilized. This endeavor involved the strategic utilization of geospatial resources procured from authoritative repositories such as Chelan County, the United States Forest Service (USFS), the United States Department of Agriculture (USDA), Washington Department of Natural Resources (WADNR) Lidar Portal, OpenStreetMaps, and various other pertinent sources.

The initial phase of this investigative process involved the development of a comprehensive base map for the designated study area. This cartographic representation was developed to capture the pertinent details, including but not limited to, administrative boundaries & setbacks, topographical features, hydrological characteristics, trail systems, road networks, and land cover attributes. The intent was to develop enough spatial context that could serve as a foundational reference for detailed site observations.

With the aid of the maps, the planning team convened a meeting on-site with key stakeholders, including representatives from the USFS and CCNRD, followed by additional site visits to all three dispersed camping sites, wherein the planning team walked the sites, cataloged observations, and documented the prevailing environmental conditions.

Field inventory excursions were executed on multiple occasions during 2023, specifically on May 23rd, May 29th (Memorial Day), and July 6th. These expeditions were designed to capture a detailed pattern of use at different times of the summer, thereby capturing how use changes, especially during the week, and also on a holiday weekend.

8.1 Observed Conditions

Information gathered during these trips included site photos, # of campfire or evidence of rings observed, evidence of vehicle travel, types of vehicles, access paths to the river, presence of trash, presence of latrines, evidence of site modifications (clearing logs, moving rocks, drag marks), evidence of new roads or paths being created, vegetated areas, and areas of erosion caused by use. This information was used to estimate the possible total number of campers that have utilized each site at any one time. In many cases, while it is impossible to determine the exact number of campers using each site at any one time, there was visible evidence of past use, including impressions of old fire rings, burnt wood/ash, garbage left at latrine sites, visible access paths, and other site modifications, e.g., alignment of logs for seating, that provided evidence where camping activities had been occurring in a particular area.

The following map (figure 6) and Table 4 summarize the observed conditions experienced at all three sites, emphasizing the evidence used to estimate use areas, site disturbance patterns, and user counts.

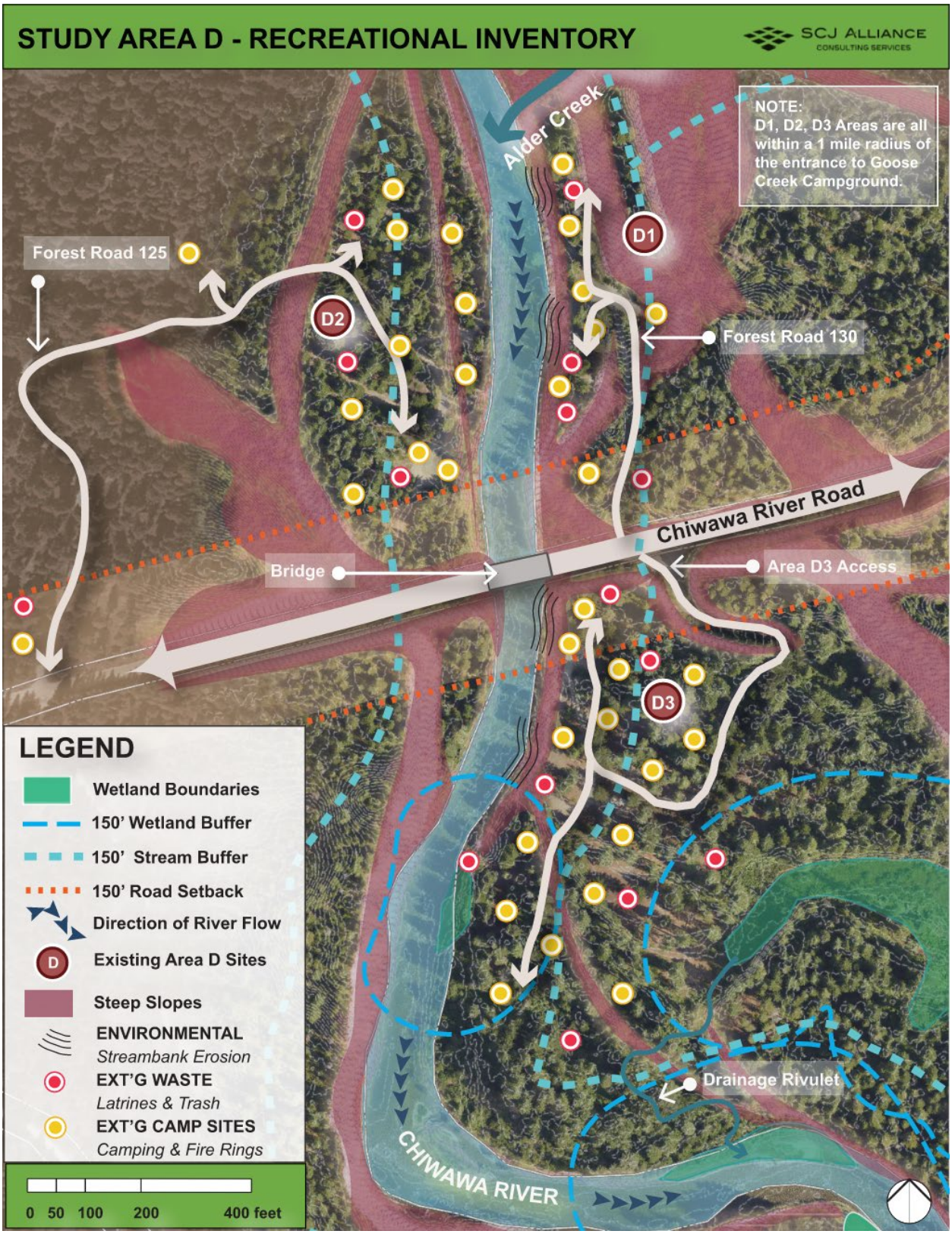


Figure 5 - Recreational Inventory

Table 4 – Existing Conditions

Dispersed Camping Area	
D1	
Vehicles Present (on Observed Days):	(One)-May 23rd, (Five)-May 29th, and (One)-July 6th
Vehicles Observed:	Vans, RV Trailers, Cars, Pick-ups
# of Campfire Rings (Total):	Six
# of Latrines (Total):	Three
Notes:	Despite its picturesque beauty, access to the spot is limited due to the topography and access roads to the East. This forces users to navigate along a narrow bench at the river's edge. All observed camping areas are within the 150' setback of the river, including one that was immediately adjacent to Alder Creek. The steep slopes to the East also result in latrine locations that are very close to the river and neighboring campers. Past site visits and observations noted that a chemical toilet had been discarded along the bank of Alder Creek. Evidence of a fair amount of shoreline erosion is apparent, along with the stacking of rocks to provide access down to the water. Wheel marks and tracks indicate numerous spots that have been created, including evidence of rocks and fallen timber being dragged out of the way to allow access.

Table 4 – (Continued) **Dispersed Camping Area**	
D2	
Vehicles Present (on Observed Days):	(Two)-May 23rd, (Seven)-May 29th, and (Zero)-July 6th
Vehicles Observed:	Vans, RV Trailers, Cars, Pick-ups
# of Campfire Rings (Total):	Eight
# of Latrines (Total):	Three
	While a bit broader than opposite the river (Site D1), this sandy bar next to the river supports a larger number of possible campers, but all within easy visual access of each other. Access on the forest service road is gentle and more passable for larger RV trailers to pull in and maneuver around large open sandy areas, even some that were within 15-20' of the river bank. Latrines were observed set farther back from the river's edge under the denser cover of trees.

Table 4 – (Continued) **Dispersed Camping Area**	
D3	
Campers Present (on Observed Days):	(Three)- May 23rd , (Eight)- May 29th, (Two)- July 6th
Vehicles Observed:	Vans, RV Trailers, Cars, Pick-ups
# of Campfire Rings (Total):	Eleven
# of Latrines (Total):	Six
Notes:	Situated on a bend in the river, this large area is broad and flat, bordered by wetlands and forested areas to the East. This site appears to be the most popular of the dispersed camping areas. The condition of the access road, with its necessary steep switchback, prevents larger RV trailers from coming down onto this sandy fan at the river bend. However, a conversation with one camper during the Memorial Day weekend detailed that many still try to get down because of the total amount of area available to set up camp visible from the main road. Old meander scars, cut channels, or rivulets have silted in after being driven over many times, allowing people to drive deeper into the site and closer to the river opening up more available areas for camping. In many cases, there was evidence of users purposefully moving rocks and trees to facilitate parking their vehicles as close to the river as possible. Latrines were scattered all over the area, focused on areas where there was denser vegetation for privacy, including at least one or two latrine sites within 35-50’ of the river.

8.2 Summary of Findings

All three dispersed camping sites were indicative of a place that is getting loved to death. The sheer number of observed camping sites, latrines, evidence of erosion, cleared vegetation, and other site modifications, indicates a user group that often ignores the intentions behind what a dispersed camping experience should be. The sites appeared to be treated more as a group RV camping area than an opportunity to commune quietly and independently in Nature. Major summary findings are listed below:

Table 5 – Existing Conditions Summary

Finding	Site Photos
Density of Camping Sites: All three sites demonstrated that the intended experience of a dispersed camping area was not being met. Camping areas were in very close proximity to each other, often with many being less than 10-15 yards away from each other. There was a lot of evidence of larger groups using specific areas, with multiple vehicles parking at each site.	
Proximity to River & Critical Areas: It was evident at all three sites that camping activities were primarily occurring within the 150' required setback from the river. In D1, due to the sharp topography just to the East, there was no way camping sites could be set up in that area without being in the setback. In D3, old drainage channels and meander scars were being crossed to gain access to areas closer to the river, which only exacerbated the site's erosion and degradation.	

Latrines within Critical Areas

It was evident at all three sites that camping activities were primarily occurring well within the 150' required setback from the river. The guidelines for burying fecal waste were often not evident, with many "temporary" toilets being left behind, including fruit crate toilets with toilet seats on top. In D1 alone, two homemade toilet facilities were left behind, both being within 10-15 yards of the river. These appear to have been in place for some length of time.



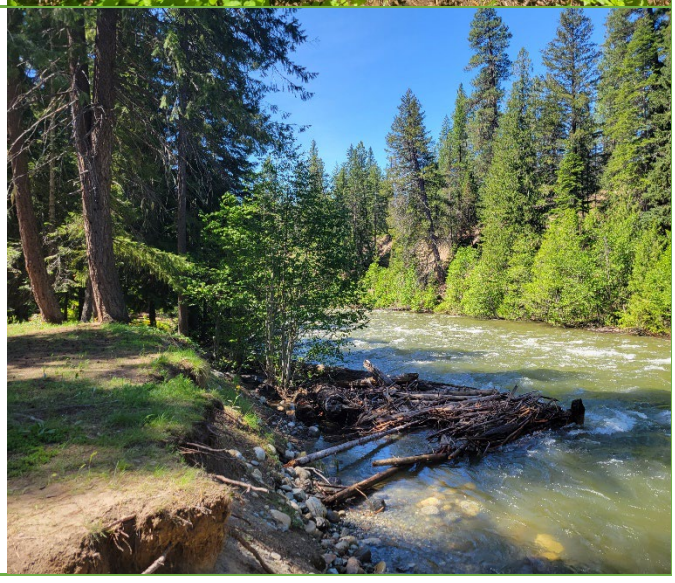
"Leave No Trace" Not Being Honored

It was also evident at all three sites that users were not honoring the pack-in, pack-out mentality that is intended for dispersed camping areas. Human feces, toilet paper, beer bottles, unburned refuse in campfires, and other assorted trash were scattered across all the sites.



Streamside Erosion & Vegetation Impacts

Creating easier direct access to the Chiwawa River and establishing camping sites right at the top of the river banks has accelerated bank erosion at all three sites. In a few cases, ordered placement of rocks as stepping stones and other bank modifications has only served to amplify the erosional impacts at these areas.



9 Recommended Site Management Options

Table 5 below and Figures 7,8,9, and 10 outline a series of recommendations not just to address the site degradation caused by the density of and impacts created by the volume of campers coming to enjoy the area, but also to reinforce the actual intended experience that dispersed camping is meant to provide. Recommendations are organized based on the type of action or response required, either as a response to current site use and management issues, physical site interventions, or suggesting changes to how USFS staff provides oversight of the areas.

Table 5 – Recommended Site Management Options

Type	Recommendation	Description
Management	**Close Area D1 and Forest Road 130**	Area D1, with its limited area outside of the setbacks from the Chiwawa River Road, the Chiwawa River, and Alder Creek, makes it impossible to have a dispersed camping area with a functional latrine space located outside of these setbacks. Additionally, the sheer volume of people and the direct access down to the river's edge make this area much more amenable to bringing in larger RV trailers. Given the geological features, there is not enough room to make this area function properly as a dispersed camping area. In addition, maintaining camping at this site will preclude the construction of engineered log jams along the left bank of the river between Alder Creek and the county bridge.
Physical	**Passive Landscape Features to Prevent Access to Sensitive Areas.**	D1, D2, and D3 areas are being overused. In all three sites, existing drainage channels and past meander scars were being filled in or traversed by vehicles. Proposed utilization of topographic modifications. This would include regrading to accentuate, deepen, widen, and ultimately restore, these landscape forms, creating impassable barriers for vehicles. (See Figures 7 and 8 below.)

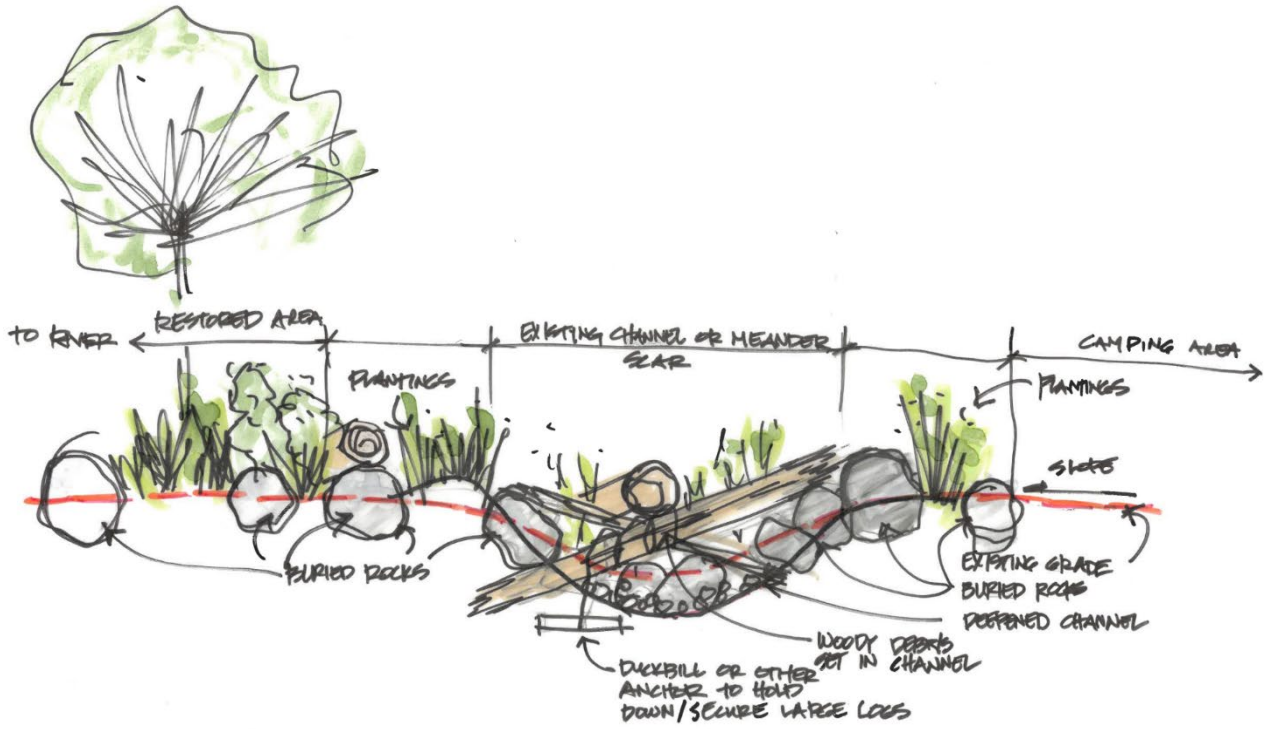


Figure 6 – Additional Woody Debris Placed in Meander Scars

Physical	**Use Shoreline Restoration and Other Techniques to Keep Vehicles and Camping Areas 150' Away From The Edge of River**	All exposed and denuded areas within the three dispersed sites that are located in the river and wetland buffers should be restored with native vegetation and protected by other passive landscape features. (See above, Figure 7, and below Figure 8). By creating woody structures to be used as barriers, specific routes used by vehicles to access different areas along the river can be blocked. This will not eliminate public access to the river itself, but additional plantings of understory shrubs and groundcovers can be used to focus foot traffic to designated pathways to specific overlooks or access spots along the river.

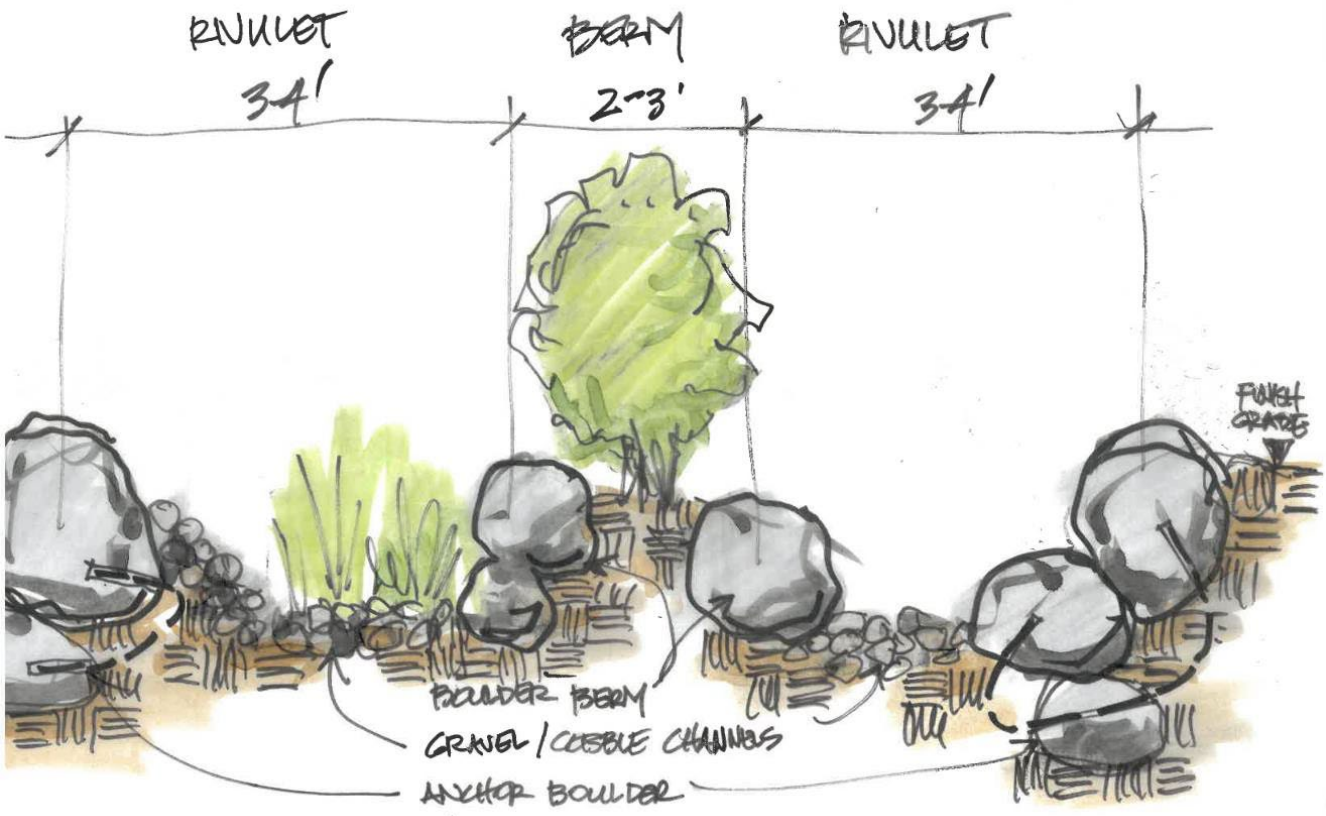
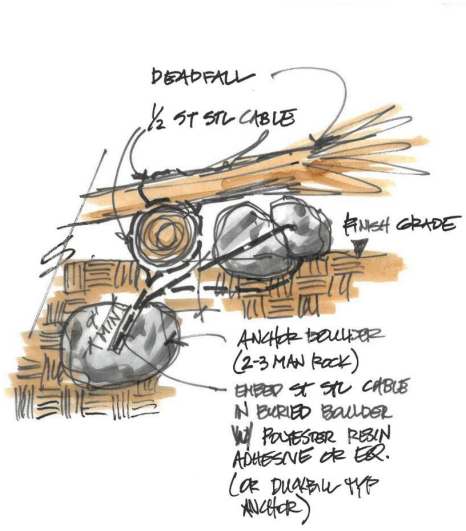


Figure 7 –Adding Impassable Objects to Existing Topographic Features

Physical	**Anchor the Landscape Features**	By using cables and other buried anchors, woody structures, fallen timbers, and rocks can be made more difficult to move by most campers who have a winch and will help to keep people away from the river's edge in most cases.  **Figure 8 - Anchoring Detail**
Physical	**Accentuate the Actual Camping Areas**	Utilize gravel or other means to informally denote access paths and routes between the camping areas and identify water access spots. Revegetate and restore currently denuded areas to accentuate the expected areas available for camping, while also funneling movement to the expected pathways.
Management & Physical	**Add Signage**	USFS should provide public dispersed camping area guidelines specific to the Okanogan-Wenatchee National Forest, both online and on-site. Each camping area should include a general information sign (there is already a kiosk at D3) with a set of intended use guidelines. Include or update signs that denote the actual number of campsites allowed in each area: D3 = Two spots, D2 = Three spots (see Figure 10).

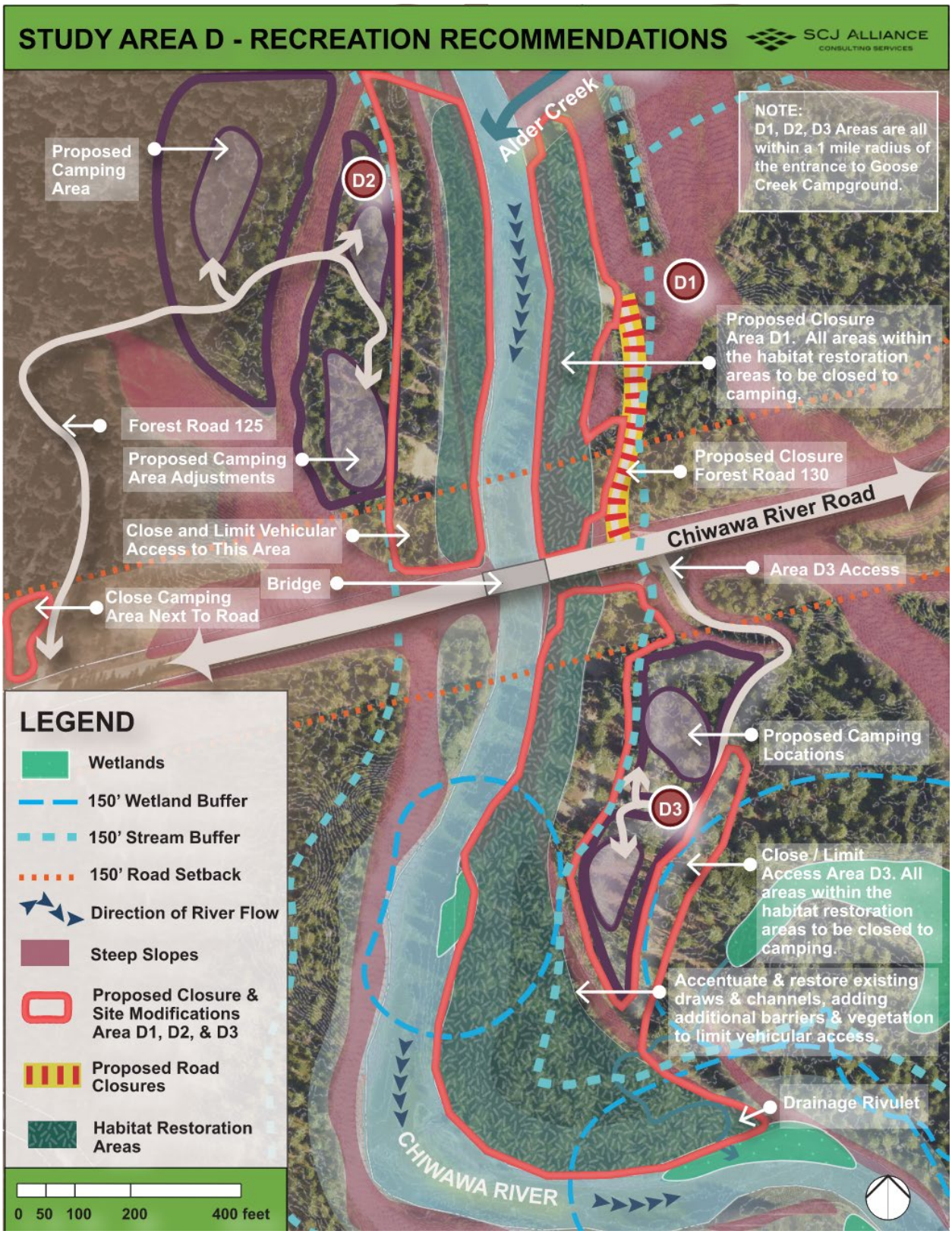


Figure 9 - Recreation Recommendations

Formulate

10 Opinion of Probable Costs Options

Formulated on the areas of proposed site modifications, an opinion of probable costs was generated for each of the three dispersed camping areas (see Table 6). Based on the impacted area and assuming that 65% of the denuded areas will be restored with plant materials and with an estimated linear length of site/barrier integration to be used per site, the following cost assumptions were used:

- General Site Restoration Cost Metric (Site degradation cleanup, erosion & sediment control, construction mobilization, protective fencing, invasive species removal, arboriculture assessment & trimming, hauling costs, water management, etc.) - $12,500/acre with 65% of the site being impacted.[1]
- Site Modification Cost Metric (Grading & Drainage Improvements) - $20,000/acre with 25% of the site being impacted.
- Cabled Large Woody Debris & Other Physical Site Obstructions (LWD, Deadfall, Rocks/Boulders & other Vehicular Barriers): $40/lf or $4000/100lf with 1 log + 1 rootwad anchored every 18-32[2] lf.
- Plantings (based on assumptions below): $15,400/acre
    - Trees: 20ft. on center (o.c.) (400 sq. ft.) with 15% coverage = 16 trees @ $300/each: $5,000/acre
    - Shrubs: 6 ft o.c. (36 sq. ft.) with 25% coverage = 302 shrubs @15$/each: $4,535/acre
    - Live stakes/grasses/groundcovers: 2 ft. o.c. (4 sq. ft.) with 25% coverage: 2,721 plugs @ $2.15/each: $5,853/acre

Table 6 - Opinion of Probable Costs

Area	Total Area	Element	Quantity	Unit Cost (per acre)	Subtotal
D1	1.95 acres	General Site Restoration	1.27 acres	$12,500	$15,875.00
		Site Modifications	0.5 acres	$20,000	$10,000.00
		Cabled LWD, Boulders, Barriers, etc.	1650 lf	$40	$66,000.00
		Plantings	0.82 acres	$15,400	$12,628.00
					Subtotal D1: $104,503.00
D2	2.83 acres	General Site Restoration	1.84 acres	$12,500	$23,0000.00
		Site Modifications	0.71 acres	$20,000	$14,200.00

[1] The Journal Ecological Restoration as well as other agencies (King County DNR, COE) have published metrics with several examples of overall site restoration costs that we've used to justify some expected per acre or linear foot costs.

[2] King County DNR has calculated the value of $142,000 (adjusted for inflation) per 100m of LWD placement (1 log + 1 rootwad w/ anchors every 20-23 ft). We used this metric to calculate a estimated cost to place additional LWD to act as vehicular barriers from the camping areas to the restored river habitat area.

		Cabled LWD, Boulders, Barriers, etc.	650 lf	$40	$26,000.00
		Plantings	1.2 acres	$15,400	$18,480.00
					Subtotal D2: $81,680.00
D3	6.31 acres	General Site Restoration	4.1 acres	$12,500	$51,250.00
		Site Modifications	1.58 acres	$20,000	$31,600.00
		Cabled LWD, Boulders, Barriers, etc.	2000 lf	$40	$80,000.00
		Plantings	2.67 acres	$15,400	$41,118.00
					Subtotal D3: $203,968.00
				Subtotal:	**$390,151.00**
				Contingency (25%)	$97,538.00
				Other Soft Costs – Permitting, Engineering, CCNRD Project Management (20%)	$78,030.00
				Total Cost Opinion	***$565,719.00***