

Nordheimer Creek Habitat Enhancement Project:

Final Basis of Design Memorandum
Salmon River, Siskiyou County, California
M&A Project # 20-079-01
May 2021



Prepared for:

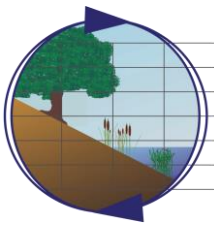
Salmon River Restoration Council

PO Box 1089

25631 Sawyers Bar, CA 96027



Prepared by:



Merkel & Associates, Inc.



Whelan Gilkerson
Senior Ecologist
Merkel & Associates, Inc.
1670 Chester Avenue
Arcata, CA 95521
wgilkerson@merkelinc.com
(707) 407-7469

Randy Lew
Certified Engineering Geologist
Pacific Watershed Associates, Inc.
PO Box 4433
Arcata, CA 95518
randyl@pacificwatershed.com
(707) 839-5130

Chris Moore
Riparian Restoration Specialist
Watershed Education &
Ecological Design Services
1675 Woody Road
McKinleyville, CA 95519
c.moore.weed@gmail.com
(707) 601-9547

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CERTIFICATION AND LIMITATIONS

The report entitled “Nordheimer Creek Habitat Enhancement Design Project, BODM” was prepared by or under the direction and oversight of a California professional geologist (PG) and certified engineering geologist (CEG) at Pacific Watershed Associates (PWA), and all information herein is based on data and information analyzed and reviewed by PWA staff. The interpretations and conclusions presented in this report are based on a study of inherently limited scope. Observations range from qualitative to quantitative and are confined to surface expressions of limited extent and shallow investigations of subsurface materials and groundwater conditions. Interpretations of problematic geologic, hydrologic and geomorphic features (such as surface and subsurface water table, stratigraphy and bedrock) and fluvial processes are based on the information available at the time of the study and on the nature and distribution of existing features.

The conclusions and recommendations contained in this report are professional opinions derived in accordance with current standards of professional practice and are valid as of the submittal date. No other warranty, expressed or implied, is made. PWA is not responsible for changes in the conditions of the property with the passage of time, whether due to natural processes or to the works of man or changing conditions on adjacent areas. Furthermore, to be consistent with existing conditions, information contained in the report should be reevaluated after a period of no more than three years, and it is the responsibility of the project proponent to ensure that all recommendations in the report are reviewed and implemented according to the conditions existing at the time of construction. Finally, PWA is not responsible for changes in applicable or appropriate standards beyond our control, such as those arising from changes in legislation or the broadening of knowledge, which may invalidate any of our findings.

Certified by:



William R. Lew, California PG #7872, CEG #2747

Pacific Watershed Associates, Inc.

1 PROJECT SUMMARY AND BACKGROUND

The Nordheimer Creek Habitat Enhancement Project is being developed to address the need to improve instream habitat conditions for listed Salmonid species within this important tributary of the Salmon River. The project aims to achieve the following goals, including improving cold water habitat and access for salmonids; increasing retention and facilitating sorting of gravels; increasing pool frequency and cover; and enhancing riparian vegetation. Previously the project goals included enhancing floodplain connectivity and shade for thermal refugia. While enhancing shade remains a secondary goal for sites where riparian enhancement treatments are proposed, these goals originally applied to the river bar at the mouth of Nordheimer Creek, and were subsequently found not to be appropriate at that location due to site conditions. Therefore, this option was eliminated from further review and the project moved forward with focusing on enhancing riparian vegetation only. The project will accomplish these goals through the development of instream wood loading design features that will serve to increase the frequency and scale of roughness elements within the active channel and riparian margins of Nordheimer Creek. Implementing these design elements will improve overall aquatic ecosystem productivity, while enhancing cover, thermal and velocity refugia, and spawning habitat for salmonids.

The project was initially conceived by the Salmon River Restoration Council (SRRRC) in consultation with Fiori Geosciences (FGS), Watershed Education and Ecological Design Services (WEEDS), and Merkel & Associates (M&A). Rocco Fiori (Professional Geologist and Licensed Timber Operator) served as the Licensed Professional overseeing project design and data collection efforts. Under Mr. Fiori's lead, the initial project efforts included a number of elements that were investigated and partially completed with the assistance of SRRRC staff and Chris Moore (WEEDS) to support a coupled hydro-geologic engineering-based approach to habitat enhancement, including a subsurface geotechnical assessment at the Nordheimer Confluence Bar; water level monitoring to relate surface and ground water elevations; and design hydrology /hydraulics, jam mobility and force balance analysis to support preliminary Factor of Safety (FoS) evaluation for design features.

In addition to these efforts, low-altitude, high resolution color aerial imagery of the project area including reaches 1-5 of Nordheimer Creek and adjacent upstream and downstream reaches of the Salmon River mainstem was captured in December 2018 using a small unmanned aerial vehicle (UAV) platform and processed to develop a rectified orthomosaic of the study area. The acquisition and processing of aerial imagery data, stream stationing, and Geographic Information System (GIS) support was led by Whelan Gilkerson (M&A), with assistance from Chris Moore (WEEDS).

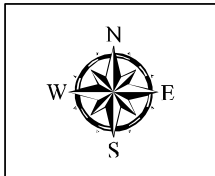
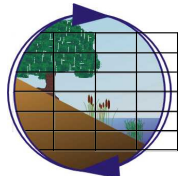
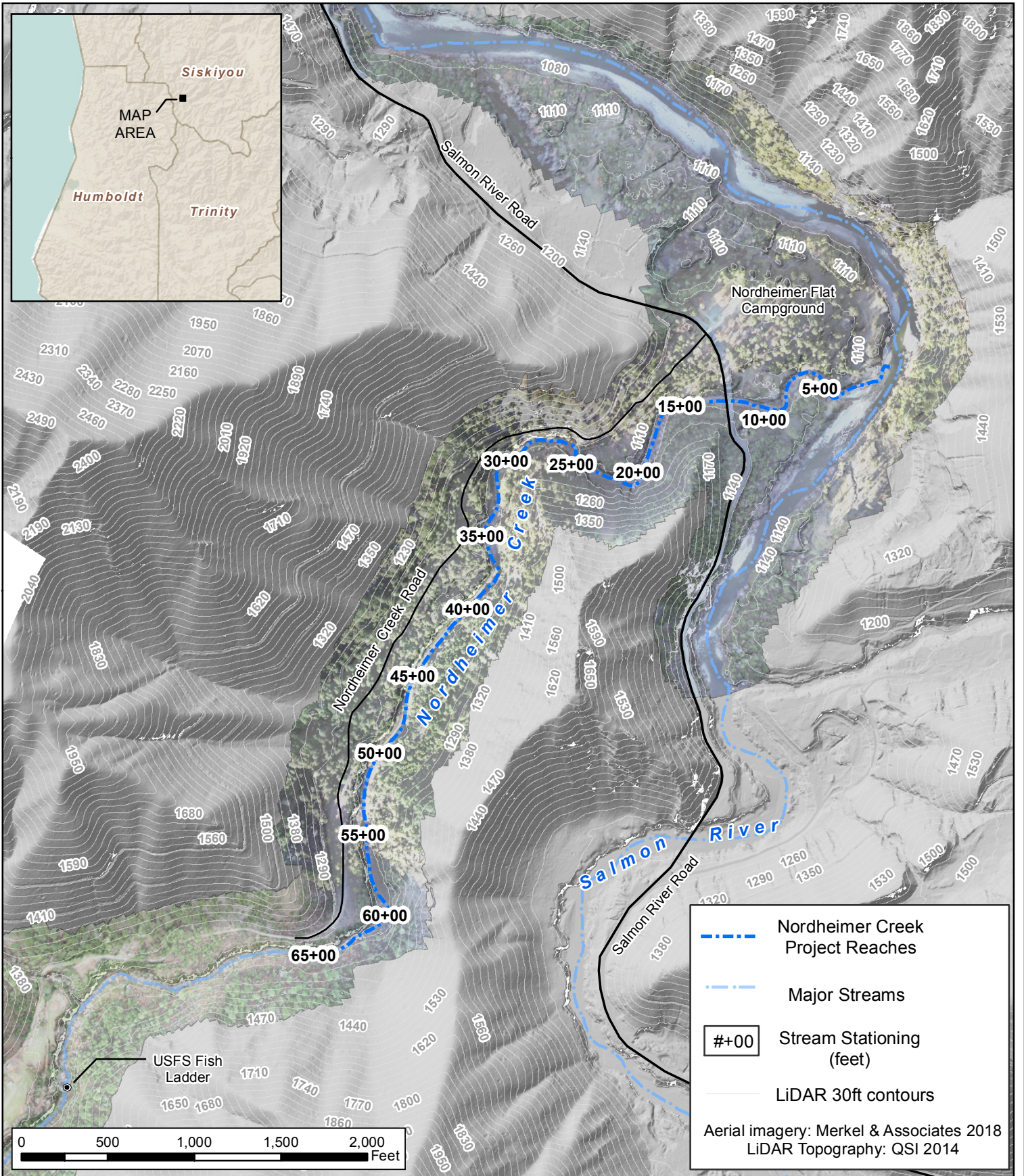
Beyond these preliminary investigations and analyses, existing data and information were compiled by SRRRC and FGS to evaluate watershed background conditions pertinent to design development. Information and data assessed and incorporated into the design process included historic and recent aerial imagery; a bare earth Light Detection and Ranging Digital Elevation Model (LiDAR DEM; QSI 2014); the Nordheimer Creek Bridge Plans (Fiori, 2019; Appendix C); salmonid redd distribution and fish observation data (SRRRC and USFS); stream gage data from nearby published gaging stations (USGS); peer-reviewed publications, and grey literature. A detailed description of the results of these investigations, background research and analyses is presented in the 30% Basis of Design Report (BODR; Fiori, 2019; Appendix C). Preliminary investigations were presented to the project's Technical Advisory Committee (TAC) at a project kickoff meeting held on March 7, 2019, the 30% BODR was shared with the

TAC on September 5, 2019, presented to the TAC on October 23, 2019, and an onsite was held with the TAC on November 13, 2019.

Following completion and submittal of a revised 30% Basis of Design Report, Mr. Fiori stepped away from his role in the project unexpectedly, resulting in the need to identify an appropriate and willing design partner to lead the project through to completion. Ultimately, in recognizing a strong desire to maintain continuity with the remaining project team and given the group's recent experience working collaboratively to design and implement similar instream enhancement treatments in nearby Methodist and Knownothing Creeks under his professional charge, SRRC reached out to Licensed Engineering Geologist Randy Lew of Pacific Watershed Associates (PWA) to help facilitate the project through to completion.

In assuming the design leadership role and in consideration of the broad basis of support among TAC participants with respect to initiating in-stream enhancement treatments in Nordheimer Creek, Mr. Lew in consultation with SRRC, project team members and agency staff, proposed a subtle shift in emphasis away from a more engineering-centric approach incumbent on subsurface geologic investigations, water level monitoring and hydraulic modeling, to a more geomorphic approach based on wood loading using sized key logs and a variety of anchoring techniques to support structure stability and persistence. This revised approach facilitated achieving the project's original design goals and objectives without triggering the need for more complex engineering level analysis with respect to instream enhancement design and downstream risk analysis. This approach is supported by recently updated California Department of Fish and Wildlife (CDFW) Fisheries Restoration Grant Program design criteria in low-risk watersheds such as Nordheimer Creek, which calls for using bankfull width/depth to guide minimum sizing specifications for key logs and a combination of helicopter placement of key logs with supplemental hand crew anchoring support where equipment access is limited, and anchored bank-based jam structures where heavy equipment access is feasible.

This shift in emphasis following completion of the 30% BODR submittal, allowed the project team to focus on a more expedited and streamlined design process given the shortened timeframe for project completion, with an emphasis on siting of key piece logs by helicopter and through accelerated recruitment, construction of bank-based anchored jams using heavy equipment, and riparian enhancement treatments (willow baffles) in locations likely to achieve the greatest benefit to salmonids within the lower reaches of Nordheimer Creek (from the confluence bar to the lower portion of reach 4 near station 65+00; Figure 1). The emphasis on designing treatments primarily within the three lowest reaches of Nordheimer Creek leading up to the transition to step pool channel morphology that defines reach 4 is consistent with recommendations presented at the March 7, 2019 and October 23, 2019 TAC meetings (SRRC, 2019), that identified bedrock channel sidewalls as factors limiting riparian anchoring potential and equipment access in reach 4, suggesting design and implementation of treatments in this reach should be considered for a future phase of implementation.



Project Location Map
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure 1

With this revised approach to instream enhancement design in mind and with the support of funding agency CDFW staff, the project team then initiated site investigations in November 2020 during low flow conditions to identify and target specific locations, treatment strategies, techniques and associated equipment access logistics required to support instream enhancement design and subsequent implementation, and emphasizing an anchored wood loading approach in the context of a low-risk watershed setting.

2 WATERSHED SETTING AND HISTORIC CONTEXT

2.1 Geography

The Salmon River watershed is located entirely within the southwestern portion of Siskiyou County, in northwestern California, bordering Humboldt and Trinity Counties along its southern drainage divide. The Salmon River is the second largest tributary to the Klamath River, with watershed area of 751 square miles and mainstem stream length of 19.6 miles. Nordheimer Creek is a large perennial stream of the lower Salmon River, consisting of an approximately 31 square mile watershed area. Within the Nordheimer Creek basin, elevations range from nearly 7,000 feet near its headwaters along the north slope of Salmon Mountain in the Trinity Alps Wilderness, to 1,080 feet at the confluence with the mainstem Salmon River. In both the Nordheimer Creek basin and the Salmon River Watershed more broadly, the landscape is characterized by steep terrain and deeply incised stream channels, with characteristic land cover consisting of subalpine vegetation and exposed bedrock at higher elevations, mixed coniferous forest on the mid and upper hillslopes, with pockets of oak woodland and chaparral appearing on drier southern exposures and rocky outcrops at lower elevations. Deciduous broadleaf trees and shrubs represent the dominant vegetation cover in floodplain and riparian areas within the lower canyons. The watershed's complex geology, high relief topography, location, biogeographic history and climatic regime have all contributed to making this area a hotspot for biodiversity within the Pacific Northwest.

2.2 Land Management

The entirety of the Nordheimer Creek Project Area is located within Klamath National Forest and is administered by the U.S. Forest Service (USFS).

2.3 Historic Context

A brief history of the Salmon River Watershed was recently documented and captured through archival research and interviews conducted with community elders by SRRC staff (SRRC, 2014), and is summarized below. Additional historical analysis of the effects of mining, forestry, and fire management on erosion, stream diversion, sediment delivery and alteration of the Nordheimer Creek basin with respect to aquatic habitat conditions are presented in the 30% BODR (Fiori, 2019; Appendix C).

The human history within the Salmon River watershed and larger Klamath River basin dates back over many thousands of years, with tribal populations and cultural traditions tightly coupled with the River's fisheries upon which they subsisted. Prior to the arrival of white settlers in the mid-1800s, tribes within the basin worked collaboratively to manage fish populations in an equitable and sustainable manner (SRRC 2014).

Beginning in 1849 with the discovery of gold bearing placer deposit near Cecilville by white settlers and furthered by the identification of rich placer deposits near the Forks of Salmon in 1850, the relationship between humans and the landscape of the Salmon River watershed began to change dramatically. The gold rush of the 1850s brought an influx of prospectors, and with it, the first large scale mining operations and associated ground disturbance, primarily within readily accessible alluvial deposits located along the river banks and near the surface of floodplains and terraces. In the 1860s as many of the surface and river placers were becoming depleted, hydraulic mining operations became the principal source of gold within the watershed. An extensive network of surface water diversion infrastructure, including reservoirs, flumes, ditches and pipelines were built throughout the watershed including within the Nordheimer Creek basin to facilitate hydraulic mining to expose deeper placer deposits within the river's floodplains and terraces.

The result of this activity led to substantial alteration of the river's floodplains and channels. The legacy effects of hydraulic mining include substantial loss of soils and gravels within floodplain and riparian areas resulting in many areas of the watershed remaining more sparsely vegetated to this day; large and mostly barren remnant mine tailings consisting of cobbles and boulders scattered throughout the river's floodplains; channel infilling and loss of deep pools in response to cobble/boulder-dominated sediment accretion; and loss of shade associated with degradation of riparian habitat.

Beyond the effects of historic mining operations which were beginning to scale down by the late 1800s concurrent with the depletion of the largest commercially viable gold deposits, the initiation of aggressive fire suppression policies on federal lands beginning in the 1930s, and industrial timber harvesting and associated road building activity following World War II brought with it the next phase of large-scale landscape disturbance within the watershed. Clearcutting and ensuing even-aged stand management, in conjunction with decades of active fire suppression have resulted in diminished forest diversity, increased fuel loads, and greater susceptibility to severe fire. The combined effects of these practices have resulted in accelerated surface erosion and contributed to mass wasting, resulting in a substantial increase in sediment delivery.

In Nordheimer Creek, the 1977 Hog fire burned through the majority of the watershed, in many areas at moderate to high severity. Following the fire, salvage logging operations resulted in removal of large trees right up to the banks of the creek, as well as clearing of instream wood, under the assumption that fire and timber harvest-related sediment and large wood delivery to the stream was affecting fish passage (Fiori, 2019). To this day, several large mine tailing deposits within Nordheimer Creek remain poorly vegetated, while legacy hillslope ditches constructed to support downstream hydraulic mining operations, still present a diversion potential for tributaries within the watershed.

While all of these factors have contributed to the loss of aquatic habitat complexity, increased water temperatures, reduced capacity for natural recruitment of large wood and impaired functional capacity to support the watershed's beleaguered salmonid populations, several factors make Nordheimer Creek a compelling location to implement instream habitat enhancement efforts, which are discussed in greater detail in sections 3 and 4 below.

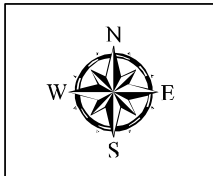
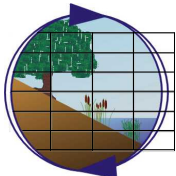
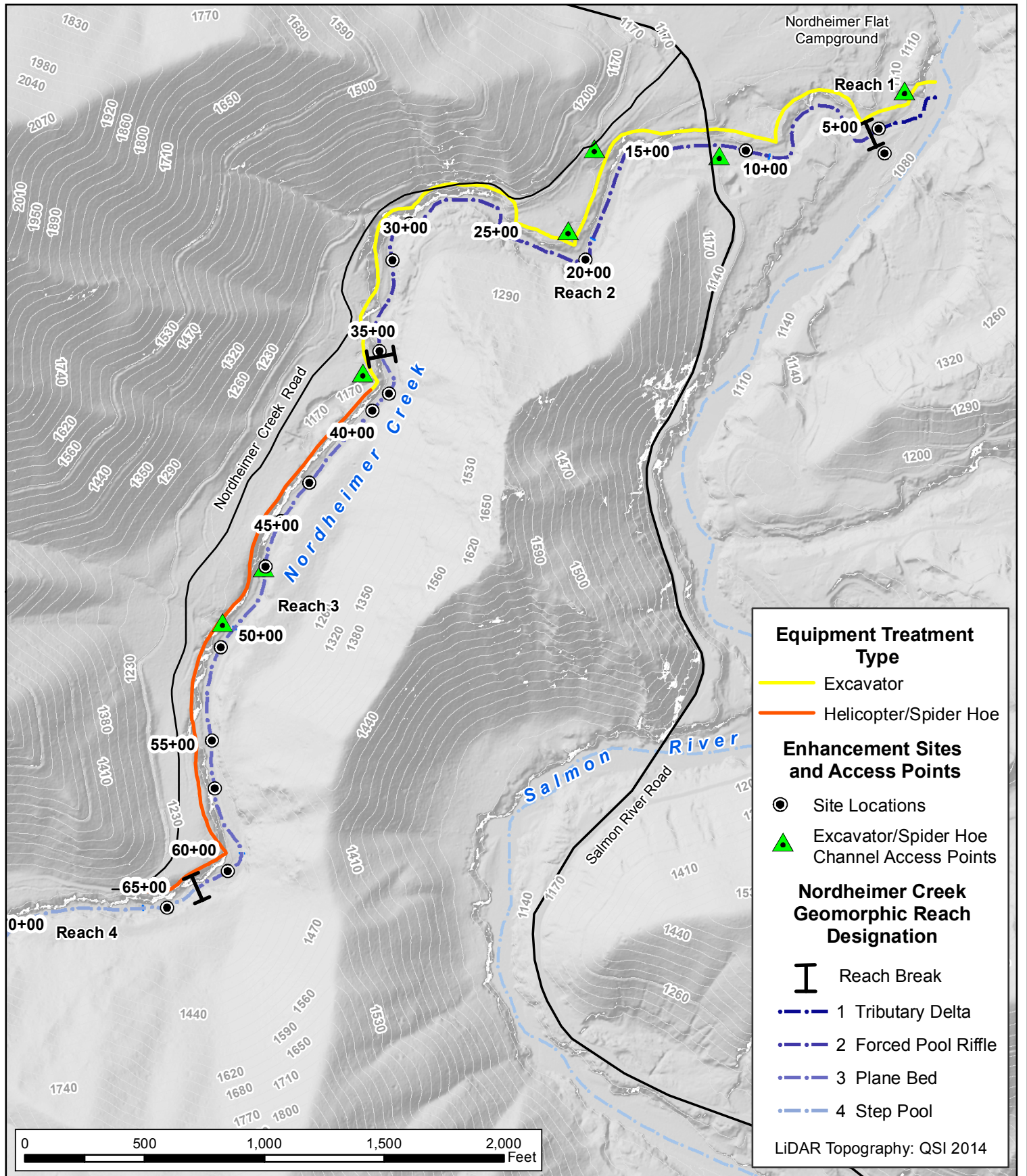
3 GEOLOGIC AND GEOMORPHIC SETTING

The regional geology of the Salmon River watershed is composed of diverse rock groups including several distinct metamorphic belts, intrusive granitic batholiths, alluvial terrace deposits, colluvial deposits, and recent alluvial deposits. The Salmon River watershed is part of the greater regional physiographic Klamath Mountain Province (CGS, 2002) with elevations ranging from approximately 500 feet above sea level in the lowest river canyons to over 9,000 feet at the summit of Mount Eddy. Both poorly consolidated and sheared to well-indurated metamorphic rocks, as well as deeply weathered granitic rocks that are particularly susceptible to erosion and mass wasting during periods of sustained or heavy rainfall are exposed throughout the watershed.

Published geologic mapping of the area (Ernst, 1998; Wagner and Saucedo, 1987) shows that the project area is underlain by Quaternary alluvium (Qal), while the adjacent hillslopes are composed of meta-volcaniclastic, meta-sedimentary and meta-volcanic rocks from the Western Paleozoic and Triassic Belt Hayfork terrane. A characterization of subsurface materials during the 30% design phase within the project area identified alluvial deposits and bedrock exposures consistent with these published California Division of Mines and Geology (DMG) maps. A detailed description of subsurface materials, stratigraphic relationships, depths to inferred bedrock and the water table are also included in the 30% BODR (Fiori, 2019; Appendix C).

The geomorphic setting of the greater project area is dominated by channel and alluvial fan processes where the Nordheimer Creek stream valley transitions from the steeper and confined upper and middle watershed into its lower gradient reaches near the confluence with the mainstem Salmon River. Similar to many geomorphically comparable areas in the Salmon River watershed, much of the upper and middle Nordheimer Creek watershed is located in steep, mountainous terrain with hillslope gradients frequently exceeding 70% along inner gorges, headwalls and upper ridge slopes. A more detailed discussion of local geomorphic conditions can be found in the 30% BODM (Fiori, 2019; Appendix C).

Within the lower portion of Nordheimer Creek, the entirety of reaches 1-4 and the lower portion of reach 5 were characterized by geomorphic channel typing according to criteria developed by Montgomery and Buffington (1997); a LiDAR-derived (QSI, 2014) longitudinal profile of the lower Nordheimer Creek channel as well as representative cross sections associated with the channel type indicative of each reach are presented in the 30% BODR (Fiori, 2019; Appendix C). The extent of reaches 1-4 where design efforts have been advanced in support of the 65% basis of design, including identification of site access, logistical constraints, and associated equipment treatment recommendations are presented in conjunction with channel geomorphic reach designations in Figure 2.



Site Access And Equipment Treatment Type

Nordheimer Creek Habitat Enhancement Project
Basis of Design, Siskiyou County, California

Figure 2

4 FISH HABITAT

The lower reaches of Nordheimer Creek support coho salmon (*Oncorhynchus kisutch*), fall-run and spring-run Chinook salmon (*Oncorhynchus tshawytscha*) as well as steelhead (*Oncorhynchus mykiss*). Although conditions within the watershed have been altered by past land-use and management activities, the lower reaches of Nordheimer Creek continue to provide critically important cold water refugia during summer months when warmer water temperatures in the mainstem Salmon River can become inhospitable to salmonids (Stillwater Sciences, 2018). In addition to providing the cold water required by salmonid species that include over-summering juvenile life histories (e.g., coho, summer steelhead, and spring-run Chinook), low-gradient channel conditions that characterize reaches 1-3 are also of particular importance to the recovery of coho (NMFS 2014) due to their inability to access suitable spawning areas in higher gradient reaches further upstream. These factors in particular, make lower Nordheimer Creek a priority for restoration.

Recent habitat assessment work completed by SRRRC (2014) identified a lack of woody debris, existing jams, and habitat complexity as currently limiting opportunities for spawning and rearing by coho and other salmonids within Nordheimer Creek. Spawner surveys and fish observations conducted over the last 20 years through a collaborative effort involving SRRRC, CDFW, Tribal and USFS staff, as well as volunteers indicate consistent utilization of Nordheimer Creek by spawning fall-run Chinook in particular, as well as more limited observations of adult and juvenile coho presence and spawning between the Nordheimer confluence bar and reach 3 (Figure 3), with substantial year to year variation, and relatively low spawning density indicative of the limited availability of suitably sized gravels within the system.

A 2009 survey conducted in Nordheimer Creek identified 7 coho redds (SRRRC, 2010), however; spatial data depicting redd locations relative to project reach designations was not identified. In terms of spawning activity by reach designation over time, reaches 2, 3 and 4 have supported the largest total number of redds, with lower levels of spawning activity observed in reaches 1 and 5 (Table 1). The project design team observed several fall-run Chinook redds during site investigations conducted in November 2020, within reaches 2 and 3. Reviewing these observations relative to USFS mapped redd locations from the same year, resulted in the identification of two additional redds that have been incorporated into redd distribution data depicted in Table 1 and Figures 3 and 4. It should be noted that reach 5 was only partially assessed in support of proposed design work associated with this project and that spawner surveys conducted within this reach have been more limited and variable in extent over time due to challenges and safety concerns related to high-flow conditions (Fiori, 2019).

Table 1. Salmonid Redd Observations (2000-2020), Nordheimer Creek, Salmon River, California.

Geomorphic Reach Type	Reach Number	Reach Length (ft)	Redd Number									
			2000	2006	2013	2014	2015	2017	2018	2019	2020	Total
Confluence delta	1	329						1	1	2		4
Forced pool-riffle	2	3284	9	3	8	20	3	3	2		1	49
Plane-bed	3	2623	9	1	8	6	5	6	9	1	4	49
Step-pool	4	2218	4		6	14	6	7	1	1	2	41
Step-pool*	5	N/A			4	6	1					11
Total Redds/Year			22	4**	26	46	15	17	13	4	7	154

*Only the lower portion of reach 5 was assessed, therefore; the geomorphic reach length is unknown.

**2006 redd surveys only included coho salmon. All other spawning observations are of fall-run Chinook salmon.

Of greater concern than the relative completeness/consistency of survey efforts through time within reach 5 are the clear indications of reduced numbers of spawning fall run Chinook during the last several years relative to what was observed prior to 2015 (Table 1 and Figure 4). Lower flows in recent years appear to limit upstream spawning migration extent, with redd observations concentrated in lower reaches relative to a broader distribution during years prior to 2015. Given the low overall spawning density, spatial variability in clustering of spawning activity, and limited retention/availability of spawning sized gravels within the lower reaches of the creek, it has been postulated that spawning fish may be keying into transient pulses of spawning sized gravels that are episodically mobilized and transported during periods of higher discharge (30% BODR; Fiori 2019). The recent emergence of spawning activity observed in reach 1 (2017-2019) concurrent with substantial reductions in overall spawning activity and a lack of redds observed in reach 5 since 2015, all point to the urgency of implementing design efforts that address factors currently limiting spawning and rearing within the lower reaches of the creek. When factoring in previous observations that suggest reach 4 appeared to retain spawning gravel of greater quality and moderate quantity, in contrast to the general scarcity of suitable spawning-sized gravel present within reaches 1-3 (Fiori, 2019) and recent further indications suggesting a downstream shift in spawning intensity (Figure 4), proposed design efforts have been focused on enhancing instream habitat conditions primarily within the lowest three reaches of the creek.

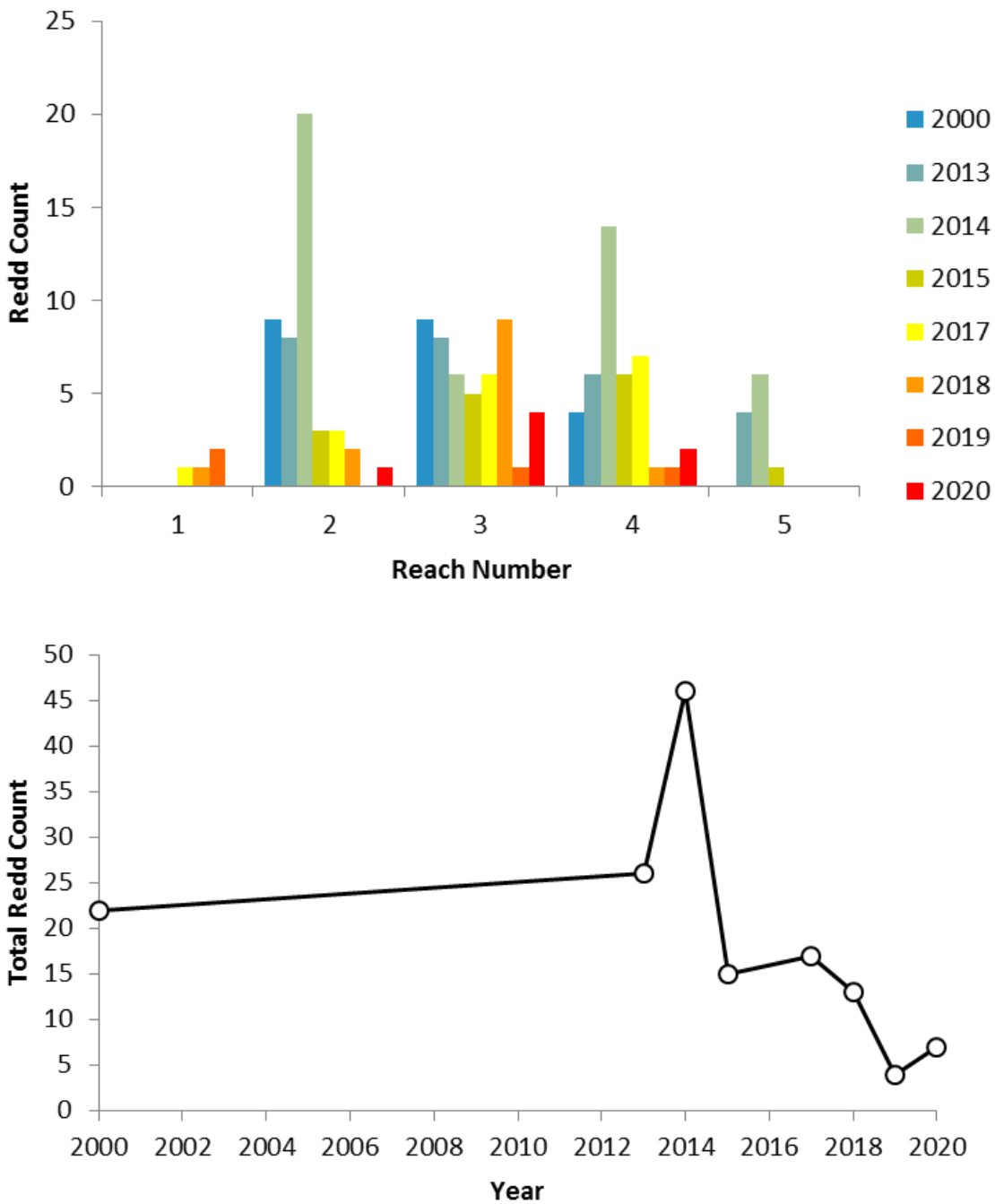


Figure 4. Fall-run Chinook redd observations by stream reach and year in lower Nordheimer Creek.

5 HYDROLOGY

Design hydrology criteria for Nordheimer Creek were investigated and developed during the initial phase of the project using a combination of temporary gage deployment during the 2018 water year to establish discharge estimates for the creek; comparison and proportional scaling of runoff area to

several nearby USGS gaging stations; and evaluation of flood recurrence estimators (30% BODR; Fiori 2019; Appendix C). Flood recurrence intervals and associated discharge estimates developed from this earlier effort are presented along with discharge estimates provided through application of the USGS StreamStats program (Gotveld et al. 2012) and are provided in Table 2. The differences in discharge estimates may partially be a reflection of uncertainty/error with respect to mean annual precipitation statistics for the basin. While StreamStats applies a mean annual precipitation of 74.7 inches to the Nordheimer Creek Basin, it is believed that the actual value may be somewhat lower (Melissa Van Scoyoc, pers. com. 2021), with estimates ranging from approximately 35 inches per year in the South Fork Salmon River Canyon to approximately 85 inches per year in the North Fork, Little North Fork, and Wooley Creek sub-basins (NCRWQCB, 2005).

Table 2. Flood recurrence frequency discharge statistics for the Nordheimer Creek Basin, Salmon River, California.

Method	Flood recurrence Interval (years)					
	2	5	10	25	50	100
	Discharge (cubic feet per second)					
(Fiori, 2019)	1,071	2,016	2,764	3,826	4,705	5,662
StreamStats	2,820	4,760	6,120	7,850	9,140	10,400

6 INFRASTRUCTURE

Infrastructure concerns in the Nordheimer Creek Project Area are relatively limited in scope but have been previously identified and called out by stream station (30% BODR; Fiori 2019): These include the Nordheimer Creek Bridge (Station 12+37), several domestic water intakes (located between Stations 80+00 and 96+00), a USFS fish ladder (Station 85+40), and a water wheel located along the channel’s left bank (Station 96+20). As the Project’s basis of design has shifted to an emphasis on wood loading primarily within reaches 1-3 (downstream of station 65+00), the proposed instream enhancement design elements are focused on risks posed by the project to downstream infrastructure which at present are limited to the Nordheimer Creek Bridge. Using key piece log sizing criteria in conjunction with anchoring and weaving of bank-based jams to live alder and maple trees growing in the riparian corridor, or alternatively bedrock outcroppings/exposures along channel margins will mitigate the risk of wood mobilization and minimize potential for impacts to the bridge associated with project implementation.

7 SITE ASSESSMENT AND MAPPING

In late fall of 2018, instream assessment and mapping efforts were initiated within the lower reaches of Nordheimer Creek. Initial efforts included acquisition and development of rectified UAV orthoimagery and coupled ground survey data collection, conducted during low stream discharge conditions and following leaf shed associated with the predominantly deciduous hardwood canopy comprising the

riparian channel margins. The combination of low stream stage and leaf-off conditions provided optimal circumstances for resolving geomorphic features and characteristics of interest within the active channel; vegetation characteristics including approximate numbers and dimensions of mature hardwoods suitable for anchoring within riparian areas; and preliminary indications of suitable access routes for walking heavy equipment from Nordheimer Creek Road down to the channel while minimizing soil and tree canopy disturbance along lower canyon and valley sidewalls. The resulting orthomosaic covered Nordheimer Creek including the lower canyon walls and valley sideslopes up to stream station 105+00 (reach 5), and also included a section of the mainstem Salmon River from approximately ¼ mile upstream to approximately ½ mile downstream of the Nordheimer Creek confluence (Figure 1). The orthomosaic was co-registered with the recent 2014 bare earth LiDAR DEM of the Salmon River Watershed (QSI 2014) that included complete coverage of the lower four reaches of Nordheimer Creek; this was accomplished using a combination of ground control observations surveyed via RTK GPS in areas accessible by road, and by incorporating prominent landscape features (e.g. bedrock exposures) readily visible in both the UAV and LiDAR data. Geomorphic channel characterization and associated reach designations were then established based on the standards defined by Montgomery and Buffington (1997) during development of the 30% BODR (Fiori, 2019) and carried forward during subsequent design development.

In November 2020, the current design team conducted follow-up site investigations within reaches 1-4 to advance preliminary design concepts explored and initially evaluated at the 30% design level. Field work included flagging and GPS data collection to identify proposed treatment locations and potential equipment access routes; pre-implementation photopoint monitoring, measurement of bankfull width and depth dimensions, residual pool depth, riffle crest depth, substrate composition based on ocular pebble counts, determination of wood dimension, inventory, and anchoring materials needed; and facies and geomorphic field mapping through completion of sketches of each site location.

8 PROPOSED DESIGN

The goal of this restoration project is to restore natural stream processes and improve salmonid habitat by reintroducing large wood that was once persistent in these creeks and by enhancing vegetative cover in poorly functioning riparian areas. By reintroducing large wood to the system, the balance of organics, water and sediment can be put on a trajectory that will better support spawning and enhance cold water summer refugia for juvenile rearing; provide cover and improved foraging habitat; and result in a more diverse range of stream flow velocities including providing high flow refugia during periods of elevated stream discharge. These are key habitat features that adult and juvenile salmonids need to survive and thrive, and that have been drastically modified within much of the Salmon River Watershed, including Nordheimer Creek as a result of past mining, logging, and homesteading activities over the last 150 years. These land use practices used streams as a means of transport and for the extraction of alluvial mineral deposits, and later timber resources, without regard to natural stream function or ecology. Over the decades these practices caused significant loss of instream and riparian wood and alluvial gold mining resulted in the loss of smaller alluvial substrate, leaving a lag of coarse boulder substrate that is largely unsuitable for salmonid spawning and rearing.

The following proposed design elements have been developed to address the principal driving factors currently limiting greater salmonid utilization of lower Nordheimer Creek. These include a lack of available gravels of suitable size to support spawning in the lower reaches of the creek (SRRC, 2014); lack of a dominant channel at the confluence delta during lower stream flow conditions (Fiori, 2019); insufficient channel structure or roughness elements to provide high-flow refugia; infrequent pool

habitat with limited cover; and impaired riparian and floodplain function (NMFS, 2014) associated with poorly vegetated, persistent bars lacking the roughness elements needed to capture fine sediment and woody material in transport during higher flows.

Wood loading and riparian enhancement treatments have been prescribed on the basis of previous investigations and prior analyses (Fiori, 2019), input from TAC members following submittal of the 30% BODR (SRRC, 2019), and subsequent background research and site level analyses, drawing from similar, wood loading efforts recently implemented in Methodist and Knownothing Creeks involving the present design team members. The emphasis of the design elements presented focus on treating the reaches most indicative of the need and anticipated response of salmonids to improved habitat conditions and seeks to balance the inputs and address concerns expressed by the TAC at the 30% design phase.

The draft proposed design plan set can be found in Appendix A (Conceptual Plan Details) and Appendix B (Typical Design Details). Figure 5 presents an overview of conceptual design treatments in relation to geomorphic channel reach designation and by stream station within the Nordheimer Creek Project Area. Conceptual design figures include LiDAR-derived long profiles of channel segments portrayed within each design figure and include a point to indicate the location of proposed design features relative to the plotted stream profile. LiDAR-derived channel cross sections associated with each proposed feature location are also presented. Material and equipment needs for each proposed conceptual design feature are provided in embedded tables within each figure. Bankfull channel dimensions derived from field measurements were used in conjunction with LiDAR topography data to delineate bankfull channel dimensions associated with each proposed design feature, and are portrayed as a semi-transparent overlay on the December 2018 Nordheimer Creek orthomosaic base map. All conceptual design figures presented are oriented with true north facing up. Finally, panoramic pre-implementation site photos and associated photo-point position and direction indicators are presented to provide additional design context relative to existing channel conditions at proposed enhancement locations.

8.1 Willow Baffles

The project area includes multiple areas that have been identified as locations that would benefit from installation of willow baffles and riparian enhancement. The addition of these roughness elements will serve to enhance gravel bars that are currently lacking riparian vegetation; the intent is to start natural processes of riparian bank establishment through sediment deposition and accumulation of organic matter that will allow for recruitment of alder and other riparian vegetation. Over time this will have a secondary benefit of reducing solar exposure along the open bars within the project reach. The first of these proposed locations is along the left bank of the mainstem Salmon River, at the confluence bar immediately upstream of the mouth of Nordheimer Creek. The second proposed location occurs along the right bank of Nordheimer Creek at station 3+00 near the upstream boundary of reach 1. These proposed treatments have been developed as a paired design feature (Figure 5) to address factors affecting juvenile rearing conditions and access to lower Nordheimer Creek during summer/fall low flow periods. These treatments will enhance riparian function, reduce water temperatures, and provide velocity refugia during high flow events within the mainstem at the confluence. A secondary benefit of this site is sediment deposition that will promote a dominant channel during low flow periods of the summer and fall. Willow baffles have also been proposed at station 36+00 along the right bank of the channel to enhance riparian conditions and address the coarse cobble/boulder lag deposit that has persisted in a poorly vegetated condition for several decades based on previous evaluation of historic aerial imagery.

8.2 Large Woody Material

Large wood (logs and logs with rootwads) will be installed throughout the Nordheimer Creek project reaches (Appendix A). The purpose of the large wood is to mimic natural stream conditions where wood was an important component of salmonid habitat including: creating overhead cover, maintaining scour pools and shallow water habitat, and providing high flow refugia. Given the history of salvage logging and stream clearing within the Nordheimer Creek watershed, the current density and sizes of instream large wood pieces are relatively low compared with pre-management conditions. The project reaches have some naturally occurring large wood; however, it is relatively sparse and natural recruitment is limited.



Large wood will be installed in jams along the channel banks and active channel margins. These log jams will be placed in a variety of configurations designed to mimic natural large wood jams, improve habitat conditions, and remain stable through

flood events. Stability of the logs will be provided by key log size and through hard anchoring techniques (Appendices A and B). In addition, logs will also be woven into existing mature riparian trees. It will be assumed that the chosen existing mature trees are stable during floods. Thus, the stability of the attached logs will be reliant on the anchor rigging. The estimated dislodging forces acting on each anchor contact point will be smaller than the rigging capacity and include an estimated factor of safety of at least 1.5. Built-in anchor redundancy is preferred to prevent log movement and downstream transport (Appendix B). Movement of logs diminishes their ability to provide habitat, and downstream transport may result in logs being flushed out of the system.

A natural, channel-spanning log jam comprised of broadleaf hardwoods was discovered in reach 2 during site investigation and assessment work completed in November, 2020. This was the largest and most complex accumulation of woody material encountered within the project area. Opportunities to develop similar jams through targeted accelerated recruitment in reach 3 are presented in Appendix A.

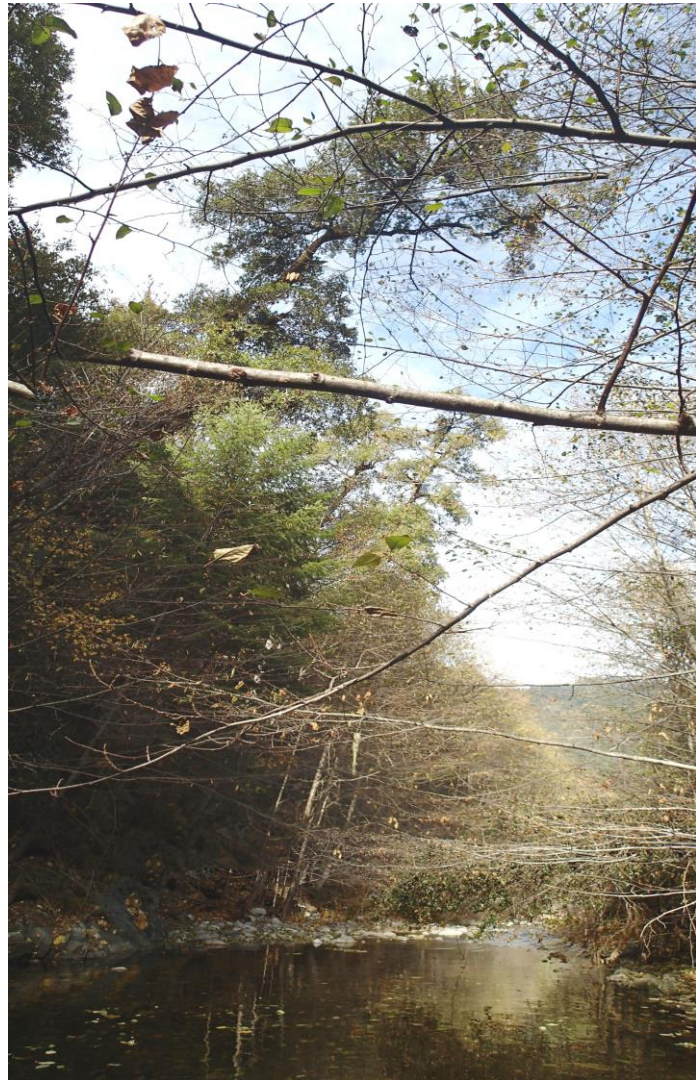
The large woody material (LWM) anticipated for project use will likely consist primarily of Douglas fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). However, several large hardwoods have been identified for accelerated recruitment at two identified site locations (Appendix A). LWM will be placed in different configurations and positioned in a manner that different sections of the logs will interact with the sites at different water depths. This is important due to seasonal variation in flows and water levels throughout the year. Although large wood installation typically involves a fit-in-the-field approach to optimize the morphology and hydraulics at each location, the following section describes the typical configurations proposed for the project.

8.2.1 Bank-Based Deflector Log Jam

The proposed design uses multiple bank-based deflector log jams (Appendix B, Sheet C4) on both the left and right banks of Nordheimer Creek (Appendix A). The bank-based jam was designed to replicate similar wood jams typically located on outside channel bends. These designed LWM jams are proposed at single locations, in-series along the same bank and also alternating along banks in relatively close proximity (Appendix A). These structures will be constructed using either: 1) a spider hoe or hydraulic excavator and hand labor, or 2) helicopter drop with spider hoe and/or hand labor assist depending upon location and access logistics.

8.2.2 Spanner Jam

The proposed design uses either a bank-based structure on both banks to support the spanner log, or a bank-based structure supporting the spanner on one side and the spanner log anchored to bedrock on the opposite bank (Appendix B, Sheet C3). The log spanner will be located above bankfull depth on one bank and below bankfull depth on the opposite bank. The spanner jam was designed to replicate similar wood jams, where large, keys logs become wedged at natural constrictions or onto existing bank-based jams. These structures will be constructed



Several large Canyon live oaks, some of which exhibited partial crown death, were encountered growing on steep slopes and partially overhanging the channel within reach 3. Access for heavy equipment is limited within this portion of reach 3, making accelerated recruitment a compelling treatment option for improving cover and providing high-flow refugia in this location.

using either: 1) a spider hoe or hydraulic excavator and hand labor, or 2) helicopter drop with spider hoe and/or hand labor assist.

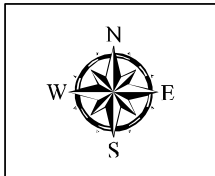
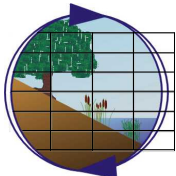
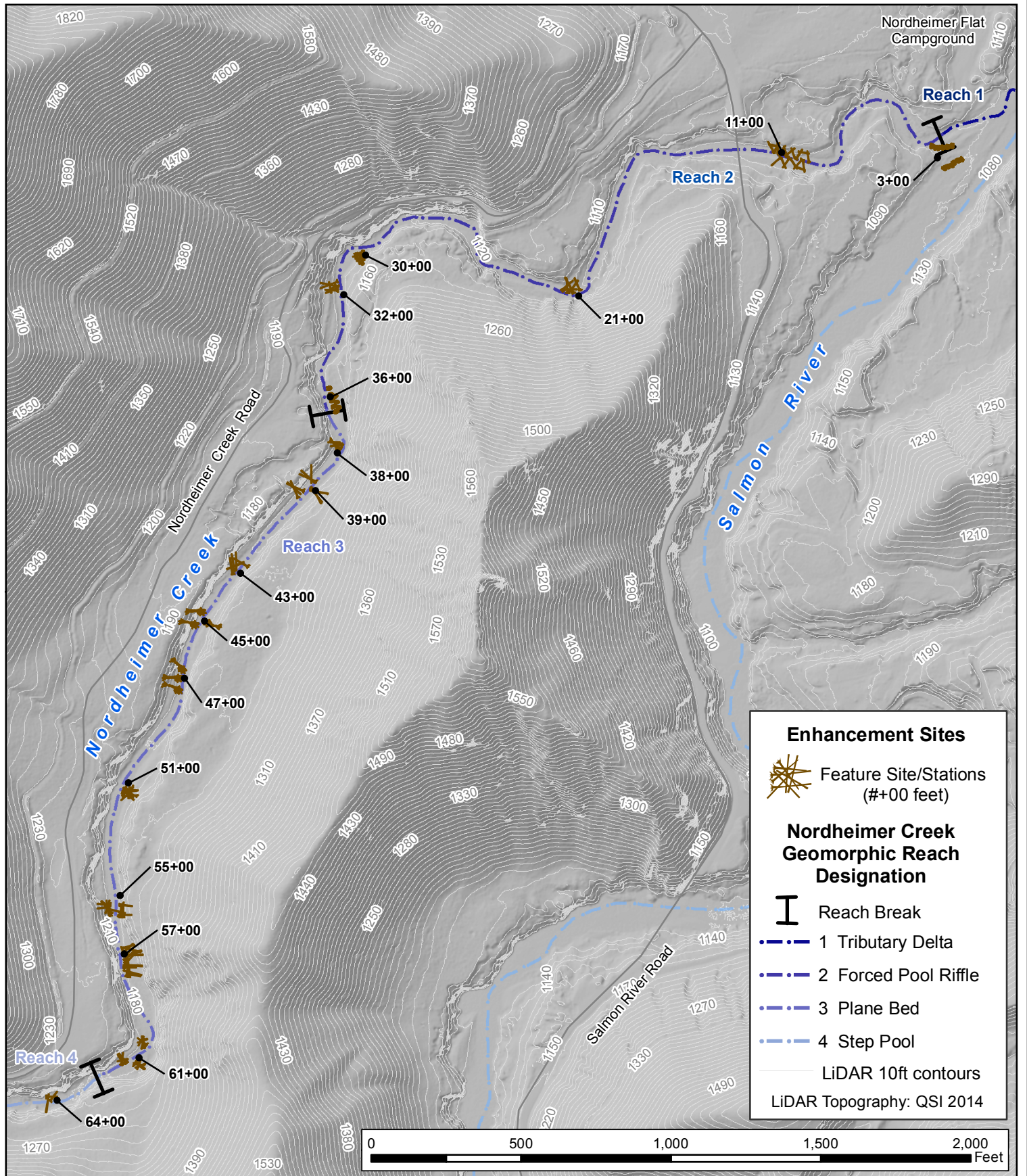
8.2.3 Accelerated Recruitment

The project area includes two site locations where small groves containing large Canyon live oaks (*Quercus chrysolepis*) occur on steep slopes above the channel within reach 3, and where equipment access to the channel appears impractical. Several of these trees appear to be perched above the channel and opportunistically available for accelerated recruitment, including at least two individuals exhibiting partial crown death in November 2020. The proposed design includes precision falling of several of these trees into the channel to accelerate natural processes already on-going. The trees proposed for recruitment will meet the Key Log standard specified in the design plans (Appendix B) for unanchored wood, and provide a unique opportunity to introduce, complex, desirable roughness elements and cover to a relatively inaccessible, unstructured section of this plane-bed dominated reach.

8.2.4 Unanchored Helicopter Wood Loading

With strategically placed and anchored, bank-based and channel spanning large wood structures underpinning the proposed enhancement design and providing critical roughness elements (currently lacking within the reaches proposed for treatment) to capture mobile wood within the system in place, additional unanchored helicopter wood loading is proposed with an emphasis on reaches 2 and 3. A total of 60 whole trees meeting Key Log minimum size standards for unanchored wood (Appendix B) are recommended for helicopter-based placement beginning immediately upstream of the proposed bank-based LWM jam located at Station 21+00 above the Nordheimer Creek Bridge and continuing upstream to Station 65+00 near the lower end of reach 4 (Figure 5). Unanchored helicopter log distribution will generally be proportional throughout reaches 2 and 3. However, the exact location of each log will be determined prior to helicopter arrival, through a field-based assessment to determine actual log drop locations. If sufficient funding is available and can be leveraged to support it, unanchored wood loading efforts could be extended further upstream within reach 4 and possibly reach 5 if it is determined that potential mobilization of unanchored wood poses an acceptable risk to the fish ladder present at station 85+40.

The total number of whole trees recommended for unanchored helicopter placement represents approximately 30-35% of the total large wood by volume, prescribed in support of the proposed LWM design within reaches 1-4. This element of the project is intended to bridge the gap between the installation of anchored/secured LWM jams needed to help entrain woody material transported during high flow events and the time anticipated for maturation and subsequent availability of sufficient trees to support natural recruitment of woody material to the channel. Given the history of large wildfires, subsequent salvage logging and stream clearing activities within the basin, the proposed placement of unanchored wood will provide immediate direct benefits of additional cover and habitat, while delivering the raw materials necessary for kick-starting a more process-based approach to large wood recruitment, entrainment, and enhancement of instream habitat complexity within the system.



Overview of Proposed Enhancement Treatments

Nordheimer Creek Habitat Enhancement Project
Basis of Design, Siskiyou County, California

Figure 5

9 PROJECT CONSTRAINTS

A number of potential constraints to project implementation were considered and evaluated during development of proposed designs. These are identified and described below.

9.1 Water Supply

Beyond existing natural climate and precipitation variability, there are no current indications that water supply will be impacted by this project. Implementing the proposed design will not impact natural water supply in the basin.

9.2 Water Quality

Water quality has not been identified as a constraint. Application of standard BMPS will be sufficient to address any concerns relating to water quality that may arise as a result of implementation. Appendix B, Sheet C-6 contains water quality monitoring requirements and water management details aimed at minimizing water quality impacts during construction.

9.3 Existing Infrastructure

The Nordheimer Creek Bridge on Salmon River Road has been identified as the principal infrastructure of concern associated with this project. The application of key piece log sizing criteria in conjunction with anchoring and weaving of bank-based jams to live alder and maple trees growing in the riparian corridor, or alternatively bedrock outcroppings/exposures along channel margins will mitigate the risk of wood mobilization and minimize potential for impacts to the bridge associated with project implementation. In addition, the overall span between the existing bridge piers (90 ft) and headwall height to the lower bridge cord ordinarily allow for the effective conveyance of LWM through the structure. Historically, the bridge has not been a site that collects or racks LWM during high magnitude storm events.

9.4 Biological Restrictions

Designated critical habitat for Northern Spotted Owl (*Strix occidentalis caurina*) is present in close proximity to the project area but does not appear to include the lower portions of the Nordheimer Creek basin, presumably due to the lack of mature and/or old growth forest cover associated with the lower portion of the watershed. The project team will confer with the USFS to determine whether any actions should be taken during project implementation to avoid potential impacts.

The Southern Oregon – Northern California Coast (SONCC) Evolutionary Significant Unit (ESU) coho Salmon (*Oncorhynchus kisutch*) population may be present within the project area as may Upper Klamath-Trinity River (UKTR) spring-run Chinook (*Oncorhynchus tshawytscha*), which have been recently petitioned for listing under the Endangered Species Act and whose status is currently under review. Addressing the potential presence of these and other salmonids within the project area can be effectively dealt with using a combination of implementation timing and construction-related BMPs to avoid and/or minimize any threats posed by project construction.

9.5 Large Wood Decay

Conifers likely to be sourced locally and used for construction of instream wood structures in Nordheimer Creek include Douglas fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Decay rates have been estimated to range from 25 – 60 years for Douglas fir (Johnson and Stypula,

1993). No published decay rates were found for incense cedar, however; it is considered comparable in rot-resistance to Western red cedar (ODOT, 2014) which can be expected to persist for 50-100 years (Johnson and Stypula, 1993) in instream applications that assume cyclical wetting and drying. These estimated decay rates are compatible with the design life of the project and therefore do not represent a constraint to the proposed project.

10 PROJECT COSTS

Estimated project construction costs are shown in Appendix D. The preliminary cost estimate was prepared with a 10% contingency for the project to account for fluctuations in material costs, field adjustments during structure placement and willow baffle installations, and for unforeseen conditions encountered during construction. The cost estimate includes line items with unit costs, and total costs for each heavy equipment and labor category, as well as material needs that are anticipated during construction. Costs were based on quantities estimated from the conceptual designs/drawings and typical design details, and from material and installation costs. The cost estimate assumes that all dredge spoil material will be reused onsite and large wood structure material will be purchased offsite. The cost estimate covers all implementation costs, but does not include project administration, permitting and post-project monitoring or reporting costs.

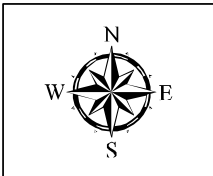
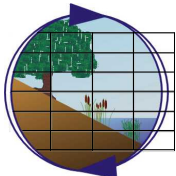
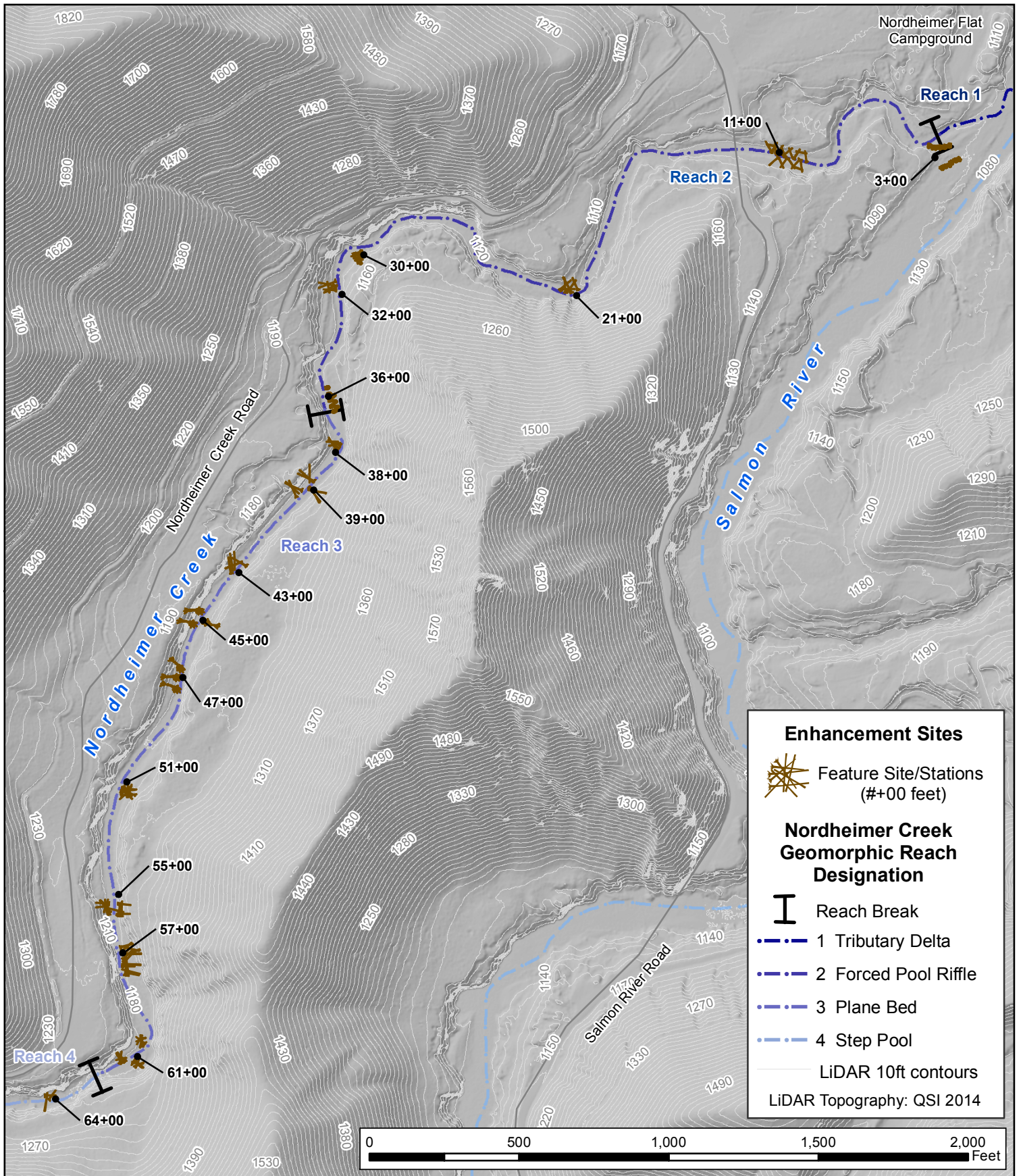
The estimated project cost for construction of the instream structures, willow baffles, accelerated recruitment tree falling, and helicopter delivery of unanchored key logs is estimated at \$708,466 (Appendix D). However, it should be noted that the estimated costs described can be highly volatile and subject to change rapidly due to unanticipated changes in market value of materials, shortages in heavy equipment/labor availability because of wildfires or other natural disasters, and other unforeseen circumstances.

Finally, this project was budgeted as a stand-alone project, and helicopter mobilization represents a significant proportional cost to completing the project. During actual implementation planning, helicopter mobilization costs may be reduced by splitting/sharing these costs with other potential nearby projects, such as wildfire suppression, logging, or other restoration projects. However, to ensure the project can be implemented as a stand-alone project, we have developed the budget under the assumption that no helicopter cost-sharing would be available.

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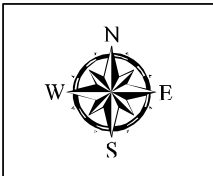
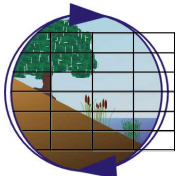
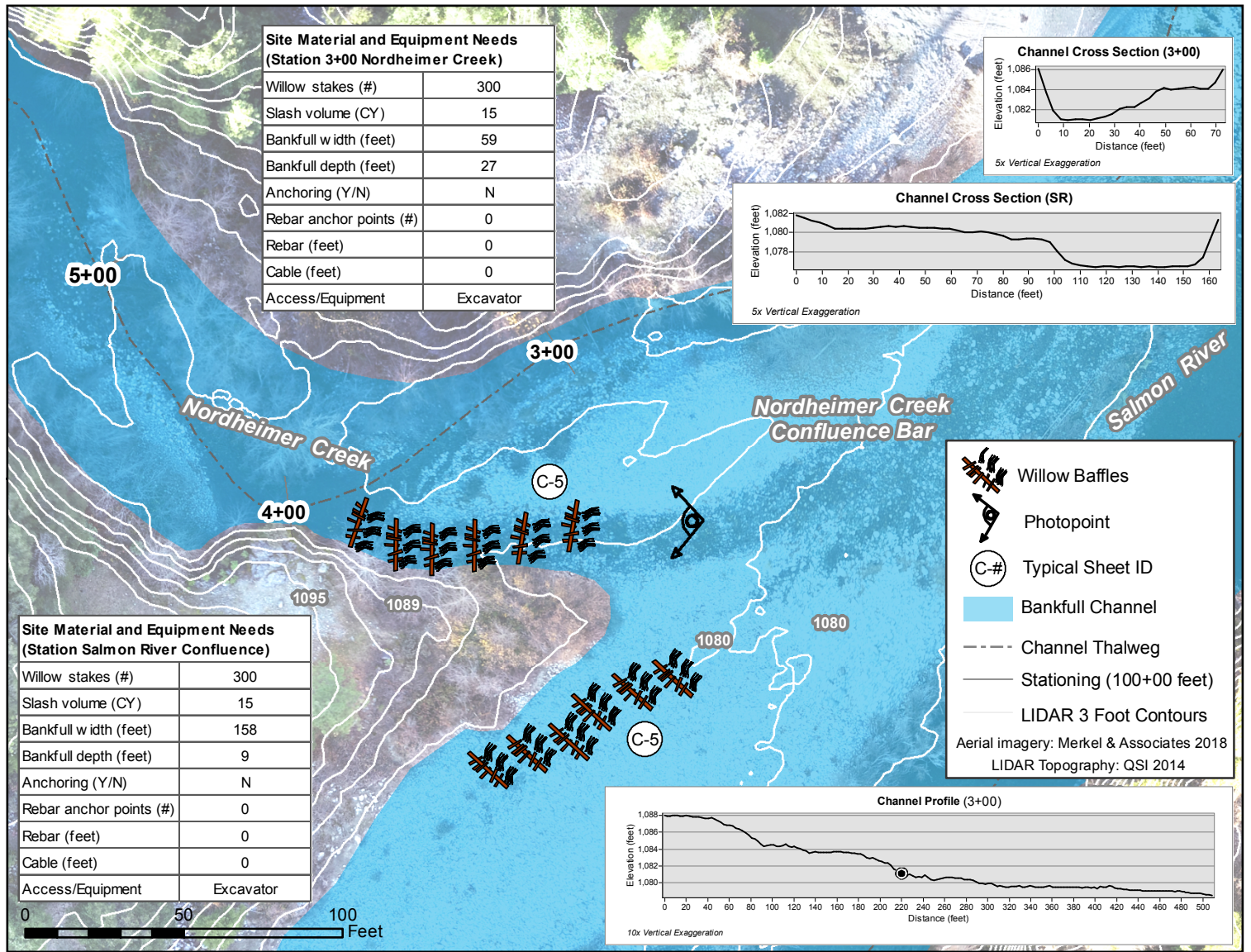
APPENDIX A
(CONCEPTUAL DESIGNS)



Overview of Proposed Enhancement Treatments

Nordheimer Creek Habitat Enhancement Project
Basis of Design, Siskiyou County, California

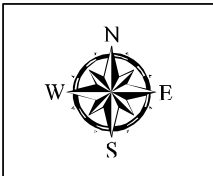
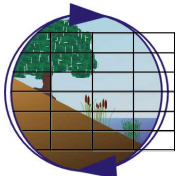
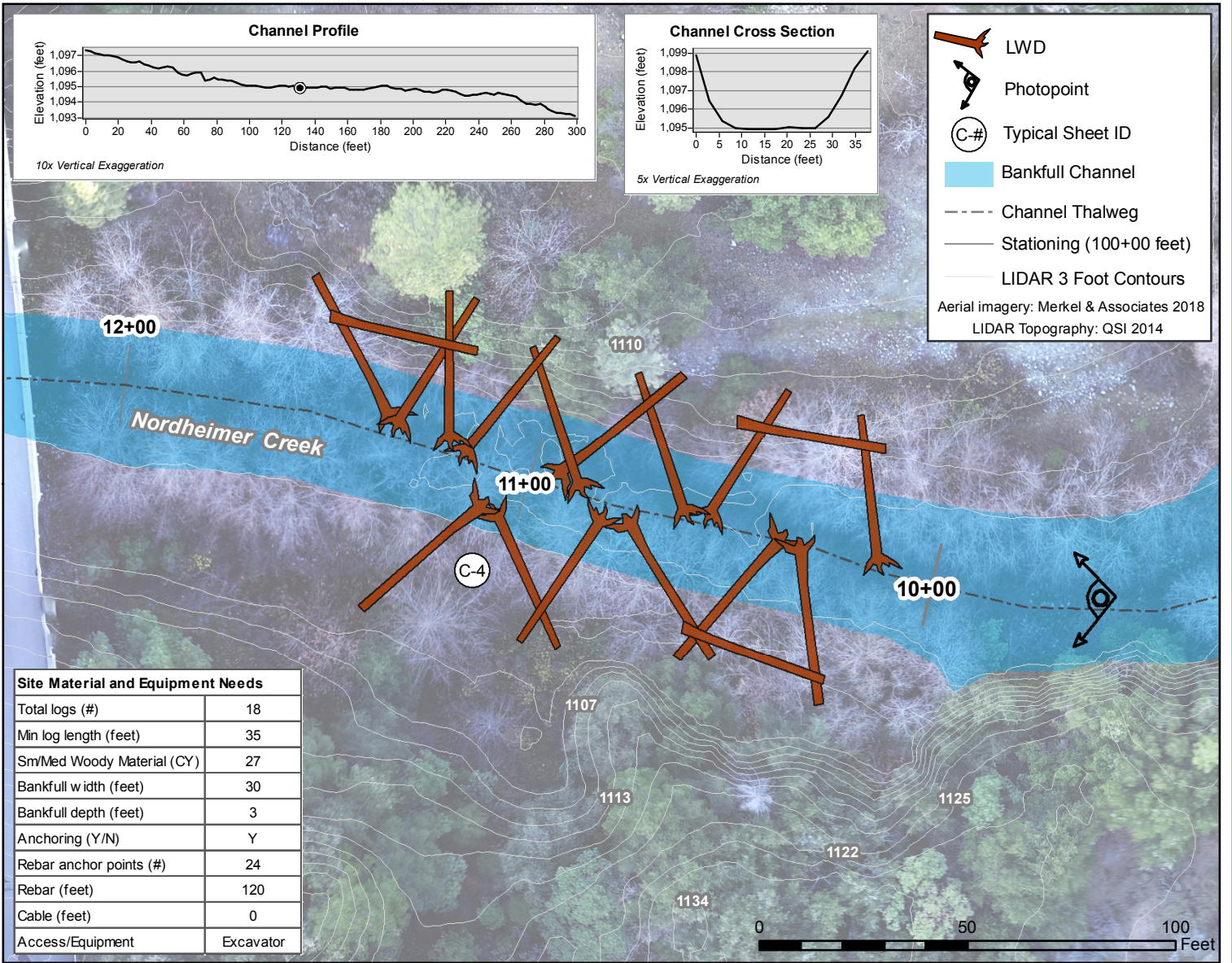
Figure A-0



Site 3+00 (Reach 1) and Confluence Bar (Mainstem)

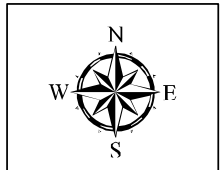
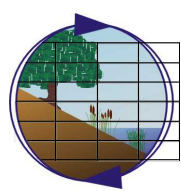
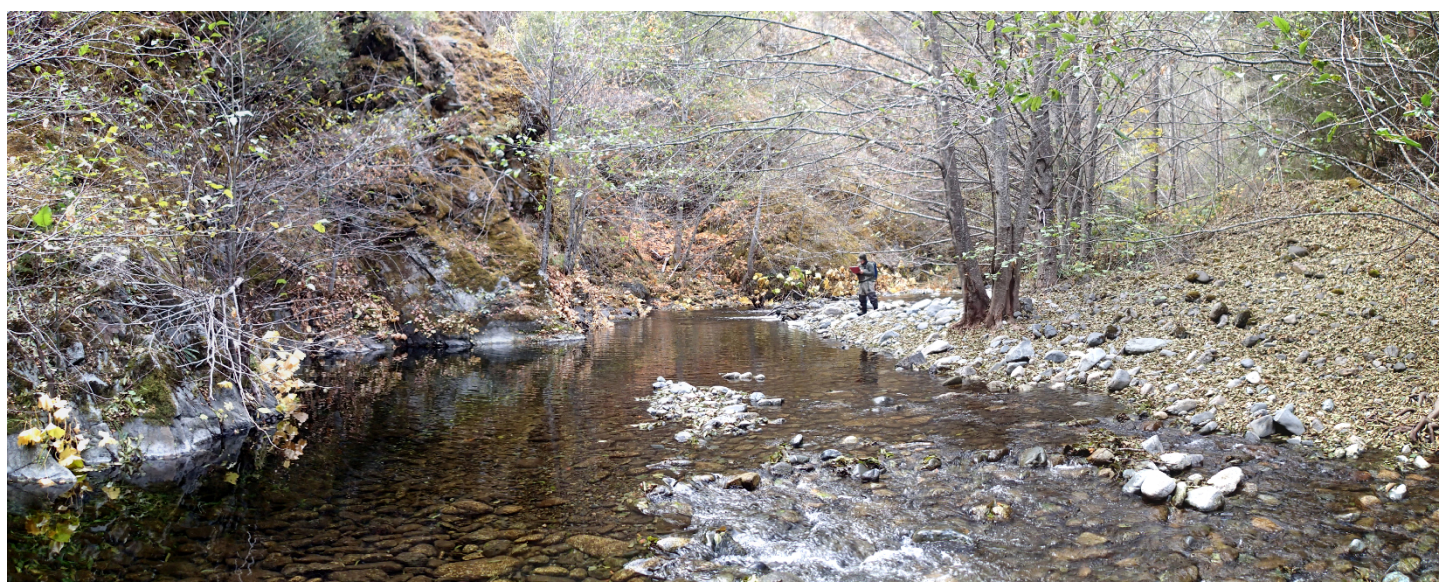
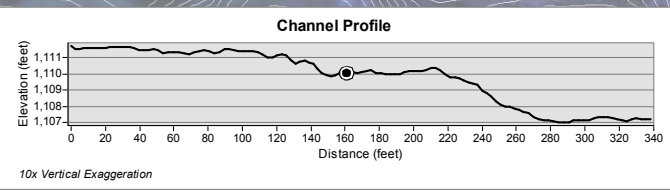
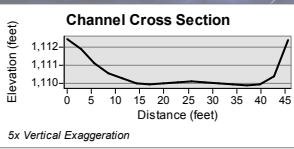
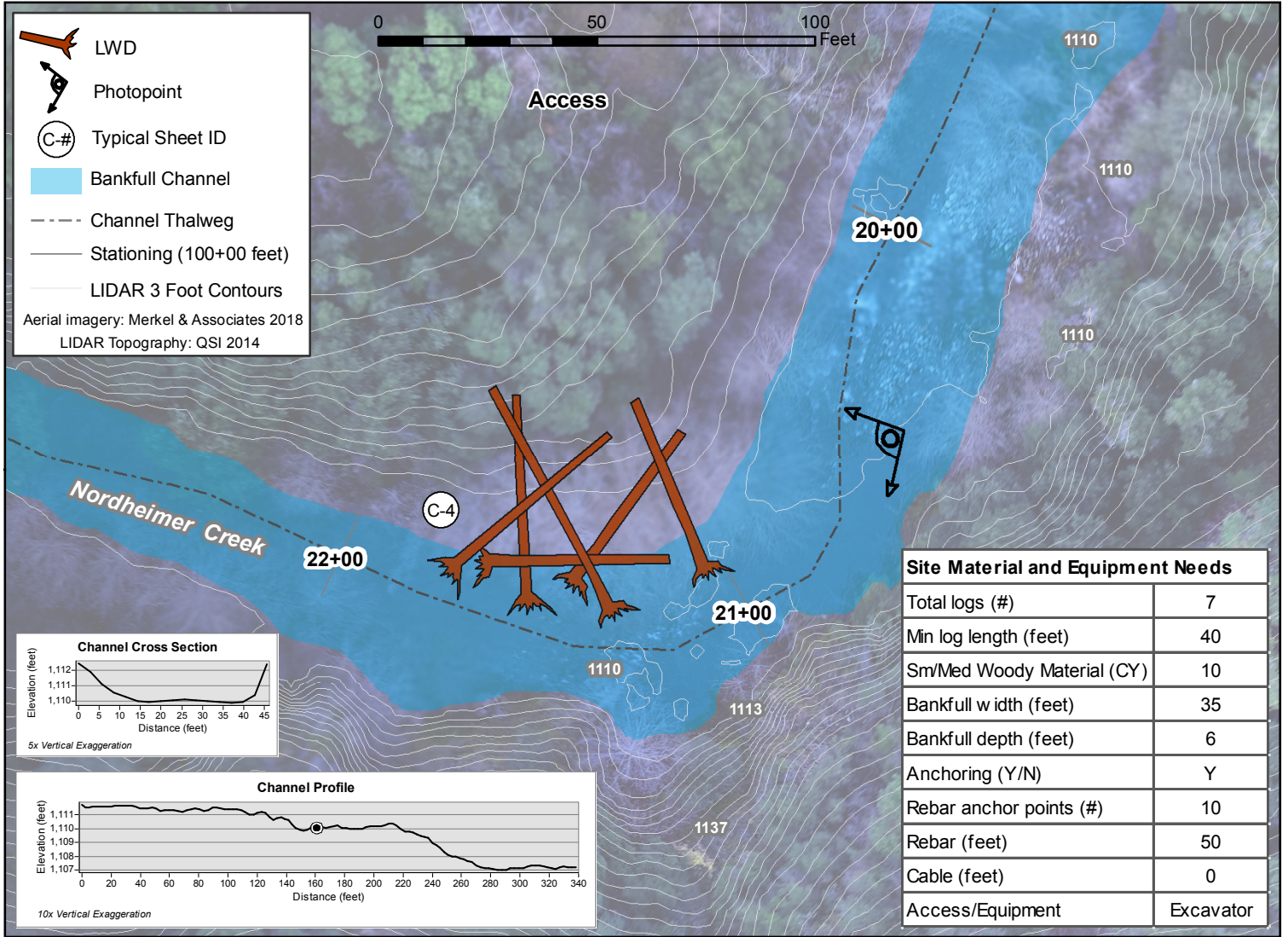
Nordheimer Creek Habitat Enhancement Project
Basis of Design, Siskiyou County, California

Figure A-1



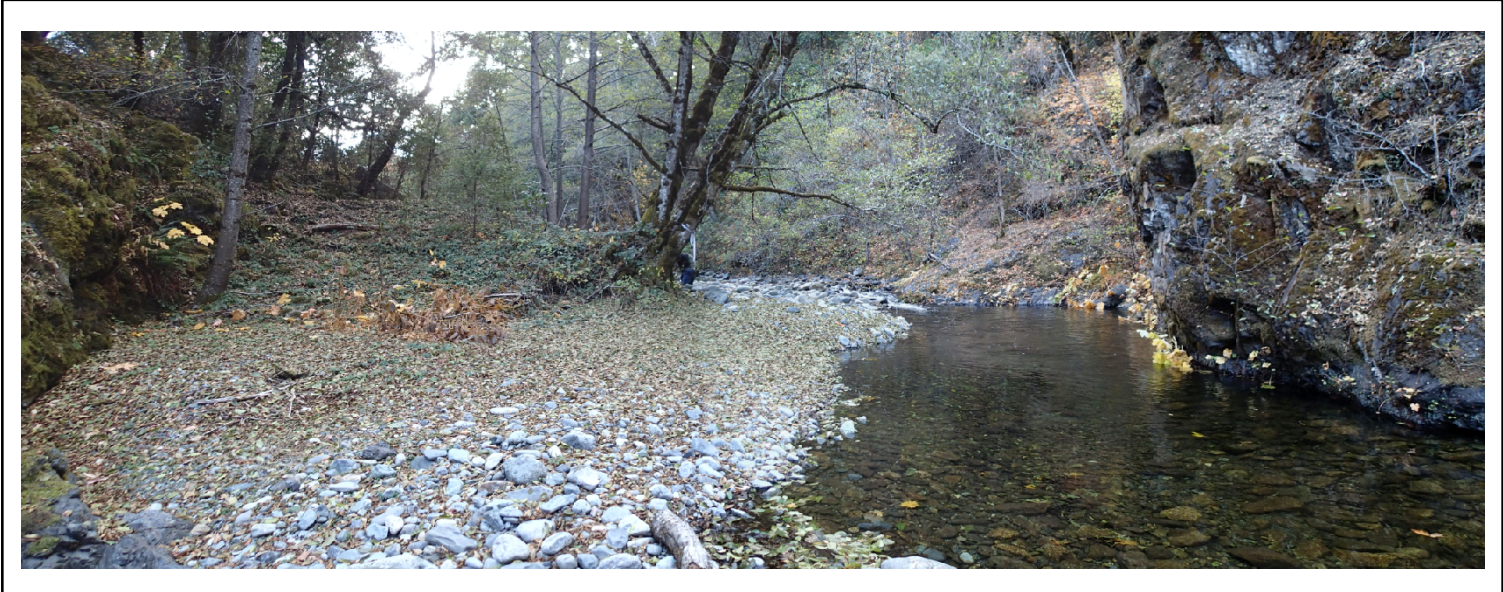
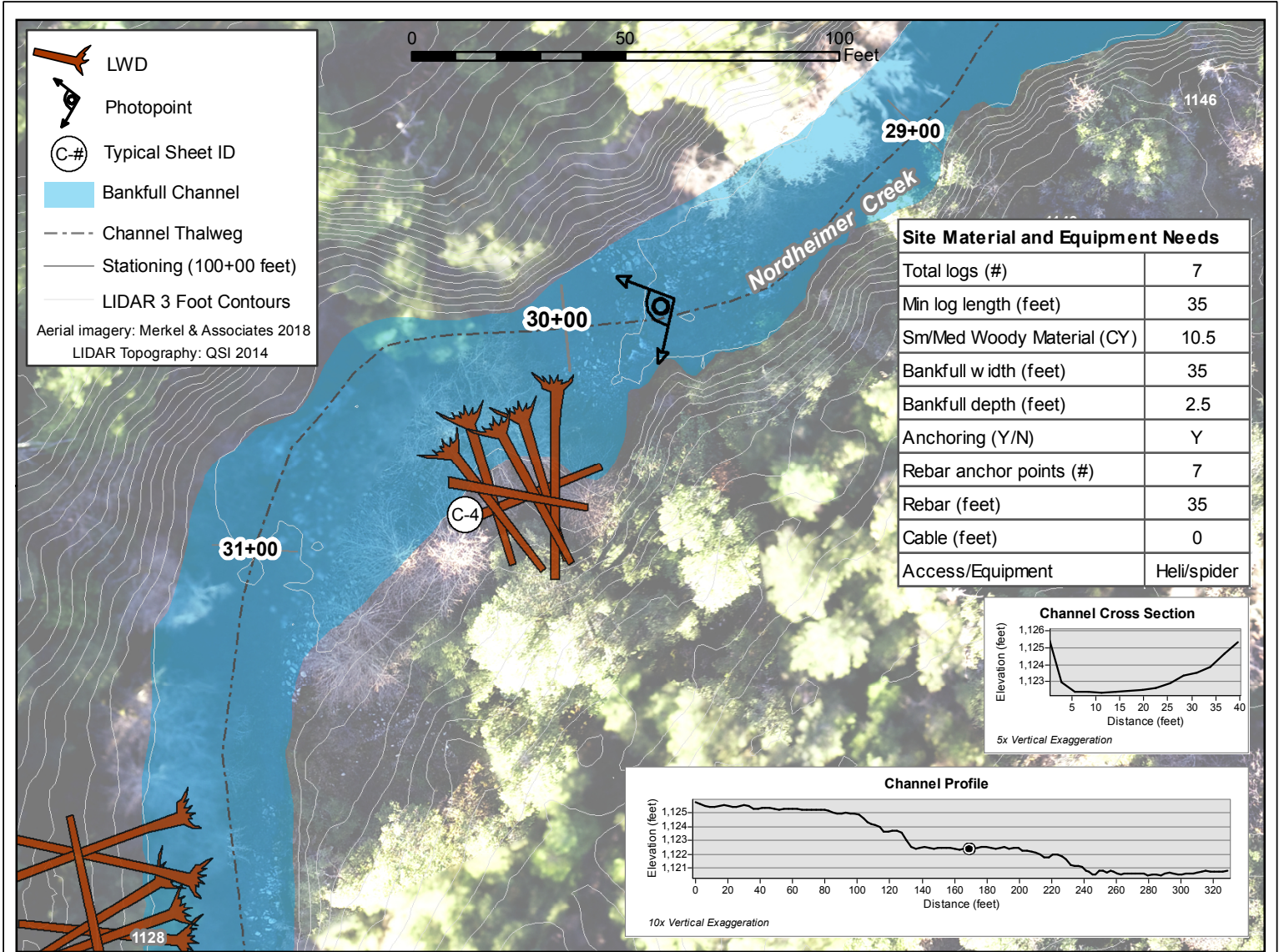
Site 11+00 (Reach 2)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-2



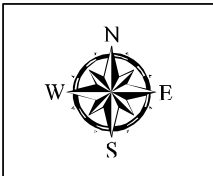
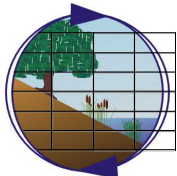
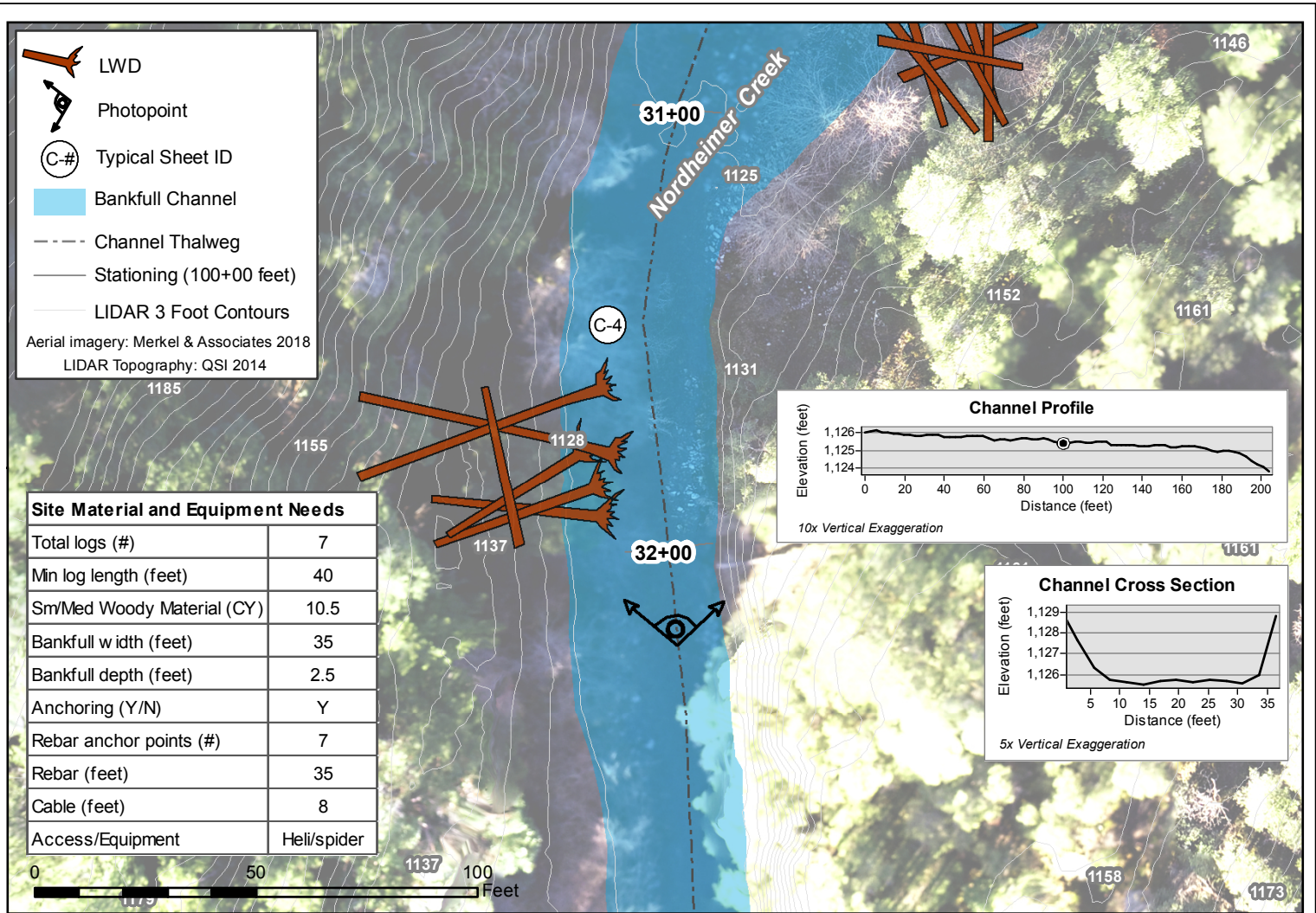
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 Basis of Design, Siskiyou County, California

Figure A-3



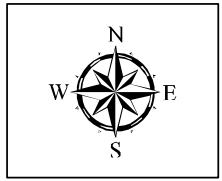
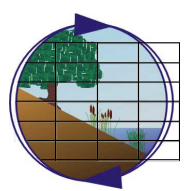
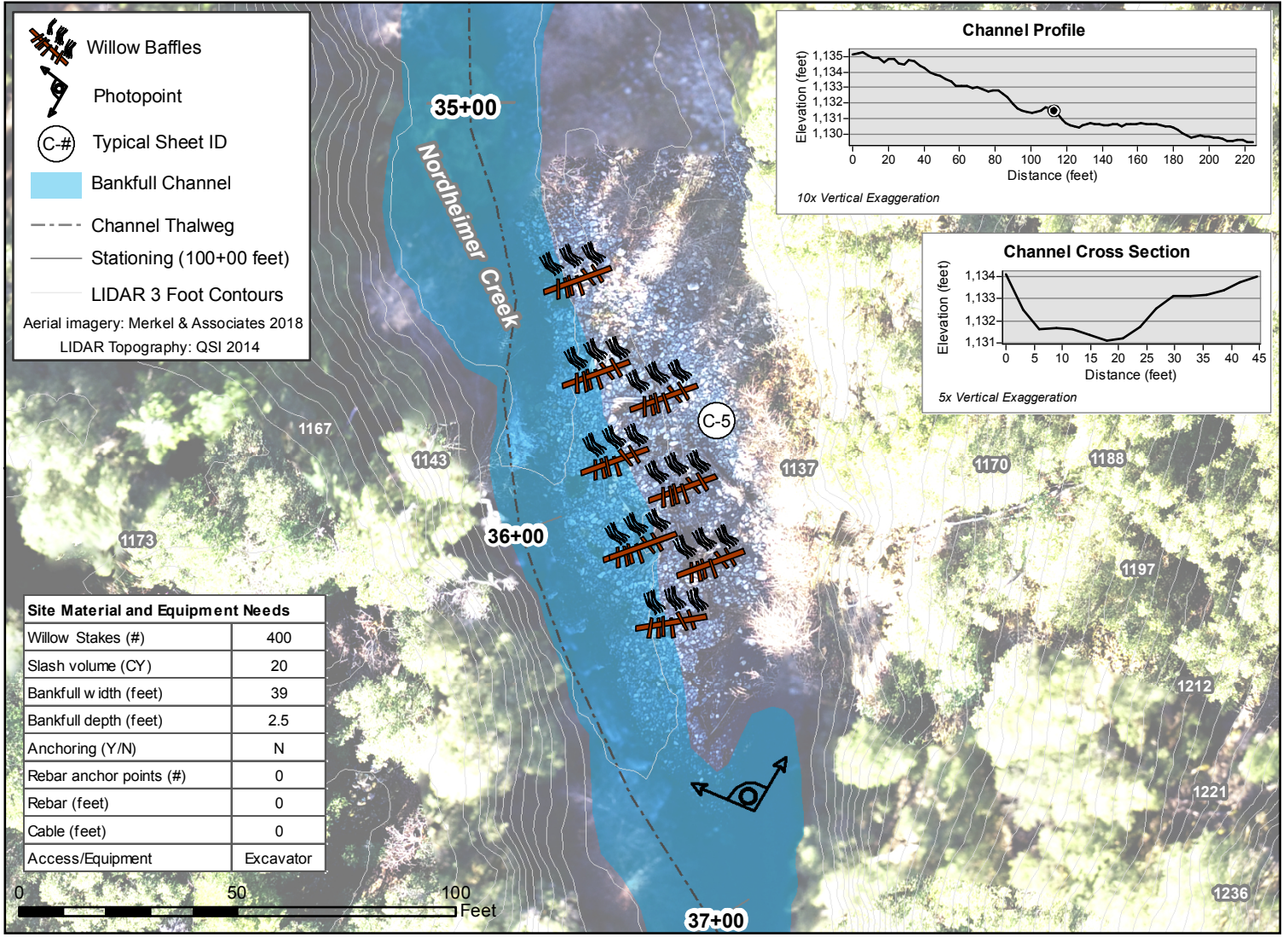
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Nordheimer Creek Habitat Enhancement Project
Basis of Design, Siskiyou County, California

Figure A-4



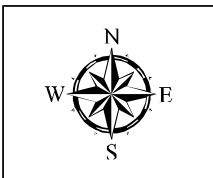
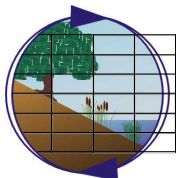
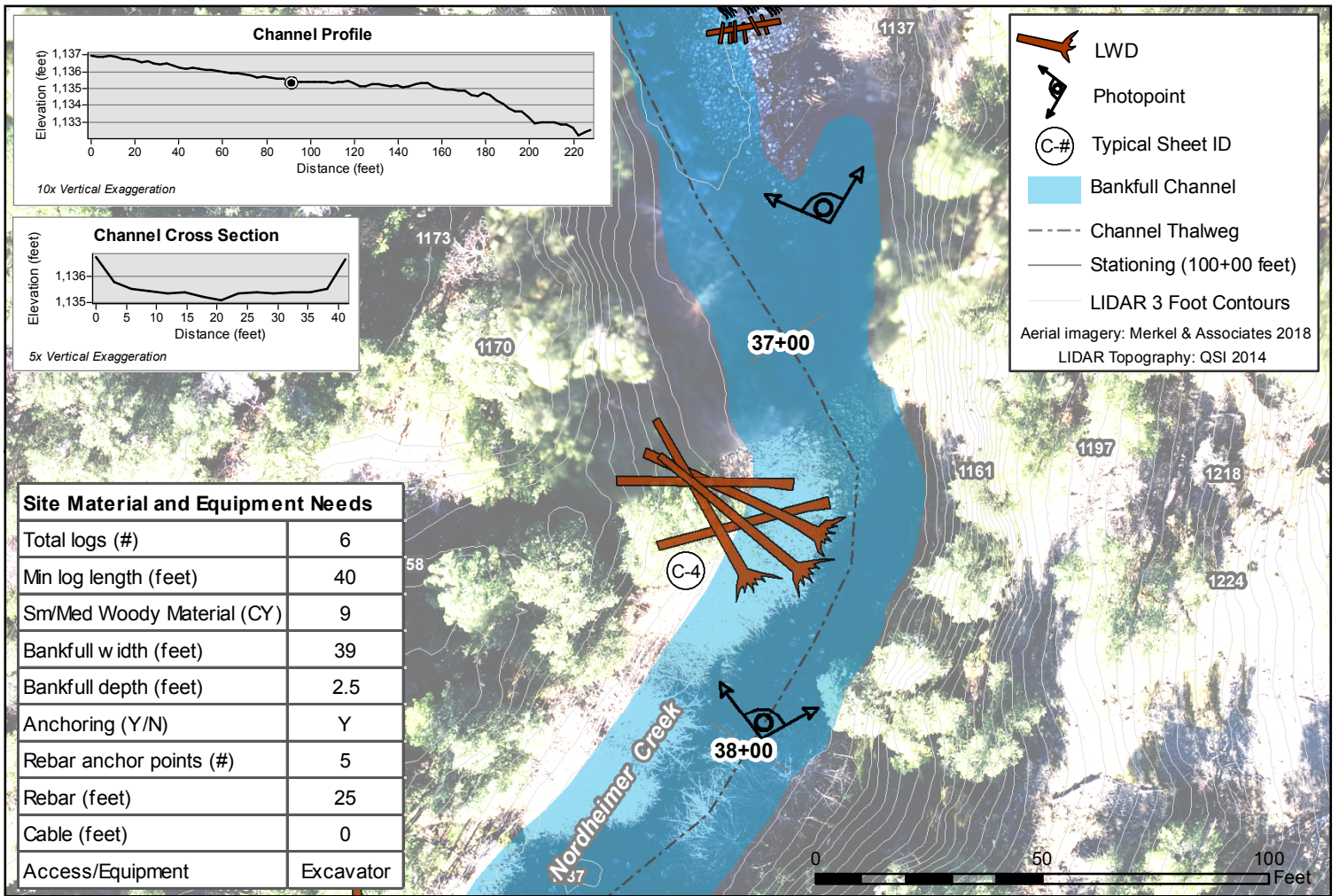
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 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-5



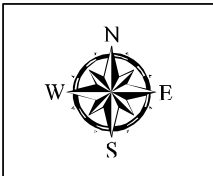
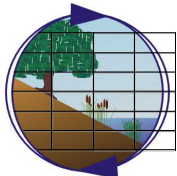
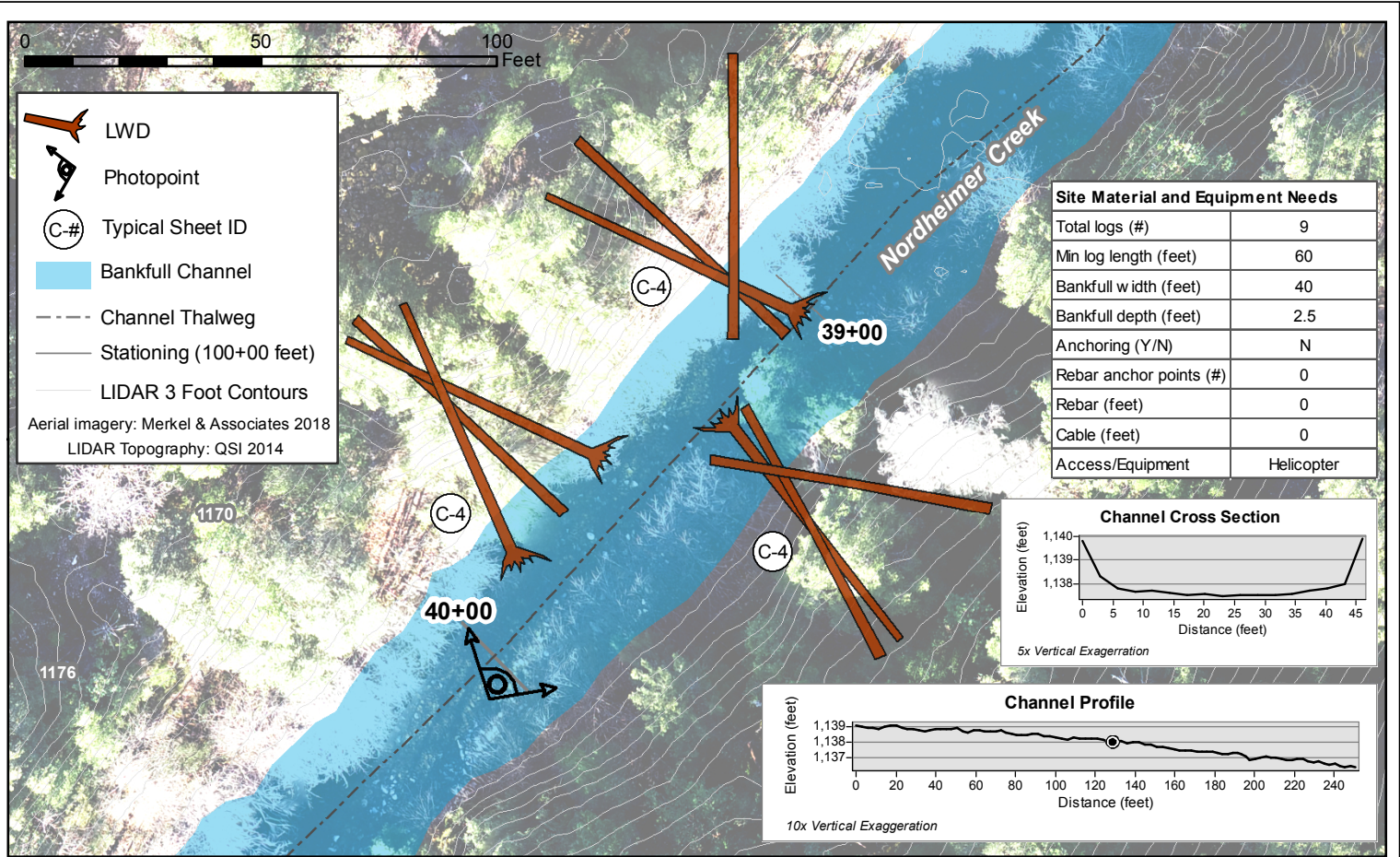
Site 36+00 (Reach 2)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-6



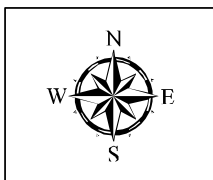
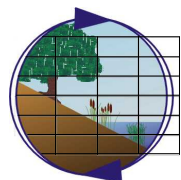
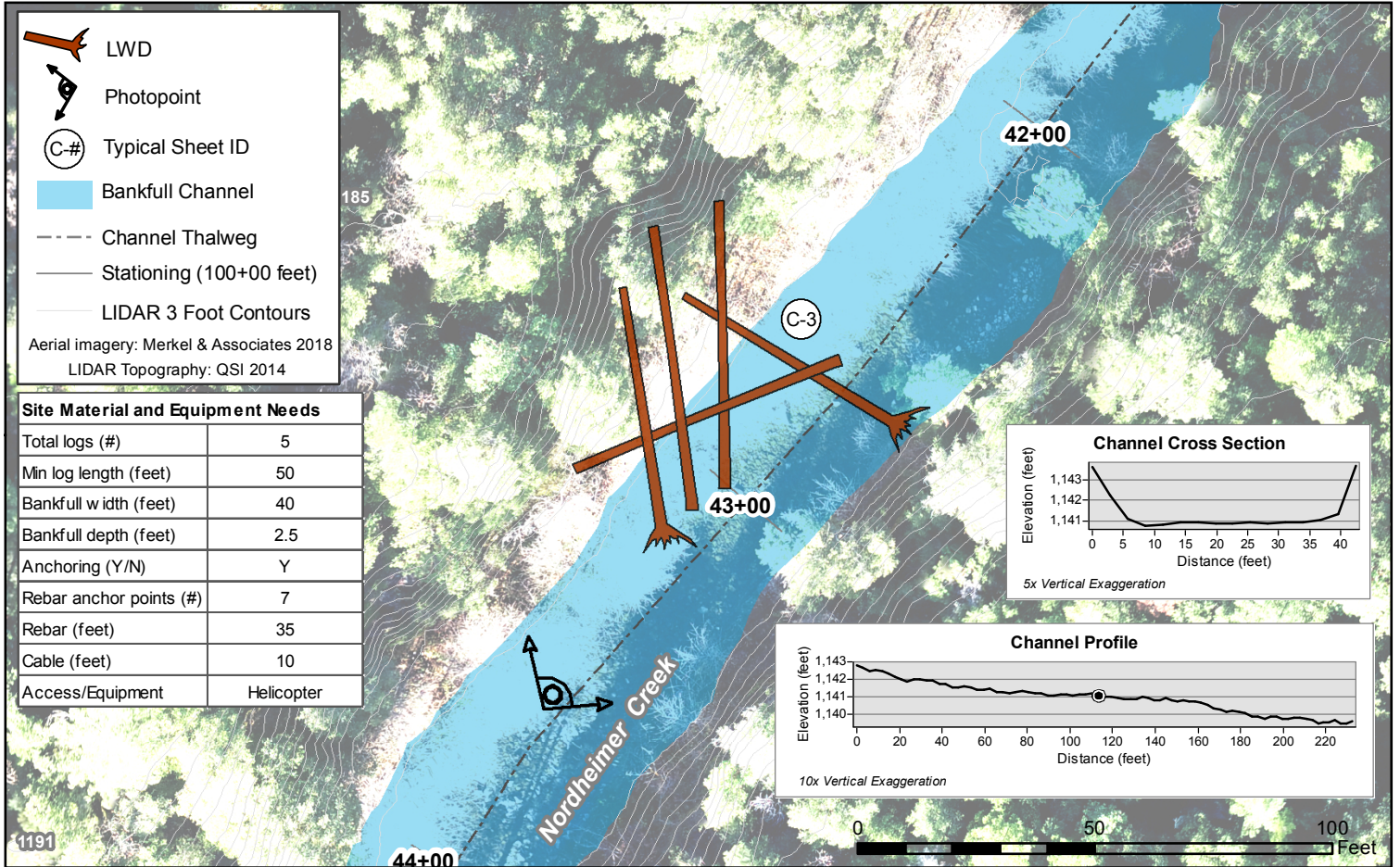
Site 38+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-7



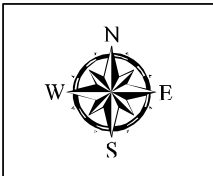
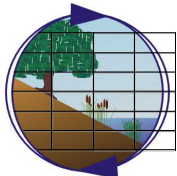
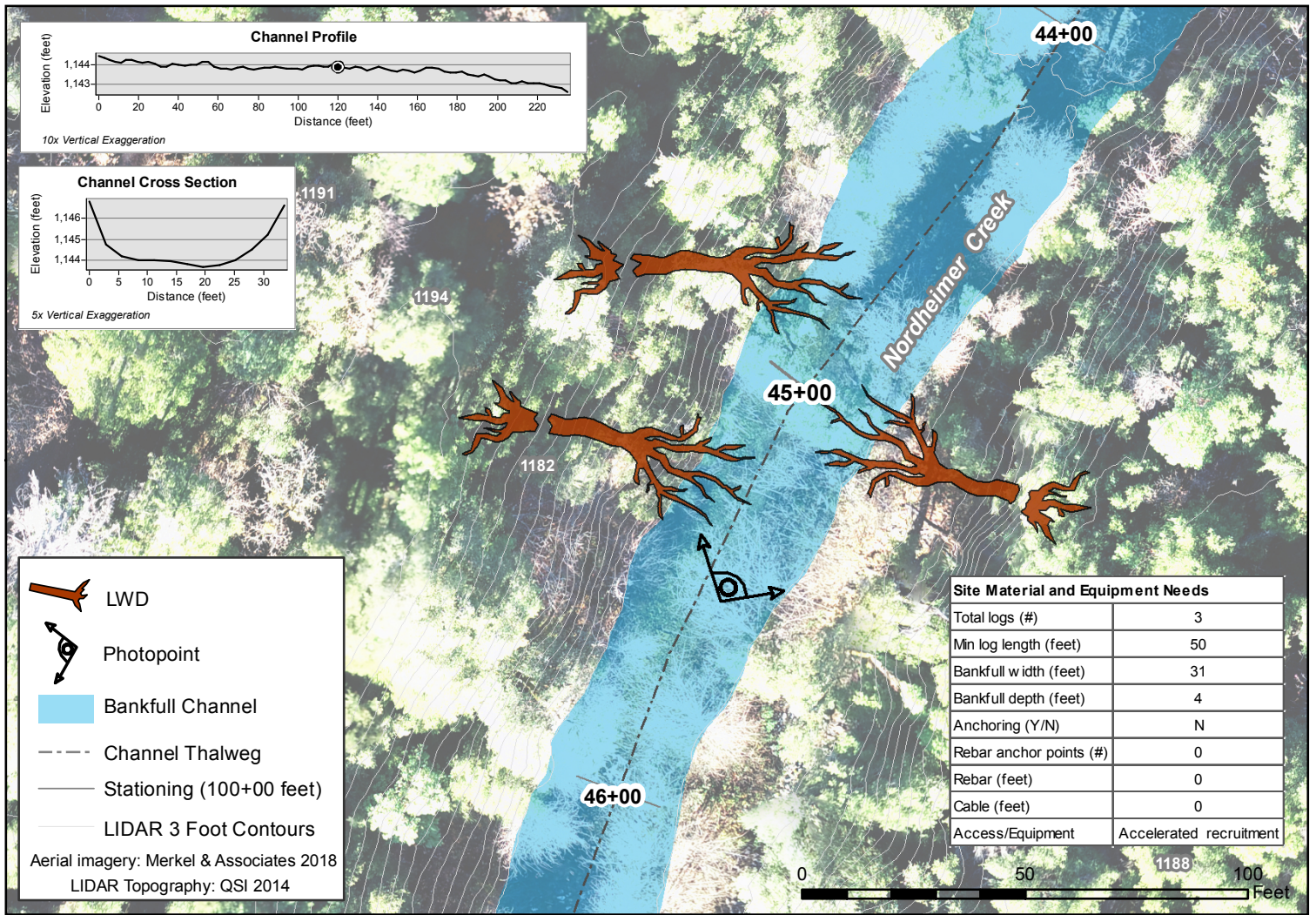
Site 39+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-8



Site 43+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California







Figure A-9



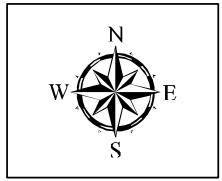
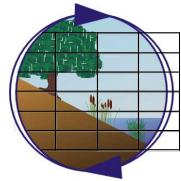
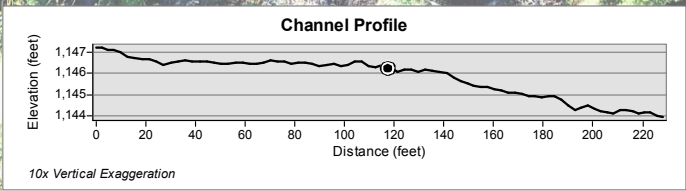
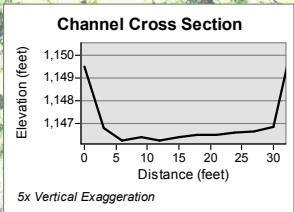
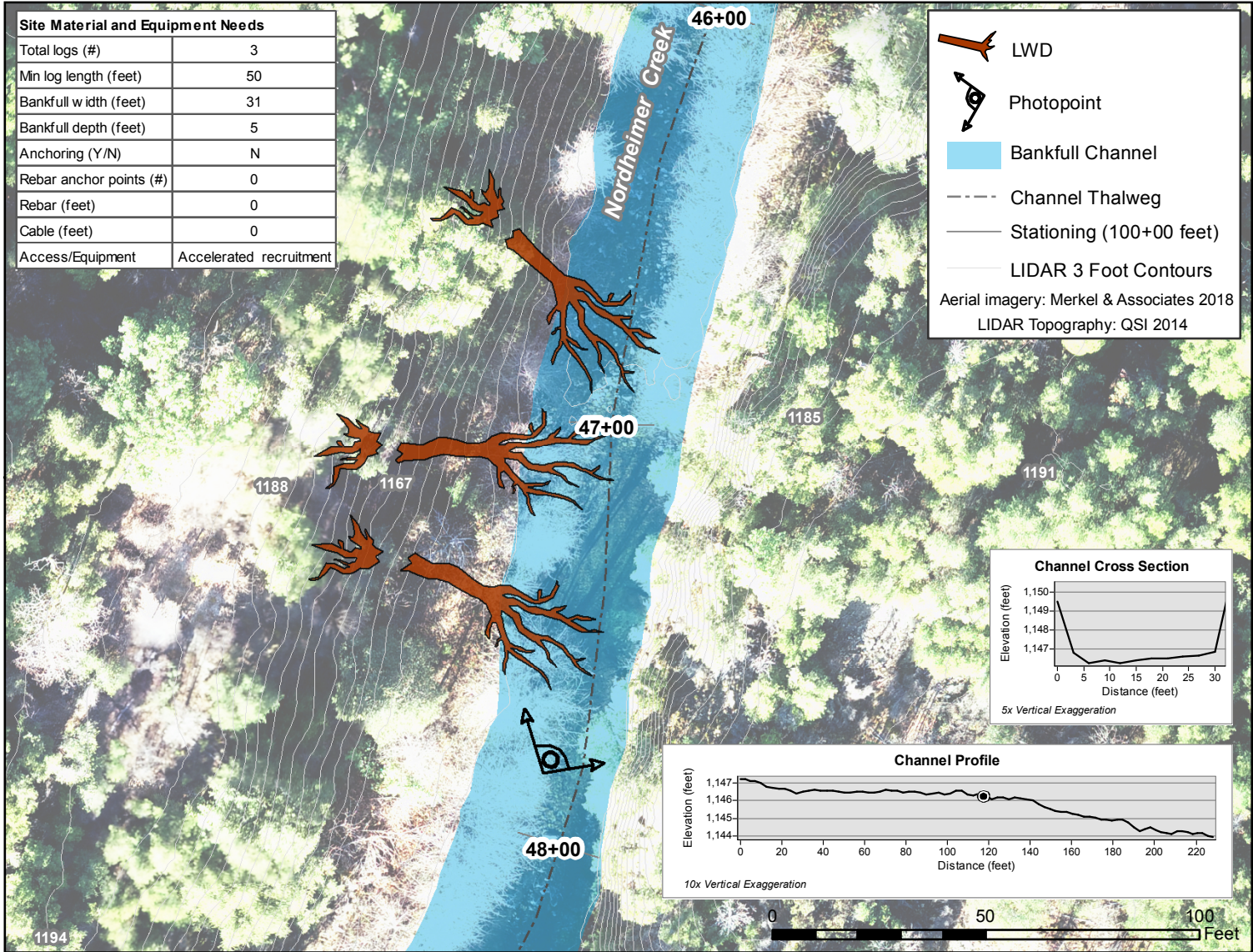
Site 45+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-10

Site Material and Equipment Needs	
Total logs (#)	3
Min log length (feet)	50
Bankfull width (feet)	31
Bankfull depth (feet)	5
Anchoring (Y/N)	N
Rebar anchor points (#)	0
Rebar (feet)	0
Cable (feet)	0
Access/Equipment	Accelerated recruitment

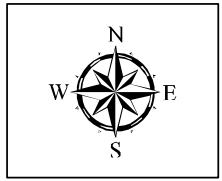
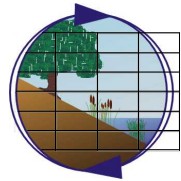
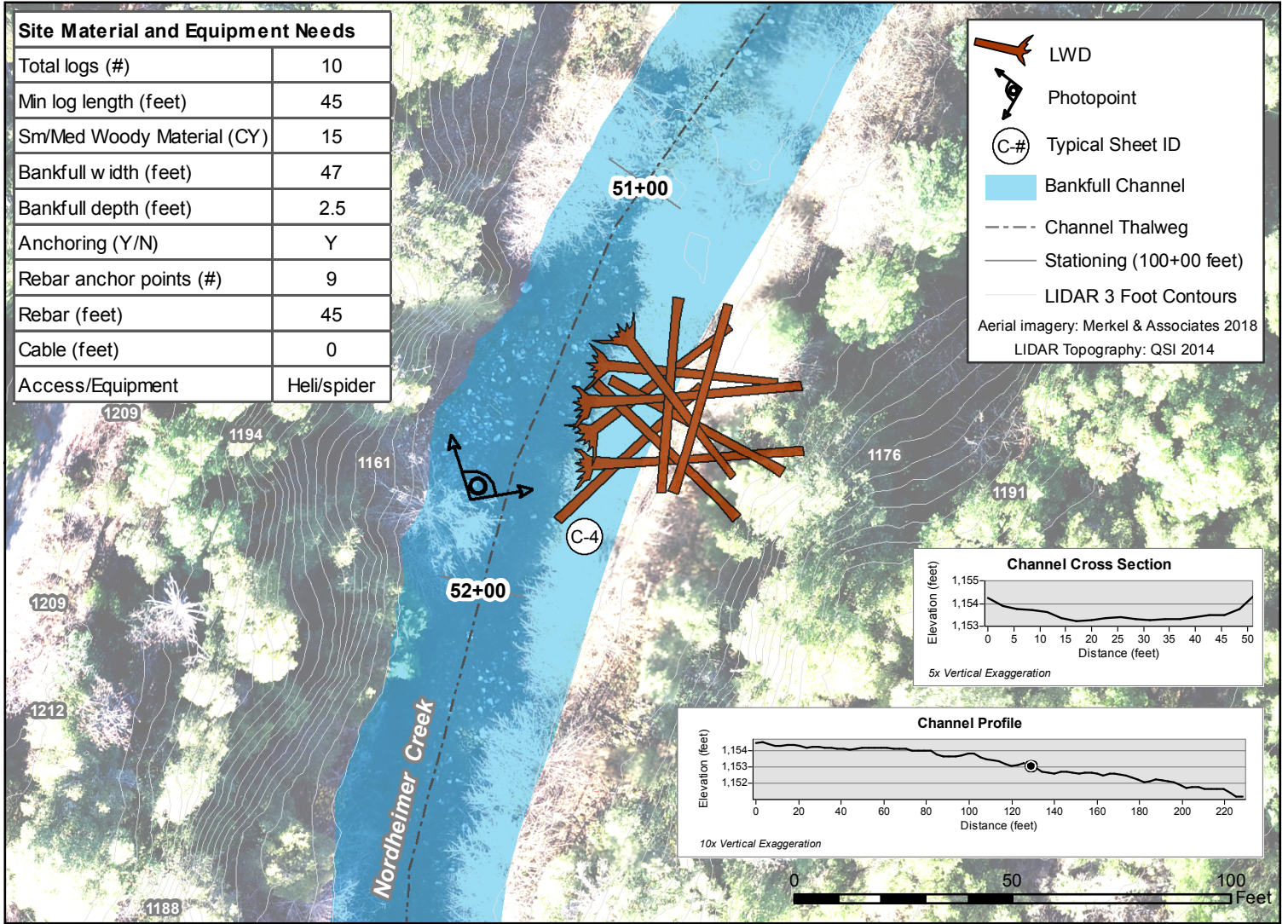
-  LWD
-  Photopoint
-  Bankfull Channel
-  Channel Thalweg
-  Stationing (100+00 feet)
-  LIDAR 3 Foot Contours

Aerial imagery: Merkel & Associates 2018
LIDAR Topography: QSI 2014



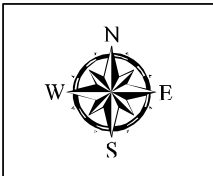
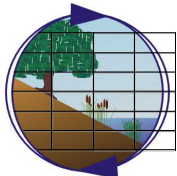
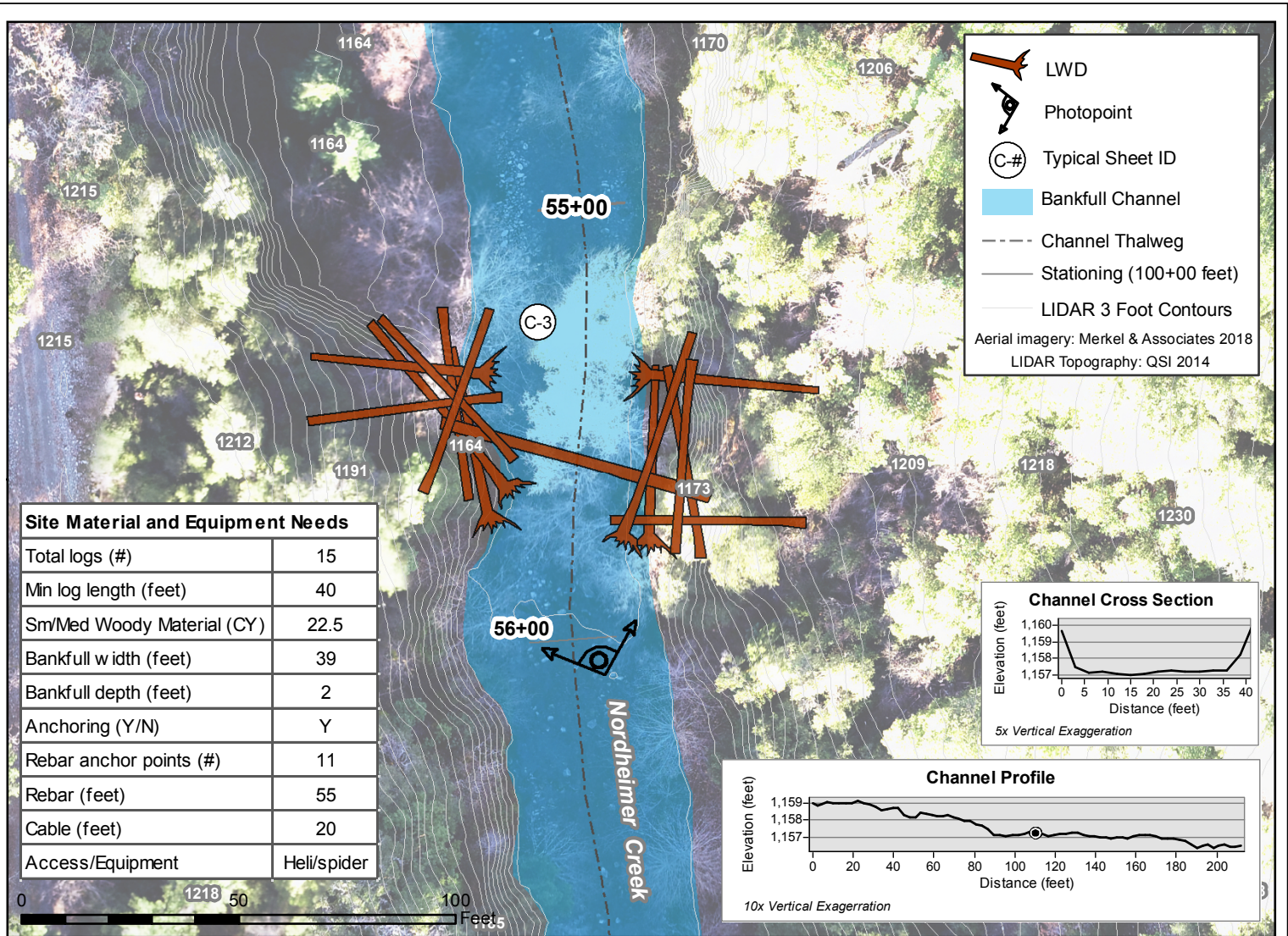
Site 47+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-11



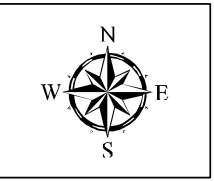
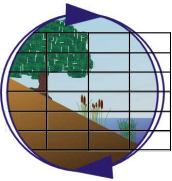
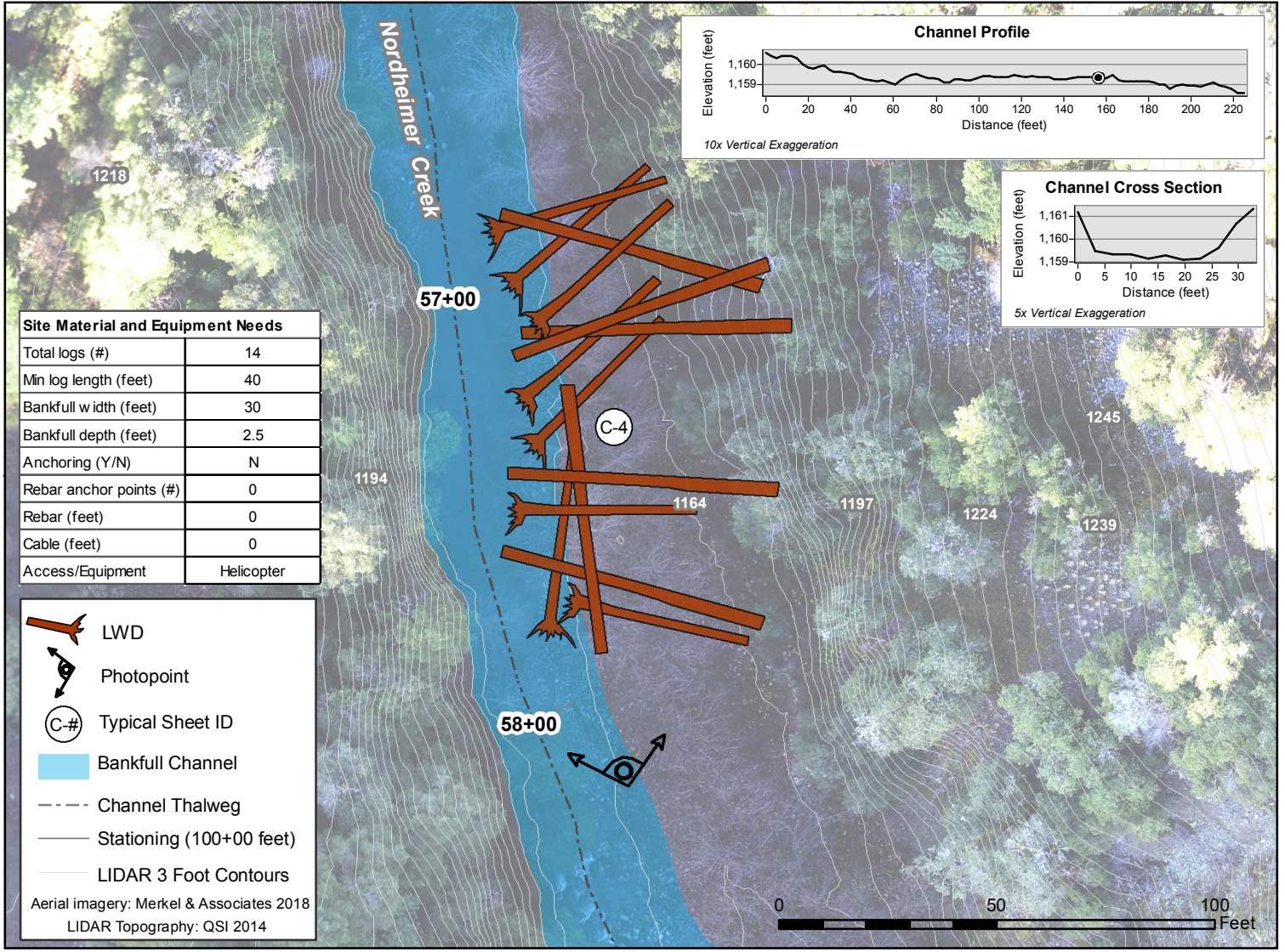
Site 51+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-12



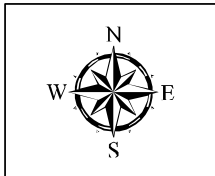
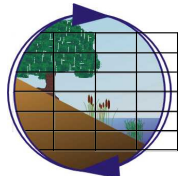
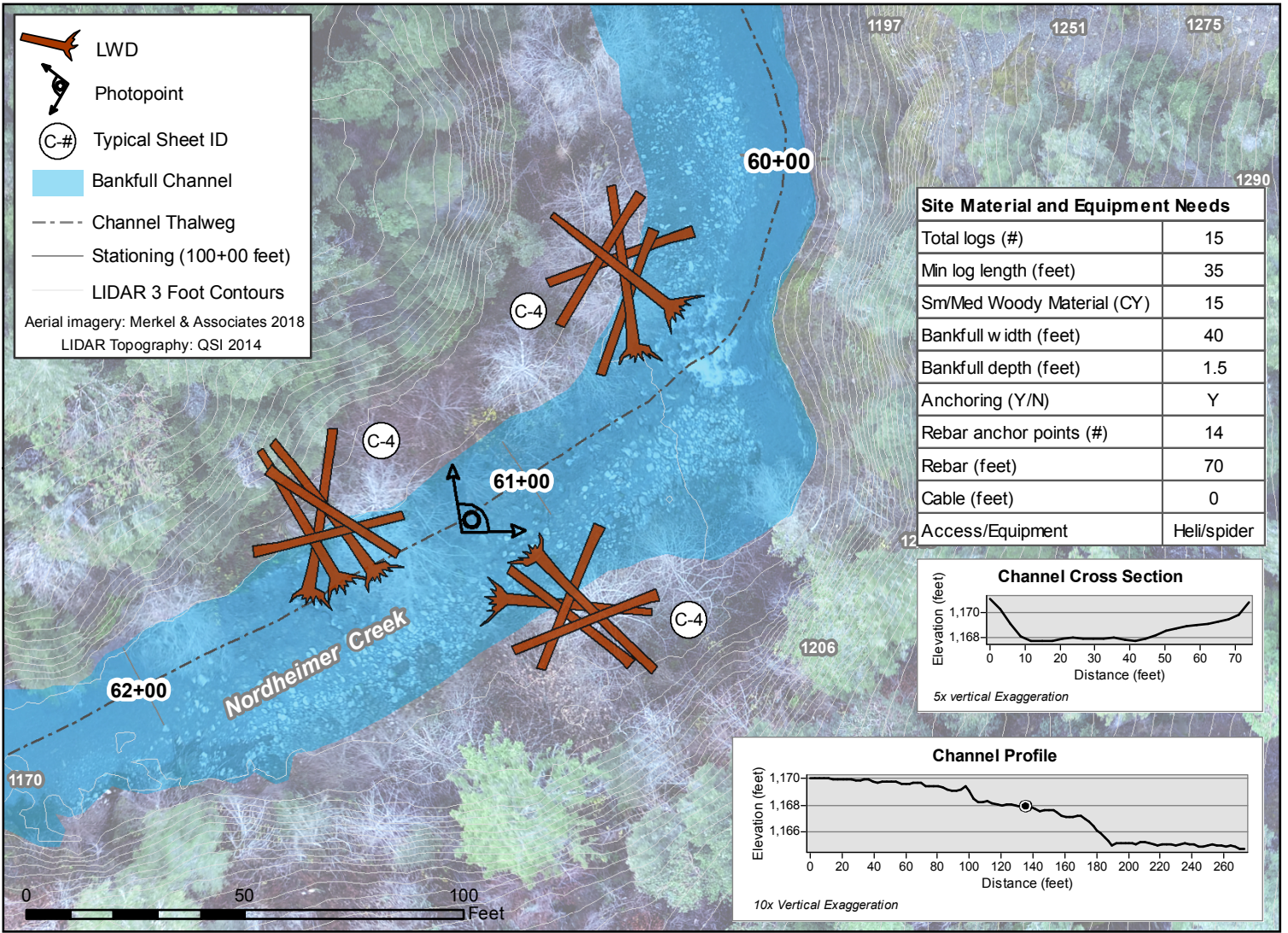
Site 55+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-13



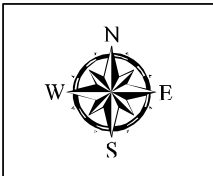
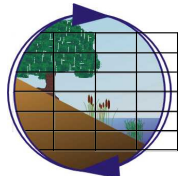
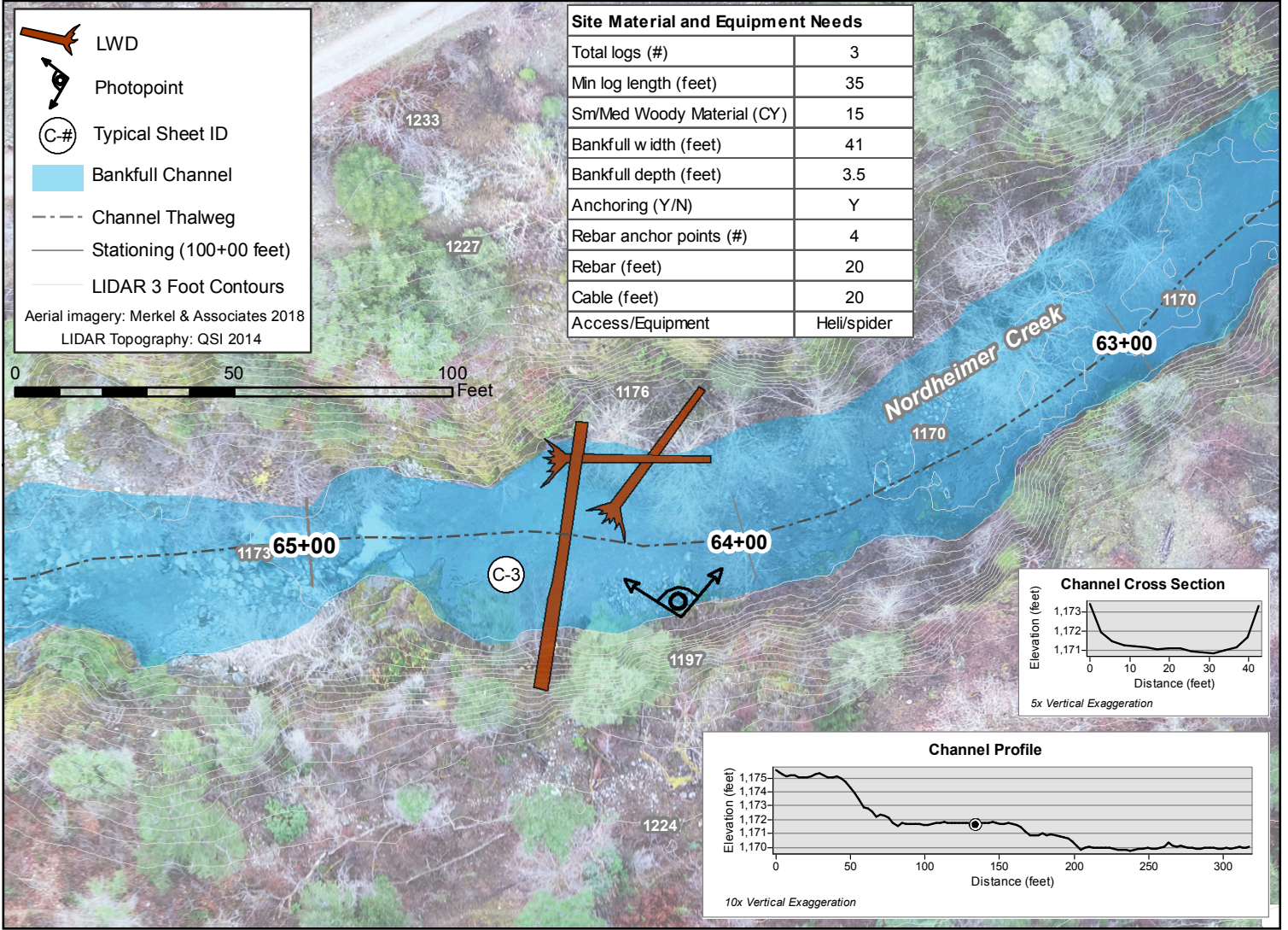
Site 57+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-14



Site 61+00 (Reach 3)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-15



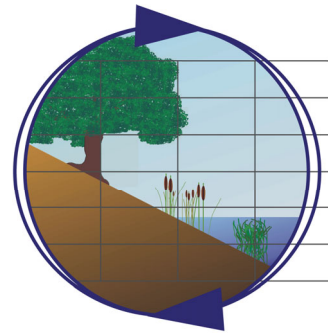
Site 64+00 (Reach 4)
 Nordheimer Creek Habitat Enhancement Project
 Basis of Design, Siskiyou County, California

Figure A-16

APPENDIX B
(TYPICAL DESIGN DETAILS)

NORDHEIMER CREEK HABITAT ENHANCEMENT DESIGN PROJECT

PROJECT LOCATION: SALMON RIVER, SISKIYOU COUNTY, CA



Merkel & Associates, Inc.

PREPARED FOR:
SALMON RIVER RESTORATION COUNCIL



100% DESIGN SUBMITTAL

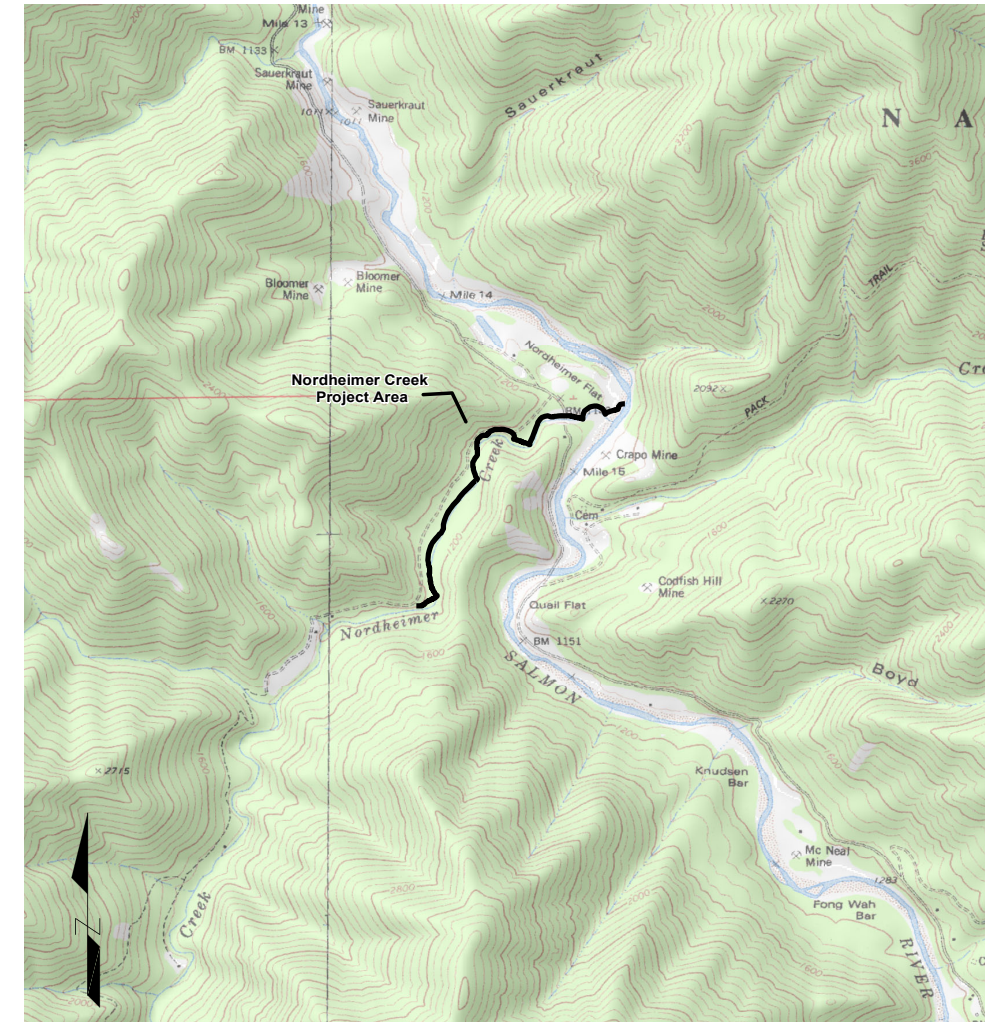
SHEET INDEX

SHEET NO.	DESCRIPTION
G-1	COVER AND SHEET INDEX
C-1	GENERAL NOTES AND SPECIFICATIONS
C-2	MULTI-LOG STRUCTURE ANCHORING DETAILS
C-3	SPANNER JAM STRUCTURE DETAILS
C-4	DEFLECTOR JAM STRUCTURE DETAILS
C-5	WILLOW BAFFLE DETAILS
C-6	WATER POLLUTION CONTROL AND DEWATERING PLAN DETAILS



VICINITY MAP

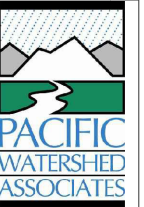
NOT TO SCALE



LOCATION MAP

FORKS OF SALMON USGS 7.5 MINUTE QUADRANGLE
NOT TO SCALE

DATE: 3/18/2021
NOTES PREPARED BY: PWA
FIGURES CREATED BY: RWL
SHEET 1 OF 7



PACIFIC WATERSHED ASSOCIATES, INC.
P.O. BOX 4433
ARCATA, CALIFORNIA 95518
PH: (707) 839-5130 FX: (707) 839-8168
www.pacificwatershed.com

DRAWING DESCRIPTION:

COVER AND SHEET INDEX

PROJECT LOCATION:
NORDHEIMER CREEK HABITAT
ENHANCEMENT DESIGN PROJECT
SISKIYOU COUNTY, CA
PWA JOB NO.: 10506

G-1

GENERAL NOTES

1. THE CONTRACTOR SHALL HAVE SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY.
2. THE CONTRACTOR IS RESPONSIBLE FOR ASSURING THAT ALL WORK IS CONSISTENT WITH ALL APPLICABLE PERMITS, THE CALIFORNIA BUILDING CODE, CALIFORNIA FISH AND WILDLIFE CODE, CALIFORNIA WATER CODE, AND OTHER LOCAL CODES AND REQUIREMENTS.
3. A COPY OF THE PLANS, SPECIFICATIONS, AND ALL PERMITS SHALL BE KEPT ON-SITE AT ALL TIMES WHEN OPERATIONS AND CONSTRUCTION WORK ARE ONGOING.
4. GROUND DISTURBANCE OR WORK NEAR AN ACTIVE STREAM SHALL NOT OCCUR BETWEEN OCTOBER 31 AND MAY 15. THE CONTRACTOR IS RESPONSIBLE FOR MONITORING WEATHER AND IMPLEMENTING THE BEST MANAGEMENT PRACTICES (BMPS) SPECIFIED IN THE DEWATERING AND WATER MANAGEMENT PLAN. BMPS SHALL BE IN PLACE NO LESS THAN 24 HOURS OF A PREDICTED RUNOFF GENERATING STORM (>0.1 INCHES OF PRECIPITATION). THE CONTRACTOR SHALL BE SOLELY LIABLE FOR VIOLATIONS OF ENVIRONMENTAL PERMITS AND CODES RESULTING FROM FAILURE TO IMPLEMENT BMPS IN A TIMELY MANNER.
5. THE CONTRACTOR SHALL IDENTIFY ANY EXCAVATION BOUNDARIES AND DIRECTIONS TO THE EXCAVATION AREA USING WHITE PAINT IN ACCORDANCE WITH THE REQUIREMENTS OF USA NORTH 811. NOTIFICATION TO USA NORTH 811 SHALL BE MADE NOT LESS THAN 2 WORKING DAYS AND NOT MORE THAN 14 CALENDAR DAYS BEFORE DIGGING COMMENCES. USA NORTH 811 MEMBERS WILL IDENTIFY THE LOCATIONS OF UNDERGROUND UTILITIES ONCE THE CONTRACTOR RECEIVES A USA TICKET NUMBER BY CALLING 811 OR APPLYING ONLINE AT [HTTP://USANORTH811.ORG/](http://USANORTH811.ORG/). IF THERE IS UNCERTAINTY REGARDING THE LOCATION OF UNDERGROUND UTILITIES WITHIN THE PERIMETER OF THE EXCAVATION AREA, THE CONTRACTOR SHALL HIRE A QUALIFIED PRIVATE UTILITY LOCATING SERVICE.
6. IF OVERHEAD UTILITIES ARE PRESENT, THE CONTRACTOR SHALL DETERMINE IF THE UTILITIES WILL INTERFERE WITH EQUIPMENT OPERATIONS. IF OVERHEAD UTILITIES COULD POTENTIALLY INTERFERE WITH EQUIPMENT OPERATIONS, THE CONTRACTOR SHALL PROVIDE A SPOTTER WHO SHALL BE CAPABLE OF COMMUNICATING CLEARANCE DISTANCES AND UNSAFE CONDITIONS TO THE EQUIPMENT OPERATOR.
7. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ALL DAMAGE TO OVERHEAD AND UNDERGROUND UTILITIES. IN THE EVENT OVERHEAD OR UNDERGROUND UTILITIES ARE DAMAGED THE CONTRACTOR SHALL CEASE OPERATIONS AND CALL 911 IMMEDIATELY.
8. IN THE EVENT THAT ARCHAEOLOGICAL RESOURCES ARE ENCOUNTERED DURING OPERATIONS, ALL WORK SHALL CEASE UNTIL A QUALIFIED ARCHAEOLOGICAL OR TRIBAL MONITOR IS CONSULTED. EXCAVATION WORK SHALL RESTART ONLY UPON THE APPROVAL OF THE QUALIFIED ARCHAEOLOGIST OR TRIBAL MONITOR. IF HUMAN REMAINS OR EVIDENCE OF HUMAN BURIAL ARE ENCOUNTERED THE CONTRACTOR SHALL ALSO CONTACT THE COUNTY CORONER.
9. IF HAZARDOUS MATERIALS, DRUMS, OILY LIQUIDS, UNUSUAL ODORS, OR EVIDENCE OF NATURALLY OCCURRING ASBESTOS IS ENCOUNTERED DURING OPERATIONS, WORK SHALL CEASE AND THE CONTRACTOR SHALL CONTACT THE PROJECT MANAGER AS SOON AS POSSIBLE. OPERATIONS SHALL RESUME ONLY UPON THE APPROVAL OF THE PROJECT MANAGER.
10. MATERIAL STORAGE AND HANDLING PROCEDURES SHALL CONFORM WITH THE MANUFACTURER'S RECOMMENDATIONS AND/OR THE INDUSTRY'S GENERALLY ACCEPTED BEST MANAGEMENT PRACTICES.
11. DETAILS AND NOTES ON DRAWINGS SHALL TAKE PRECEDENCE OVER GENERAL NOTES OR TYPICAL DETAILS.
12. DRAWINGS SHALL NOT BE SCALED. DRAWINGS ARE GENERALLY TO SCALE AND NOT TO SCALE IS SHOWN ONLY WHERE DRAWING IS OBVIOUSLY OUT OF SCALE. WRITTEN DIMENSIONS ON THE DRAWINGS SHALL TAKE PRECEDENCE OVER GRAPHICAL SCALES SHOWN ON DRAWINGS.
13. THE GENERAL CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK. THE PROJECT MANAGER SHALL BE NOTIFIED OF ANY DISCREPANCIES BEFORE WORK COMMENCES.
14. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING A CLEAN, SAFE, AND ORDERLY JOB SITE.
15. THE GENERAL CONTRACTOR SHALL THOROUGHLY INVESTIGATE THE SITE AFTER CLEARING AND GRUBBING IS COMPLETE AND BEFORE CONSTRUCTION COMMENCES. IF BURIED STRUCTURES SUCH AS CULVERTS, WOODY DEBRIS, FOUNDATIONS OR CESSPOOLS, ARE ENCOUNTERED, CONSTRUCTION SHALL CEASE AND THE PROJECT MANAGER SHALL BE NOTIFIED IMMEDIATELY.
16. THE PROJECT MANAGER SHALL NOT BE HELD LIABLE FOR CONSTRUCTION SITE SAFETY MATTERS, THE CONTRACTOR'S AND THEIR SUBCONTRACTORS ERRORS AND OMISSIONS, NOR FOR FAILURE OF THE CONTRACTOR AND THEIR SUBCONTRACTOR'S FAILURE TO ADHERE TO THE CONSTRUCTION CONTRACT, SPECIFICATIONS, AND DRAWINGS.
17. ANY ELEVATIONS SHOWN ON THE DRAWINGS ARE RELATIVE TO THE LOCAL GROUND CONDITIONS AND TEMPORARY BENCHMARKS PLACED FOR THE PURPOSE OF CONSTRUCTION.
18. SALMON RIVER RESTORATION COUNCIL (SRRC) SHALL BE RESPONSIBLE FOR SECURING ALL REQUIRED PERMITS FOR CONSTRUCTION. SRRC SHALL NOT BE LIABLE FOR ANY FINES, FEES, OR VIOLATIONS DUE TO CONSTRUCTION COMPLETED WITHOUT THE REQUIRED PERMITS.
19. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO MINIMIZE EROSION AND PREVENT THE DELIVERY OF SEDIMENT OR OTHER POLLUTANTS TO SURFACE WATERS OR OTHER SENSITIVE AREAS.
20. WORK WILL BE CONDUCTED DURING DRY WEATHER PERIODS WHEN ALL GRADING, EROSION CONTROL, AND SITE STABILIZATION MEASURES CAN BE IMPLEMENTED PRIOR TO RAINFALL.
21. CONTRACTOR SHALL KEEP PROJECT AREAS GENERATING DUST WATERED DURING THE TERM OF CONSTRUCTION.
22. SOLID WASTE, SUCH AS TRASH, DEBRIS, AND SANITARY WASTE SHALL BE PLACED IN CONTAINERS AND REMOVED FROM THE SITE PERIODICALLY OR DISPOSED OF AS DIRECTED BY THE PROJECT MANAGER.
23. IF RAINFALL GREATER THAN 1 INCH IN A 24 HOUR PERIOD IS FORECAST PRIOR TO THE COMPLETION OF OPERATIONS, OR IF ACCUMULATED PRECIPITATION HAS MADE CONDITIONS UNSUITABLE FOR CONSTRUCTION, OPERATIONS WILL CEASE, AND THE SITE WILL BE STABILIZED AND PROTECTED FROM SURFACE EROSION.

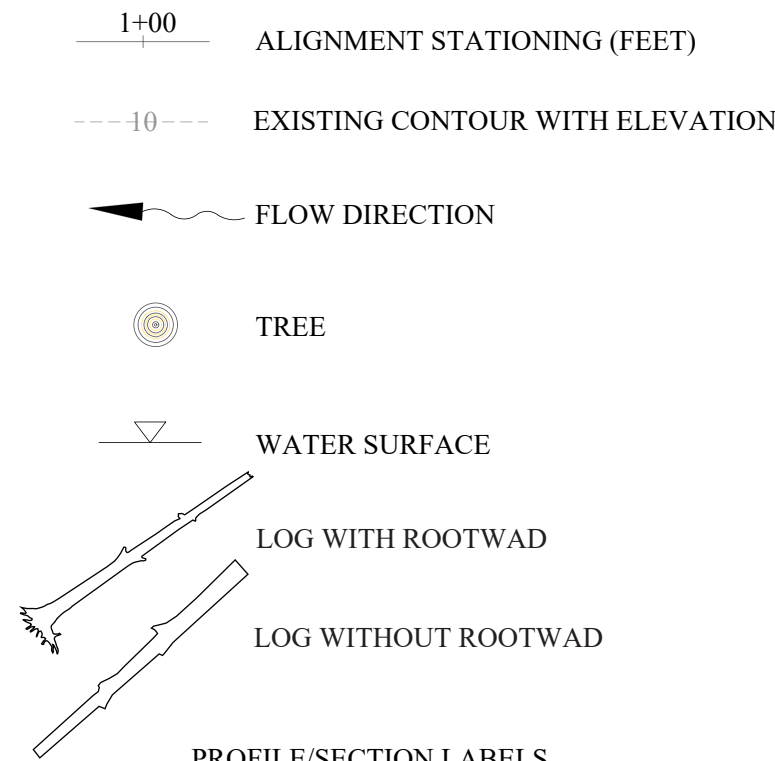
INSPECTIONS:

1. ACCESS ROUTE DEVELOPMENT
2. LARGE WOOD PLACEMENT
3. STRUCTURE ANCORING
4. ACCESS ROUTE CLOEOUT

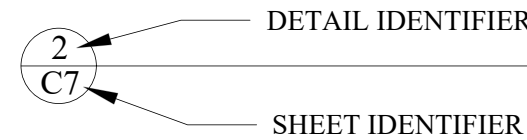
ABBREVIATIONS

APPROX, ~	APPROXIMATELY
CA	CALIFORNIA
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CP	CONTROL POINT (SURVEY)
CY	CUBIC YARDS
DIA	DIAMETER
EG	EXISTING GRADE
EL	ELEVATION
(E)	EXISTING
FG	FINISHED GRADE
FT	FOOT OR FEET
LOD	LIMIT OF DISTURBANCE
LWM	LARGE WOODY MATERIAL
MAX/MIN	MAXIMUM/MINIMUM
NTS	NOT TO SCALE
PT#	POINT NUMBER
(P)	PROPOSED
RD	ROAD
STA	STATION
SF	SQUARE FEET
TYP	TYPICAL
(3 : 1)	SLOPE (HORIZONTAL : VERTICAL)

LEGEND



PROFILE/SECTION LABELS



PROJECT DESCRIPTION: PROJECT ELEMENTS INCLUDE CONSTRUCTING LARGE WOODY MATERIAL INSTREAM HABITAT STRUCTURES AND WILLOW BAFFLES WITHIN IDENTIFIED REACHES OF NORDHEIMER CREEK. THE STRUCTURES ARE INTENDED TO INCREASE HABITAT COMPLEXITY, PROVIDE COVER, VELOCITY REFUGIA AND GRAVEL SORTING.

WATER POLLUTION CONTROL: THE CONTRACTOR SHALL DEVELOP THE DEWATERING PLAN. INFRASTRUCTURE AND EXTENTS SHALL BE DEFINED BY CONTRACTOR AND REVIEWED AND APPROVED BY PROJECT MANAGER PRIOR TO CONSTRUCTION.

LARGE WOODY MATERIAL SPECIFICATIONS: ALL LARGE WOODY MATERIAL USED IN THE CONSTRUCTION OF INSTREAM STRUCTURES SHALL MEET THE FOLLOWING SPECIFICATIONS: ALL LARGE WOODY MATERIAL SHALL BE ANCHORED ACCORDING TO THE PLANS UNLESS; LOGS WITH ATTACHED ROOTWADS EQUAL OR EXCEED 1.5X BANKFULL CHANNEL WIDTH; OR LOGS WITHOUT ROOTWADS EQUAL OR EXCEED 2X BANKFULL CHANNEL WIDTH. IN ADDITION, LOGS SHALL BE A MINIMUM OF 12 INCHES OR HALF THE BANKFULL DEPTH, WHICHEVER IS GREATER. ALL ANCHORING TECHNIQUES WILL BE ACCORDING TO THE PLANS OR ALTERNATIVELY ACCORDING TO THE CALIFORNIA SALMONID STREAM HABITAT RESTORATION MANUAL, WHEN APPROVED BY THE CDFW CONTRACT MANAGER.

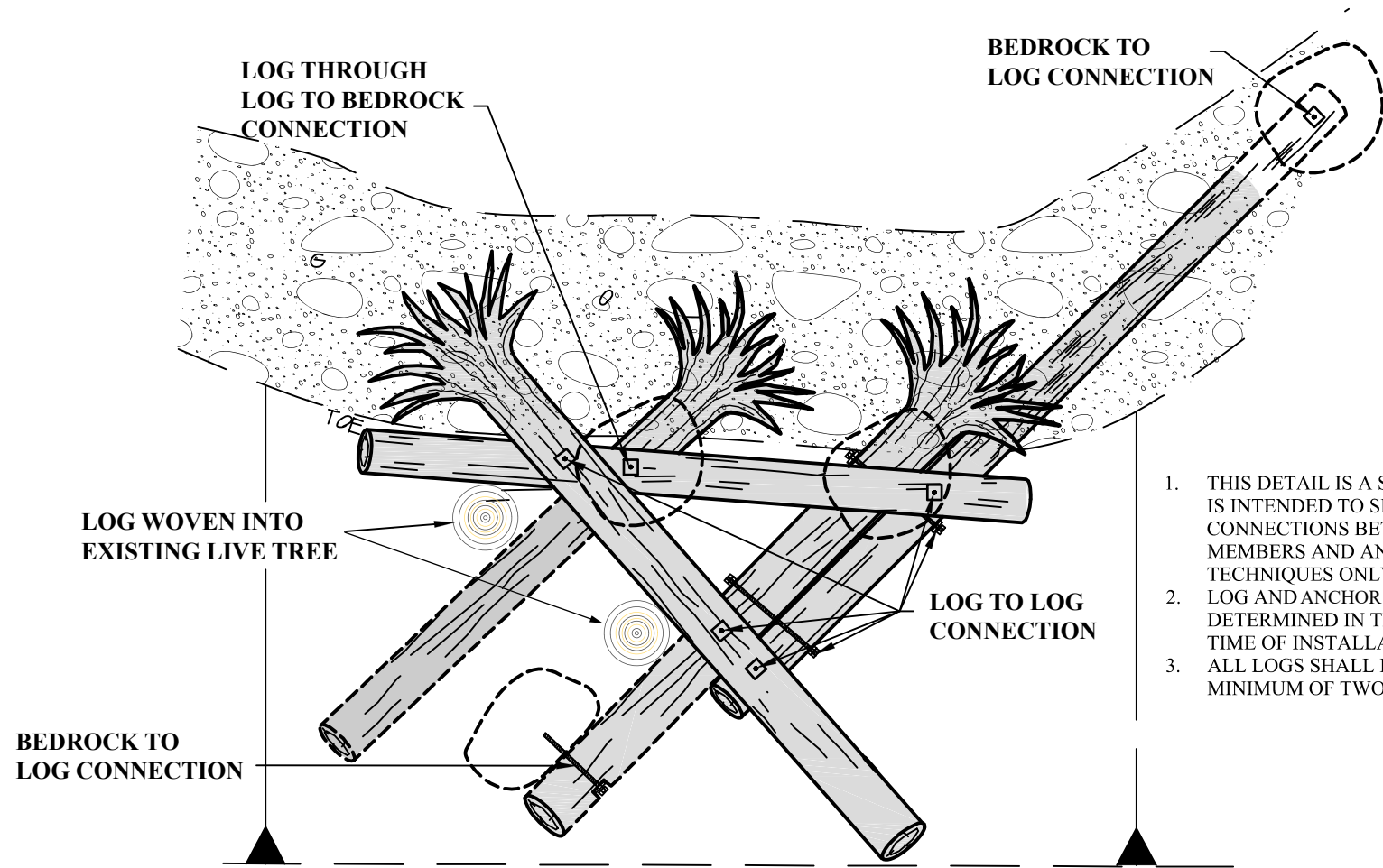


DATE: 4/20/2021
 NOTES PREPARED BY: PWA
 FIGURES CREATED BY: RWL
 SHEET 1 OF 7

PACIFIC WATERSHED ASSOCIATES, INC.
 P.O. BOX 4433
 ARCATA, CALIFORNIA 95518
 PH: (707) 839-5130 FX: (707) 839-8168
www.pacificwatershed.com

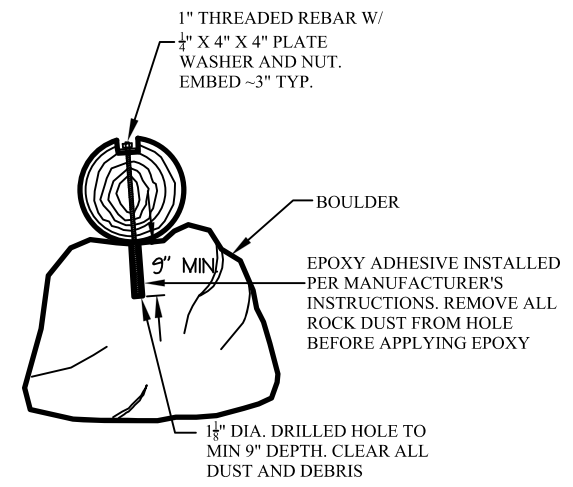
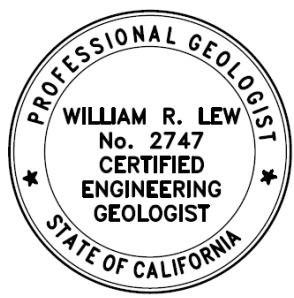
DRAWING DESCRIPTION:
GENERAL NOTES AND SPECIFICATIONS

PROJECT LOCATION:
NORDHEIMER CREEK HABITAT ENHANCEMENT DESIGN PROJECT
 SISKIYOU COUNTY, CA
 PWA JOB NO.: 10506

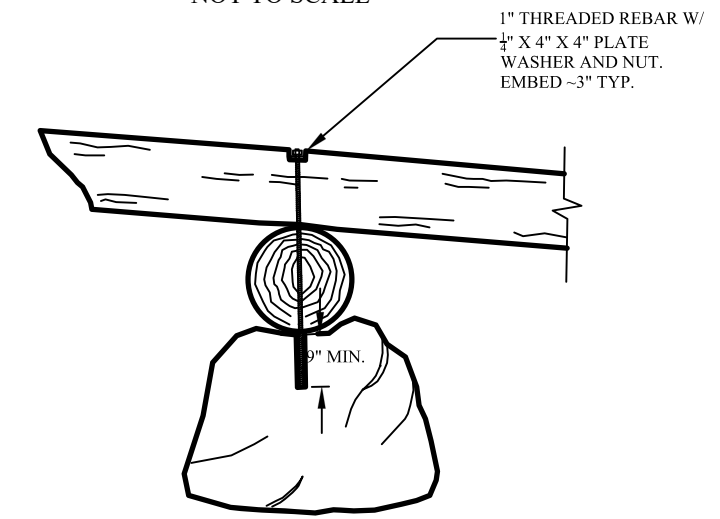


1. THIS DETAIL IS A SCHEMATIC AND IS INTENDED TO SHOW TYPICAL CONNECTIONS BETWEEN MEMBERS AND ANCHORING TECHNIQUES ONLY.
2. LOG AND ANCHOR PLACEMENT TO BE DETERMINED IN THE FIELD AT THE TIME OF INSTALLATION.
3. ALL LOGS SHALL HAVE A MINIMUM OF TWO ATTACHMENTS.

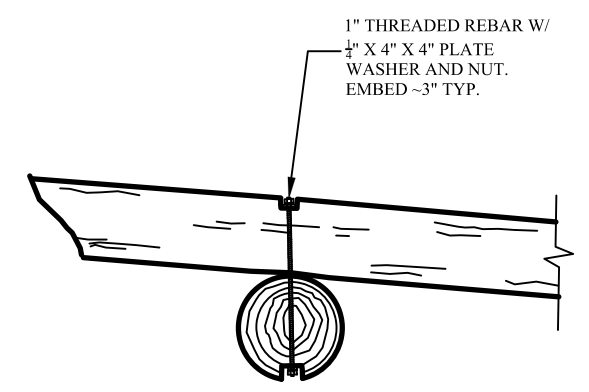
1
C2 **PLAN VIEW**
C2 **MULTI-LOG STRUCTURE TYPICAL**
NOT TO SCALE



2
C2 **TYPICAL SECTION**
C2 **LOG TO BEDROCK CONNECTION**
NOT TO SCALE

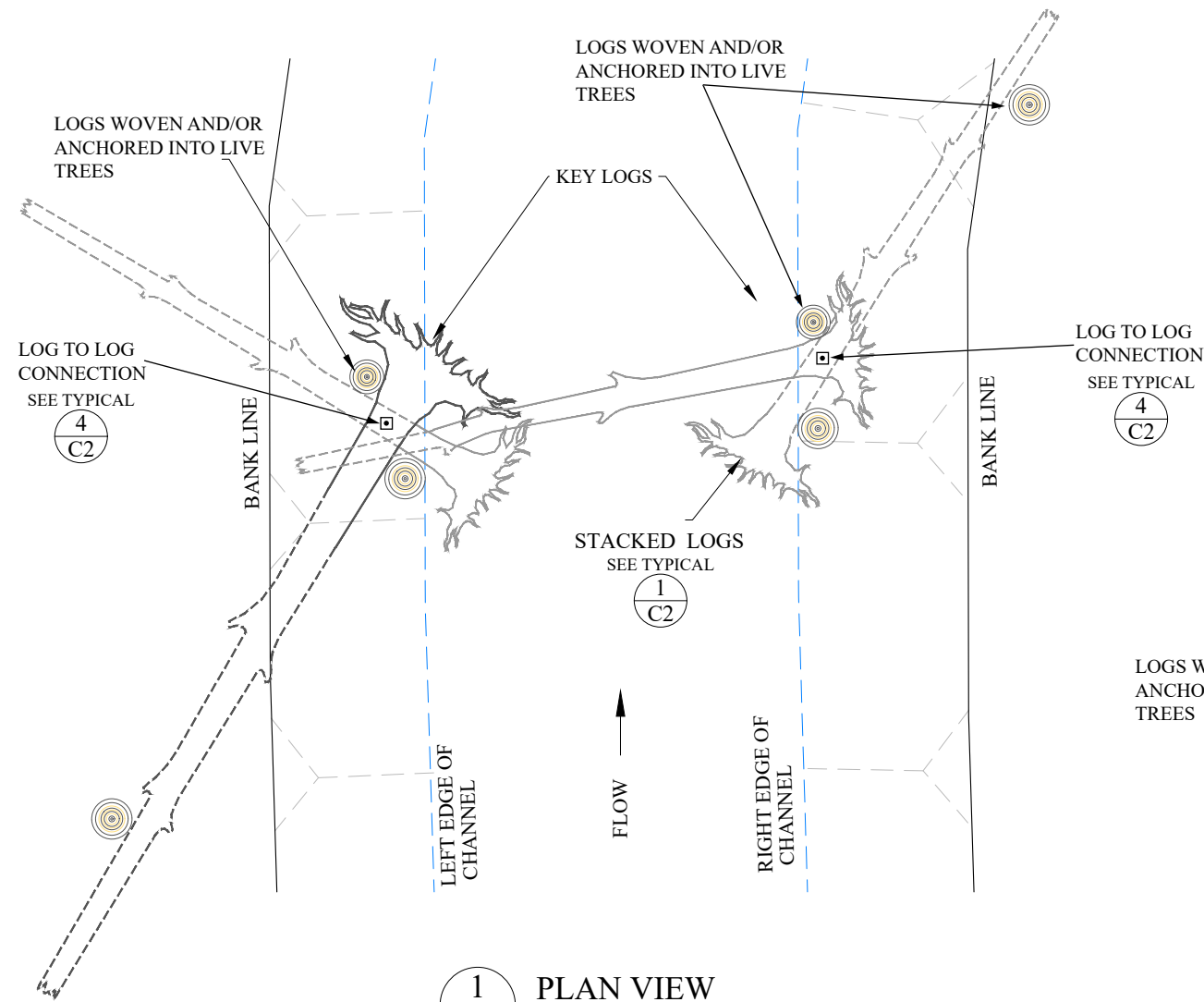


3
C2 **TYPICAL SECTION**
C2 **LOG THROUGH LOG BEDROCK CONNECTION**
NOT TO SCALE

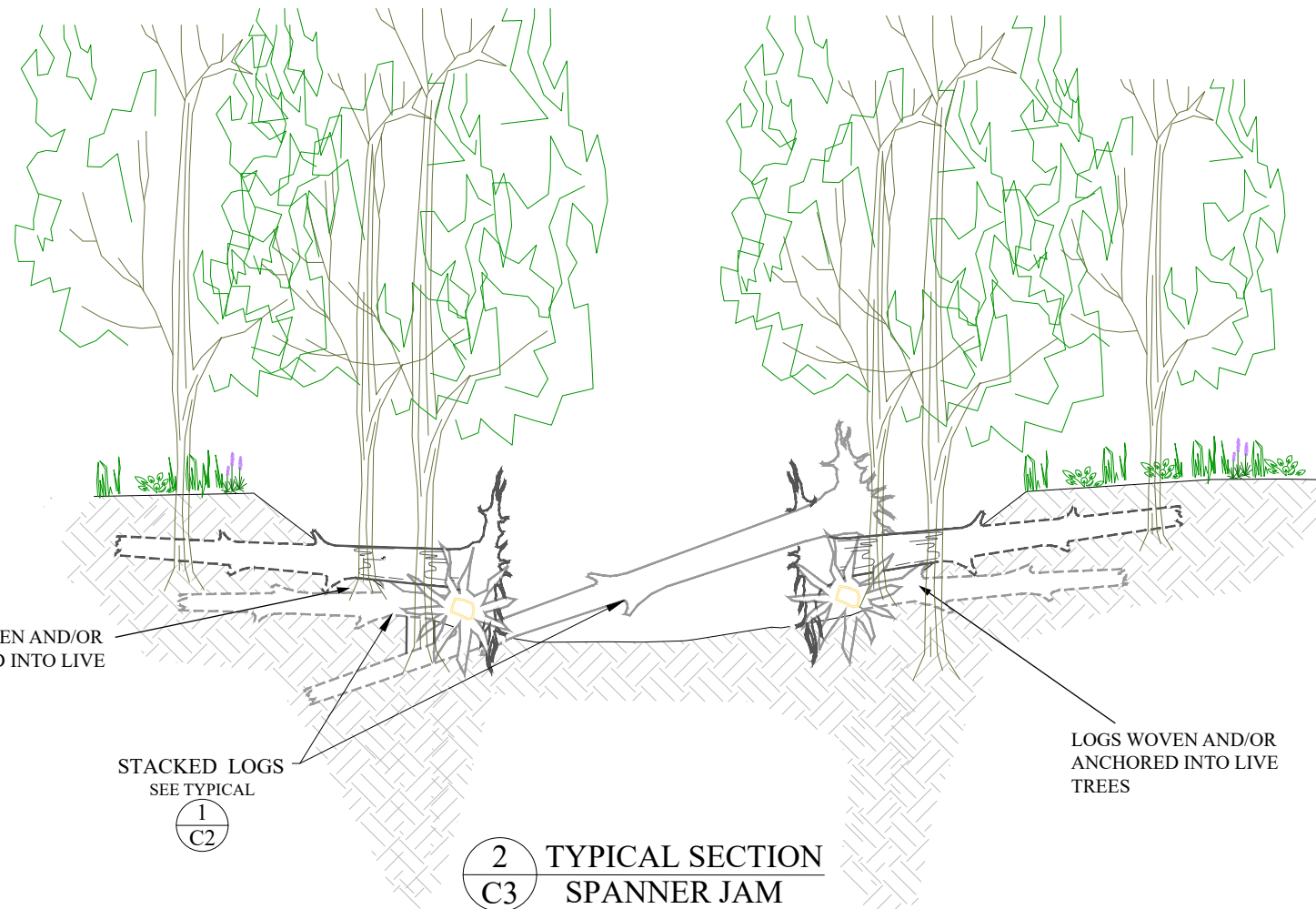


4
C2 **TYPICAL SECTION**
C2 **LOG TO LOG CONNECTION**
NOT TO SCALE

ALL ANCHORING METHODS SHALL CONFORM TO CDFW STREAM RESTORATION MANUAL



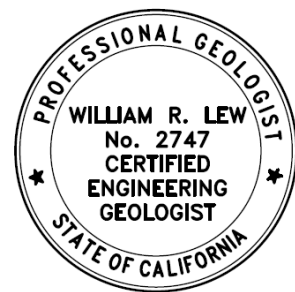
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C3 PLAN VIEW
SPANNER JAM
NOT TO SCALE

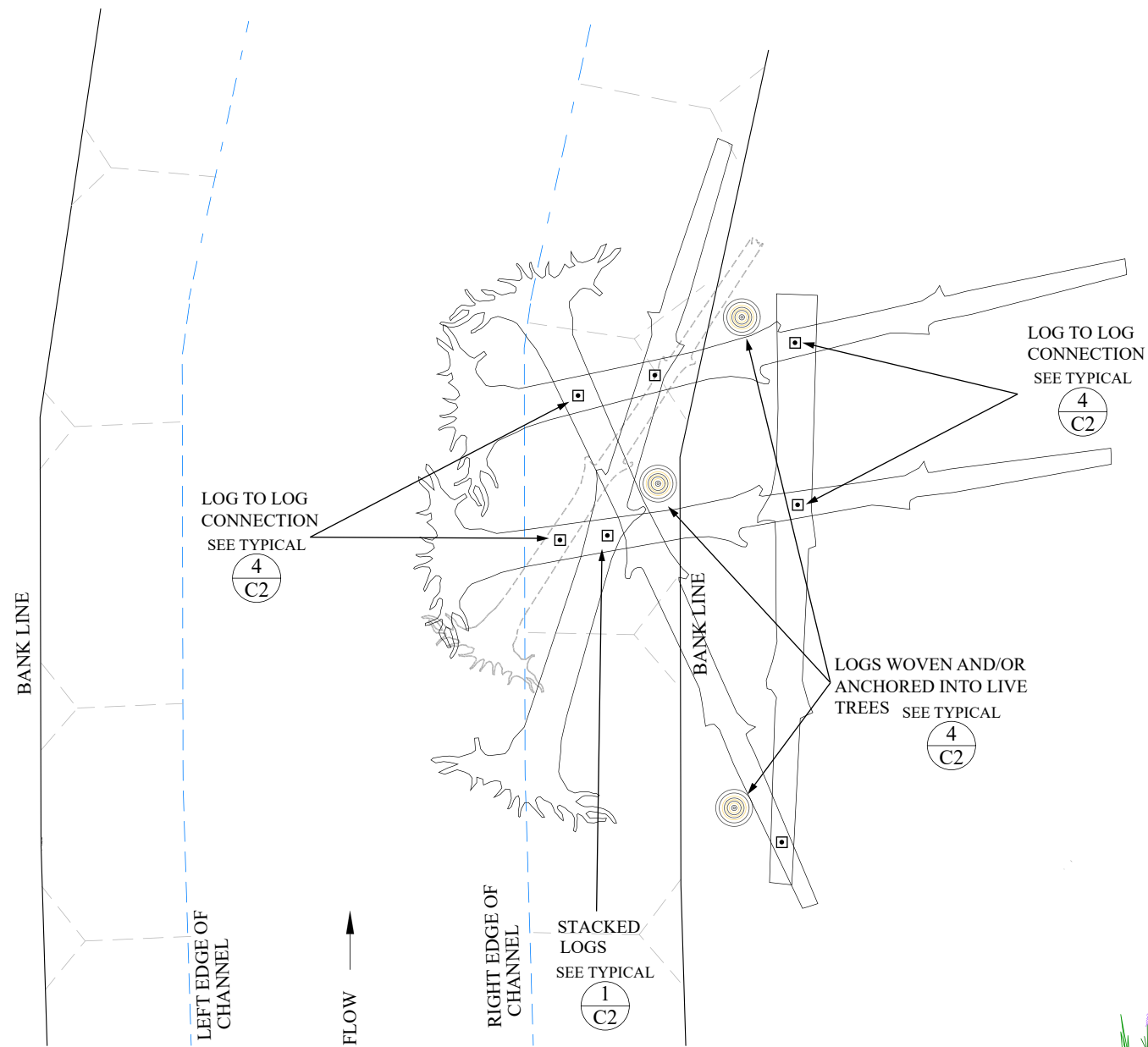


2
C3 TYPICAL SECTION
SPANNER JAM
NOT TO SCALE

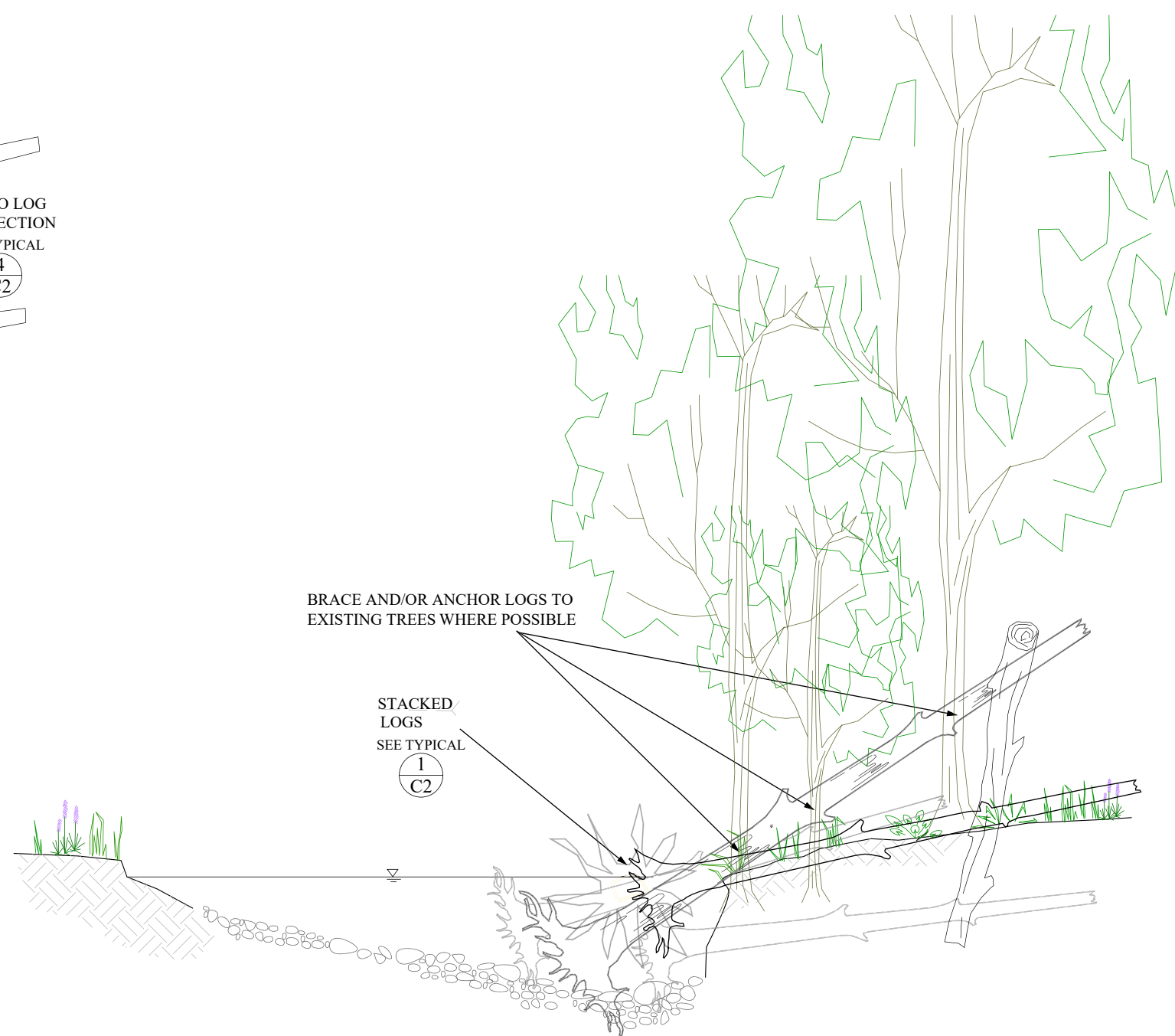
GENERAL NOTES AND SPECIFICATIONS FOR LWM STRUCTURES:

- 1) KEY LOGS WITH ROOTWADS AND KEY LOGS WITHOUT ROOTWADS SHALL MEET THE MINIMUM SIZE SPECIFIED IN THE DESIGNS/PLANS AND IN THE CONTRACT DOCUMENTS.
- 2) THESE DRAWINGS SHOWN DEPICT ONLY THE PRIMARY LWM STRUCTURAL COMPONENTS. ADDITIONAL SMALL AND MID-SIZED MATERIAL (LOGS AND/OR BRUSH BUNDLES/SLASH) SHALL BE ADDED TO THE PRIMARY STRUCTURES. THIS SMALL AND MID-SIZED MATERIAL WILL BE WOVEN THROUGH THE STRUCTURE WITHIN THE ACTIVE CHANNEL SECTION (BELOW BANKFULL DEPTH), CREATING A STRUCTURE LESS PERMIABLE TO THROUGH-FLOW. SMALL AND MID-SIZED WOODY MATERIAL WILL BE SPECIFICALLY PROCURED TO INCORPORATE INTO THE PROJECT SITES. IN ADDITION, SMALL AND MID-SIZED WOODY MATERIAL SHALL BE SALVAGED DURING SITE OPENING AND/OR CONSTRUCTION. THE CONTRACTOR WILL WORK WITH THE PROJECT MANAGER TO IDENTIFY SUITABLE ON-SITE SALVAGE MATERIALS THAT MEETS THE PROJECT'S INTENT.





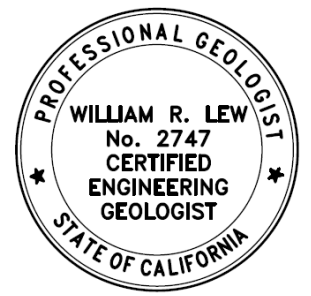
1 PLAN VIEW
 C4 BANK-BASED HABITAT WOOD STRUCTURE DEFLECTOR JAM
 NOT TO SCALE



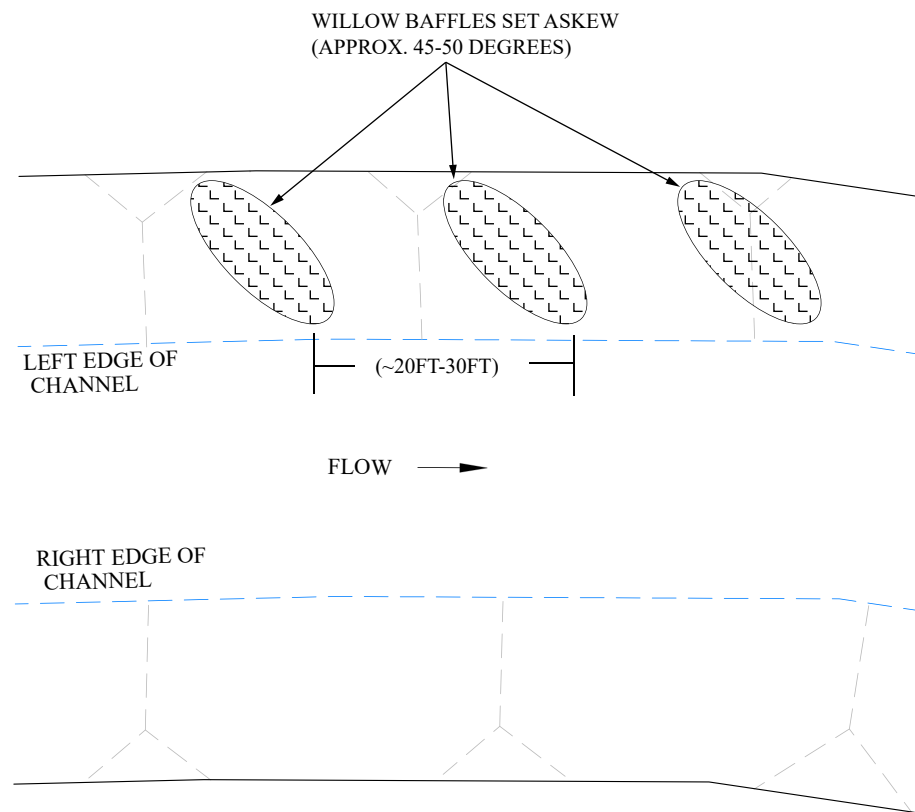
2 TYPICAL SECTION
 C4 BANK-BASED HABITAT WOOD STRUCTURE DEFLECTOR JAM
 NOT TO SCALE

GENERAL NOTES AND SPECIFICATIONS FOR LWM STRUCTURES:

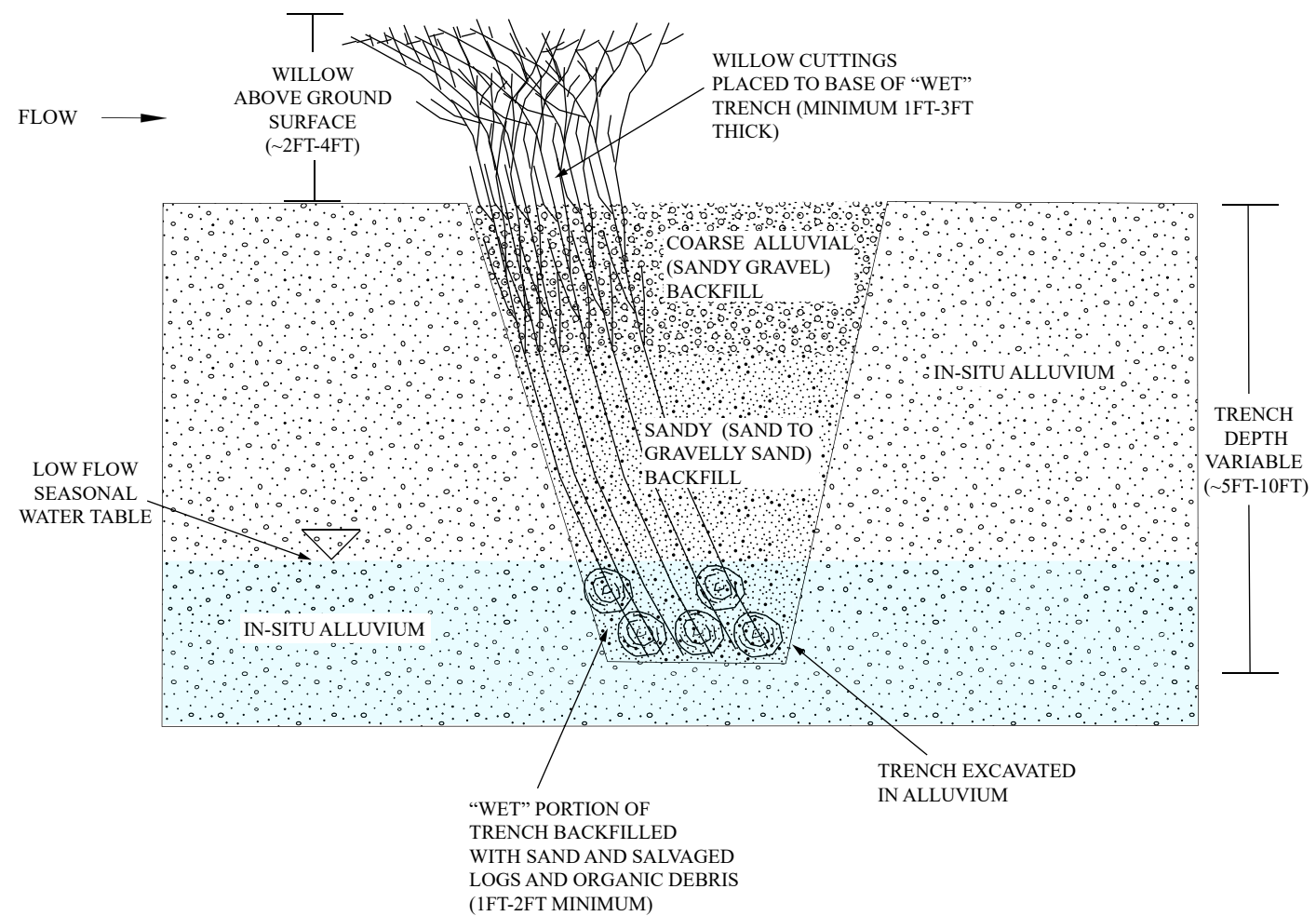
- 1) KEY LOGS WITH ROOTWADS AND KEY LOGS WITHOUT ROOTWADS SHALL MEET THE MINIMUM SIZE SPECIFIED IN THE DESIGNS/PLANS AND IN THE CONTRACT DOCUMENTS.
- 2) THESE DRAWINGS SHOWN DEPICT ONLY THE PRIMARY LWM STRUCTURAL COMPONENTS. ADDITIONAL SMALL AND MID-SIZED MATERIAL (LOGS AND/OR BRUSH BUNDLES/SLASH) SHALL BE ADDED TO THE PRIMARY STRUCTURES. THIS SMALL AND MID-SIZED MATERIAL WILL BE WOVEN THROUGH THE STRUCTURE WITHIN THE ACTIVE CHANNEL SECTION (BELOW BANKFULL DEPTH), CREATING A STRUCTURE LESS PERMIABLE TO THROUGH-FLOW. SMALL AND MID-SIZED WOODY MATERIAL WILL BE SPECIFICALLY PROCURED TO INCORPORATE INTO THE PROJECT SITES. IN ADDITION, SMALL AND MID-SIZED WOODY MATERIAL SHALL BE SALVAGED DURING SITE OPENING AND/OR CONSTRUCTION. THE CONTRACTOR WILL WORK WITH THE PROJECT MANAGER TO IDENTIFY SUITABLE ON-SITE SALVAGE MATERIALS THAT MEETS THE PROJECT'S INTENT.



DATE 3/18/2021 NOTES PREPARED BY PWA FIGURES CREATED BY RWL SHEET 5 OF 7		PACIFIC WATERSHED ASSOCIATES, INC. P.O. BOX 4433 ARCATA, CALIFORNIA 95518 PH: (707) 839-5130 FX: (707) 839-8168 www.pacificwatershed.com
DRAWING DESCRIPTION: BANK-BASED HABITAT WOOD STRUCTURE TYPICAL DETAILS		
PROJECT NAME: NORDHEIMER CREEK HABITAT ENHANCEMENT DESIGN PROJECT SISKIYOU COUNTY, CA		
PWA JOB NO.: 10506		



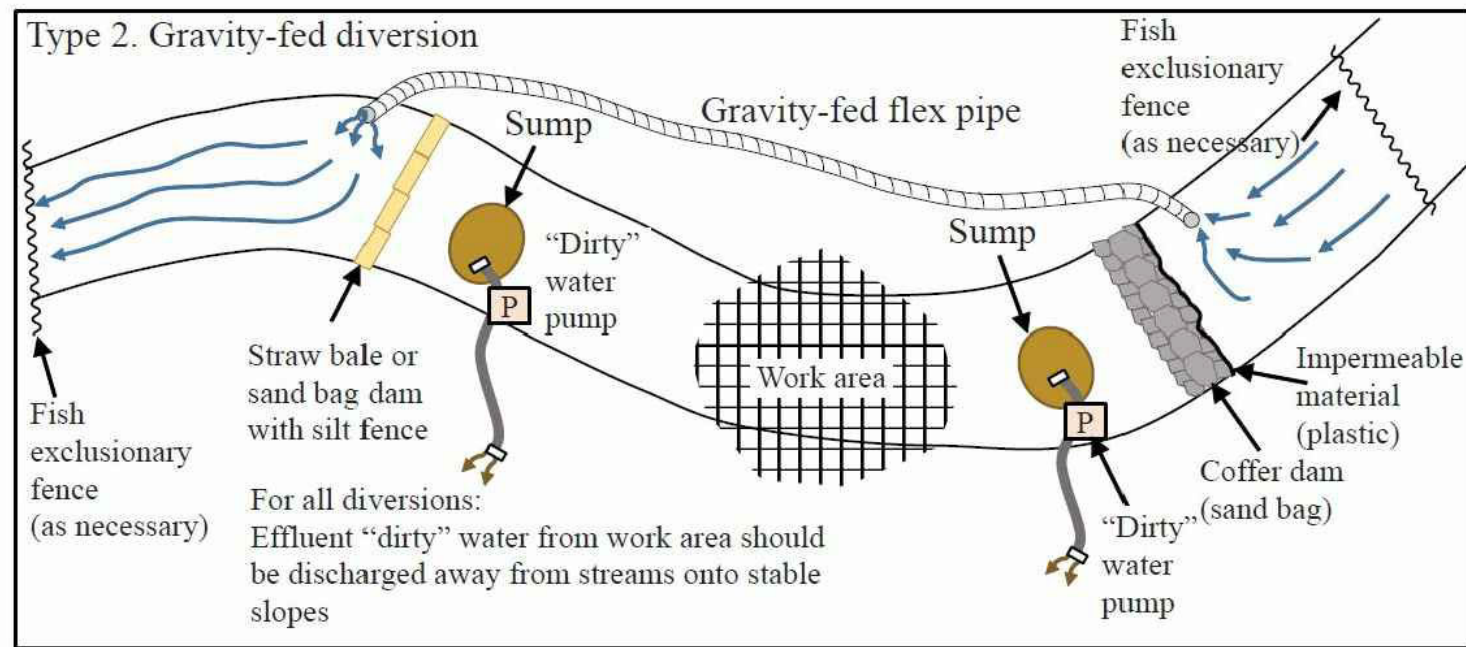
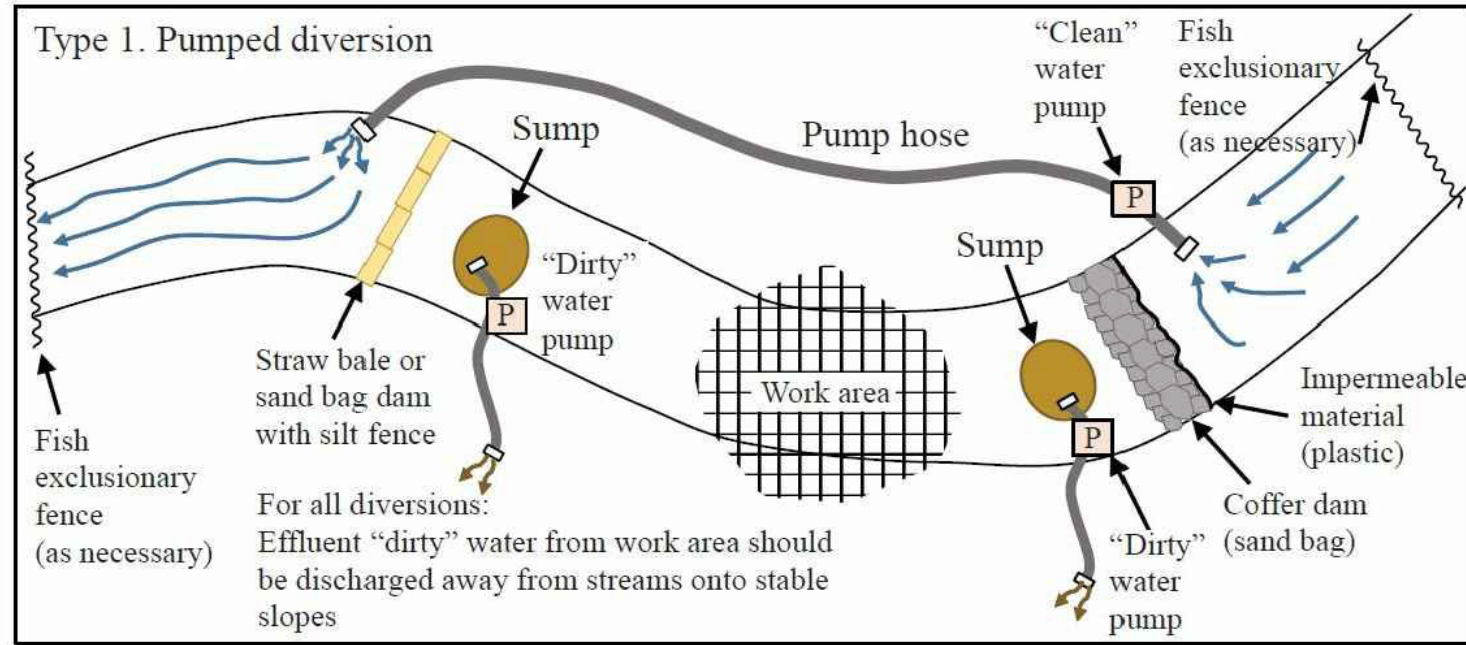
1
C5 PLAN VIEW
WILLOW BAFFLE
NOT TO SCALE



2
C5 TYPICAL SECTION
WILLOW BAFFLE
NOT TO SCALE



STREAM DEWATERING AND FISH EXCLUSION DETAILS:



WATER QUALITY MONITORING REQUIREMENTS:

SURFACE WATER QUALITY MONITORING WILL BE PERFORMED WHEN:

- PERFORMING ANY IN-WATER WORK;
- PROJECT ACTIVITIES RESULT, OR MAY RESULT, IN DISCHARGE TO SURFACE WATERS; OR
- PROJECT ACTIVITIES RESULT IN THE CREATION OF A VISIBLE TURBIDITY IN SURFACE WATERS.

SAMPLING AS DESCRIBED BELOW SHALL OCCUR UPSTREAM AND OUT OF THE INFLUENCE OF THE PROJECT, AND 300 FEET DOWNSTREAM OF THE WORK AREA.

- TURBIDITY (NTU); IN SITU; EVERY 4 HOURS DURING IN-WATER WORK; DURING CONSTRUCTION/DEWATERING AND REMOVAL/REWATERING A MINIMUM OF 3 SAMPLES MUST BE TAKEN EACH DAY ACTIVITIES OCCUR.
- VISIBLE CONSTRUCTION RELATED POLLUTANTS (OBSERVATIONS), VISUAL INSPECTIONS, CONTINUOUS THROUGHOUT THE CONSTRUCTION PERIOD.
- pH (STANDARD UNITS); IN SITU, EVERY 4 HOURS, DURING CONSTRUCTION/DEWATERING AND REMOVAL/REWATERING A MINIMUM OF 3 SAMPLES MUST BE TAKEN EACH DAY ACTIVITIES OCCUR.
- TEMPERATURE (°C); IN SITU; EVERY 4 HOURS; DURING CONSTRUCTION/DEWATERING AND REMOVAL/REWATERING A MINIMUM OF 3 SAMPLES MUST BE TAKEN EACH DAY ACTIVITIES OCCUR.
- DISSOLVED OXYGEN (mg/L & % SATURATION), IN SITU, EVERY 4 HOURS; DURING CONSTRUCTION/DEWATERING AND REMOVAL/REWATERING A MINIMUM OF 3 SAMPLES MUST BE TAKEN EACH DAY ACTIVITIES OCCUR.



STREAM DEWATERING NOTES:

PRIOR TO WORKING IN AND AROUND THE ACTIVE STREAM CHANNEL, PROPER STREAM DEWATERING AND AVOIDANCE OF INCREASING DOWNSTREAM TURBIDITY SHOULD BE EMPLOYED. DEWATERING AND FISH EXCLUSION ACTIVITIES SHALL CONFORM WITH CDFW RESTORATION MANUAL GUIDELINES (SEE PART IX, PAGES 51-52). STREAM FLOWS WILL BE ISOLATED UPSTREAM OF THE WORK AREA USING COFFERDAMS AND CONVEYED DOWNSTREAM AROUND THE WORK SITE THROUGH EITHER A PUMPED DIVERSION (TYPE 1) AND/OR BY GRAVITY DIVERSION (TYPE 2) TO KEEP THE STREAM "LIVE" (FLOWING) BELOW THE WORK AREA. AN ADDITIONAL DAM WILL BE INSTALLED DOWNSTREAM OF THE WORK AREAS TO CAPTURE ANY SUBSURFACE FLOW THAT MIGHT TRAVEL THROUGH THE CONSTRUCTION AREA. ANY "DIRTY" WATER WILL BE COLLECTED AT THIS LOCATION AND PUMPED AWAY FROM THE SITE WHERE IT CAN INFILTRATE INTO THE GROUND WITHOUT THE POTENTIAL FOR CONNECTIVITY AND DELIVERY TO THE STREAM SYSTEM.

GENERAL WATER POLLUTION CONTROL, FISH EXCLUSION AND WATER MANAGEMENT NOTES:

- THE CONTRACTOR IS RESPONSIBLE TO IMPLEMENT THE PROJECT IN A MANNER THAT ELIMINATES THE DISCHARGE OF POLLUTANTS TO WATERS OF THE STATE OR SENSITIVE BIOLOGICAL AREAS. THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL CLEAN-UP ASSOCIATED WITH WATER POLLUTION VIOLATIONS.
- THE CONTRACTOR SHALL AT A MINIMUM IMPLEMENT THE PROJECT SPECIFIC WATER POLLUTION CONTROL BMPs DESCRIBED.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO IMPLEMENT ADDITIONAL BMPs AS NECESSARY TO PREVENT THE DISCHARGE OF POLLUTANTS TO WATERS OF THE STATE OR SENSITIVE BIOLOGICAL AREAS.
- DEPENDING ON BASE STREAM FLOW CONDITIONS WITHIN THE CREEK, THE PROJECT WILL LIKELY REQUIRE A CLEAR WATER DIVERSION AND FISH EXCLUSION FROM THE WORK SITE. THE CONTRACTOR WILL PROVIDE A QUALIFIED BIOLOGIST TO SET UP THE EXCLUSIONARY FENCING AND CONDUCT THE FISH EXCLUSION. HOWEVER, 2 WEEKS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION THE CONTRACTOR SHALL SUBMIT NOTICE OF INTENT TO BEGIN CONSTRUCTION TO THE LANDOWNER, AND SHALL NOT BEGIN ANY EARTHWORK UNTIL FISH EXCLUSION ACTIVITIES HAVE BEEN COMPLETED.
- THE CONTRACTOR WILL BE RESPONSIBLE FOR PROVIDING AND MAINTAINING ALL SUPPLIES AND MECHANICAL DEVICES (PUMPS, ETC.) NECESSARY TO EFFECTIVELY DEWATER THE WORK SITE DURING CONSTRUCTION ACTIVITIES.
- BMPs SHALL BE APPLIED WHERE SHOWN ON THE MAP AND AT OTHER APPLICABLE LOCATIONS AS NECESSARY AT THE DISCRETION OF THE CONSTRUCTION MANAGER OR PROJECT ENGINEER/GEOLOGIST.
- ALL SPOILS GENERATED BY THE PROJECT WILL EITHER BE HAULED OFF-SITE AND DISPOSED OF AT A LEGAL LOCATION OR WILL BE PLACED IN LIFTS ALONG FLOODPLAIN TERRACE SURFACES (<5% GRADE) WITH NO CHANCE FOR SEDIMENT DELIVERY AND WILL BE CONTOURED IN A MANNER TO DISPERSE RUNOFF. ALL SPOILS PLACED ON-SITE WILL BE MULCHED ACCORDING TO PROJECT SPECIFIC BMP REQUIREMENTS.

DATE: 3/18/2021
 NOTES PREPARED BY: PWA
 FIGURES CREATED BY: RWL
 SHEET 7 OF 7

PACIFIC WATERSHED ASSOCIATES, INC.
 P.O. BOX 4433
 ARCATA, CALIFORNIA 95518
 PH: (707) 839-5130 FX: (707) 839-8168
 www.pacificwatershed.com

DRAWING DESCRIPTION:
DEWATERING AND WATER MANAGEMENT DETAILS

PROJECT LOCATION:
NORDHEIMER CREEK HABITAT ENHANCEMENT DESIGN PROJECT
 SISKIYOU COUNTY, CA
 PWA JOB NO.: 10506

C-6

APPENDIX C
(30% BASIS OF DESIGN REPORT)

**NORDHEIMER CREEK HABITAT RESTORATION
30% Basis of Design Report**

Prepared For:

Salmon River Restoration Council

PO Box 1089
25631 Sawyers Bar Road
Sawyers Bar, CA 96027

Karuk Tribe

64236 2nd Ave,
Happy Camp, CA 96039

California Department of Fish and Wildlife

Fisheries Restoration Grants Program
(Project # P1610525)
1625 South Main St
Yreka, CA 96097

Klamath National Forest

Salmon-Scott River
Ranger District
11263 N. State Highway 3
Fort Jones. CA 96032

By:

Rocco Fiori, Fiori GeoSciences
PO Box 387, Klamath, CA 95548

With Contributions From:

Chris Moore
W.E.E.D.S
1675 Woody Road
McKinleyville, California
95519

Whelan Gilkerson
Merkel & Associates, Inc.
1670 Chester Ave.
Arcata, CA
95521

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INTRODUCTION

The Salmon River Restoration Council (SRRC), the United States Forest Service (USFS), and their restoration partners have identified Nordheimer Creek and the confluence reach with the mainstem Salmon River as a high priority location for habitat restoration. The purpose of this project is to produce habitat restoration designs that will enhance spawning and rearing habitat for coho, spring-run chinook and other salmonids in Nordheimer Creek and the Salmon River. SRRC's goals and objectives for this project, listed below, will be used to provide design guidance and as a means to test the success of the project once it is constructed.

Goals

- Improve the quality of cold water habitats.
- Improve access to existing and improved habitats.
- Increase and improve retention and sorting of spawning gravels.
- Increase pool frequency and cover
- Enhance floodplain connectivity, riparian vegetation, and shade for thermal refugia.

Objectives

- Increase the frequency, and magnitude of in-channel and floodplain roughness elements that specifically target and will achieve the project goals.
- Use a process-based restoration approach.

The purpose of this 30% design report is to present initial findings and preliminary design considerations, and share potential design concepts in order to receive comments from the projects Technical Advisory Committee (TAC), and to use those comments to inform the development of the 65% and 95% designs. This report adds to the body of information provided at a kickoff meeting held on March 7, 2019. A list of kickoff meeting participants is provided in Appendix A. This report was prepared by Rocco Fiori, Fiori GeoSciences (FGS), with contributions from Chris Moore, W.E.E.D.S, and Whelan Gilkerson, Merkel and Associates, Inc.

APPROACH

This project was conceived to address the need to increase wood loading within the Nordheimer Watershed and to develop complementary treatments to improve fish passage at the Nordheimer Creek confluence with the Salmon River. The SRRC and FGS agreed to use an adaptive approach to move the project forward in a manner that would best meet the SRRC's goals and objectives as site level opportunities and constraints were identified.

Existing data and information needed to evaluate background conditions and develop designs was compiled by SRRC and FGS, including historic and modern digital aerial imagery, Light Detecting and Ranging Digital Elevation Model (LiDAR DEM), the Nordheimer Creek Bridge Plan, salmon spawning data, published stream gage data, grey literature, and peer-reviewed reports and publications. Design specific data was collected as a collaborative effort by FGS and SRRC. This included water level monitoring, and characterization of streambed and subsurface geotechnical conditions. Additional design specific data included acquisition of low-altitude color aerial imagery using a small unmanned aerial vehicle (UAV). Chris Moore (W.E.E.D.S) assisted with field work involving the geotechnical assessment at the Nordheimer Confluence Bar, water level monitoring, UAV aerial image acquisition, and preparation of the notes and summary of the kickoff meeting of the Technical Advisory Committee (TAC). Whelan Gilkerson, Merkel and Associates, Inc. was the lead in acquisition and post-processing of the UAV aerial imagery, and provided Geographic Information System (GIS) support for the kickoff TAC meeting presentation and this report.

BACKGROUND INFORMATION

Historic mining and logging related impacts have severely degraded the function and resiliency of the aquatic and terrestrial ecosystems of the Salmon River Sub-Basin.

Spanning an 80-year period, from ca. 1870 to the 1950's, hydraulic and dredge placer mining and related activities disrupted much of the gold bearing alluvium that comprised floodplains and terraces within the project area and many other locations within the Klamath Basin (Stumpf, 1979). De la Fuente and Haessig (1993) reported that a minimum of 15.8 million cubic yards (yds³) of sediment was delivered to the Salmon River during this time period. Recent work by Hawthorn (2017), utilizing LiDAR DEM and aerial photo analysis, reported that at least 1,859 acres of alluvial materials adjacent to the mainstem and larger tributary channels were disrupted, which resulted in an estimated 20.3 million yds³ of sediment delivered directly to the river. Within the lower 2.0 miles of Nordheimer Creek, several historical hydraulic mine sites and multiple diversion ditches are evident and recognized by the curvilinear ditch lines on the hillslopes, and the deep trenches and piles of cobbles and boulders on the valley floor. The disrupted ground lacks soils with the necessary moisture holding capacity needed to support a properly functioning riparian forest. Mine ditches constructed to route water from Nordheimer tributaries in support of larger scale mining at the confluence and along the main stem Salmon River persist and have the potential to divert surface- and ground-water runoff, which in turn can impair summer baseflow quantity and quality.

A second phase of ecosystem perturbation began in the late 1940s with the onset of industrial logging, related road building, and increased wildland fire suppression activities. While timber harvest and road building occurred in association with historical mining, the demand for wood-products and improvements to the tracked dozer following WWII combined to expedite the removal of primary forests within the Sub-Basin during this time. During the time period from 1904 to 1988, De la Fuente and Haessig (1993) estimated that a minimum of 10.4 million yds³ of landslide derived sediment and 1.4 million yds³ of surface erosion was delivered to the aquatic ecosystem of the Salmon River. Within Nordheimer Creek, pre-anthropogenic landslide sediment yields were estimated to be between 3.5 and 3.9 yds³/acre. In comparison, sediment yield was estimated to be between 5.0 and 9.9 yds³/acre during the 1989 assessment period. This represents an average 2 fold increase in sediment yield compared to pre-disturbance conditions.

In 1977, the Hog fire burned across the entire Nordheimer Creek Watershed. A majority of the burn areas were classified as moderate to high severity. Subsequent salvage logging removed merchantable standing trees down to the edge of the streambank and included instream wood removal based on the thought that increased sedimentation and large wood inputs from fire and subsequent logging were causing fish passage issues (T. Soto and K. Greenberg pers. com. 2019).

In 1986, Congress adopted Public Law 99-552, the 'Klamath Act' in order to restore the fisheries resources in the Klamath River (De la Fuente and Haessig, 1993). Sedimentation related to certain land management practices was identified as one of the factors which has degraded fish habitat in the Klamath River.

Since 1992, the SRRC and its restoration partners have been actively working to restore aquatic and terrestrial habitats in the Salmon River Sub-Basin.

EXISTING CONDITIONS

Watershed Geology and Geomorphology

Nordheimer Creek drains a 31 mi² watershed located within the Klamath Mountain Geomorphic Province of Northern California. The watershed is primarily underlain by metasedimentary and metavolcaniclastic sedimentary rocks of the Western Paleozoic and Triassic Belt (Wagner and Saucedo, 1987). The watershed is northward draining and characterized by steep mountain slopes with elevations that range from 1079 feet at the confluence with the Salmon River, to 6956 feet at the summit of Salmon Mountain at its headwaters. Basic physiographic characteristics of the watershed are provided in Table 1.

Table 1. Physiographic characteristics of the Nordheimer Creek Watershed, Salmon River Sub-Basin, California.

Drainage Area (mi ²)	Mean Annual Precipitation (inches)	Forest Coverage (percent area)	Longest Flow Path Length (miles)	Min Basin Elevation (ft)	Max Basin Elevation (ft)	Mean Basin Elevation (ft)
31	74.7	63	13	1092	6914	3771

Glacial cirques and moraines are present in the upper watershed above about 4000 feet elevation, which is consistent with Quaternary age glacial features in the Trinity Alps described by Sharp (1960) and more recently by Dickey et al. (2017). Large scale landslides and remnants of landslide dams are also present in the watershed. The larger landslides range in size from about 10 to 200 acres.

Debris Flow deposits along the lower valley floor, prominent inner gorges and bedrock knickpoints, gigantic boulders, and interlocking streambed structures distributed along the lower 2.0 miles of the channel support the hypothesis that tectonic uplift and catastrophic outburst floods from breached glacial moraines and/or landslide dams have played a significant role in shaping the landforms of the lower valley floor for at least the past ~20,000 years.

Lower Nordheimer Creek and adjacent reach of the Salmon River are semi-alluvial and confined within the inner gorge of a bedrock canyon. Prominent strath terraces are present on both sides of Nordheimer Creek and the Salmon River. Prior to the hydraulic mining era these terraces were covered by thick alluvial deposits that most likely supported a mixed conifer forest. Within the Nordheimer watershed the majority of the stream channels below ~ 4000 feet elevation are deeply incised within inner gorges with valley sidewalls comprised of near vertical bedrock cliffs or coalesced landslide deposits. At lower elevations many of these channels have a valley in valley morphology which reduces the number of mechanisms that can deliver wood and sediment directly to the active channel. These factors in combination with steep stream gradients means Nordheimer Creek and its tributaries are naturally a supply limited system (aka transport dominated). In these types of systems the dominant wood and sediment supply mechanisms are 1) large hillslope mass wasting features that have the runout capacity to reach the active channel - in some cases this requires landslides to runout across elevated terrace benches, 2) infrequent large “re-setting” floods

(typically 20-yr recurrence interval or greater) that scour the inner gorge and relocate stored sediment and wood materials further down valley, and potentially out of the system, and 3) direct delivery from mortality of trees growing along the margins and within the inner gorge.

Geomorphic channel types were used to characterize stream reaches within the lower 1.9 miles of Nordheimer Creek following criteria of Montgomery and Buffington (1997). Figure 1 depicts the geomorphic reach designations and channel stationing used in this report. Figure 2 shows the longitudinal profile, derived from the 2014 LiDAR DEM, with geomorphic reach designations, key physical attributes, example photographs and channel stationing. LiDAR DEM derived channel cross-sections and physical attributes for Reaches 1 through 4 are provided as Figure 3.

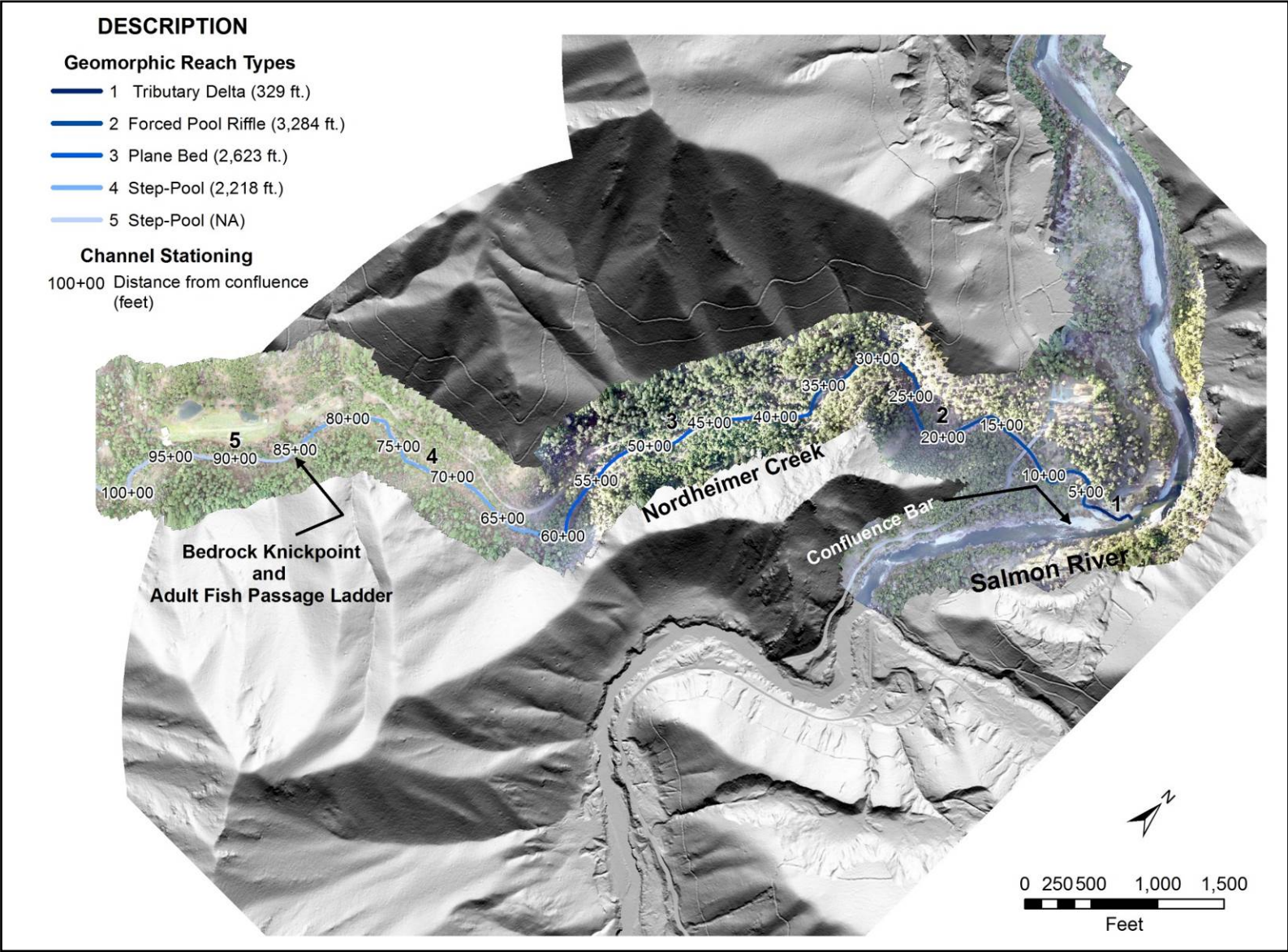


Figure 1a. Project Overview Map showing geomorphic reach types, channel stationing, and key features for lower Nordheimer Creek, Salmon River Sub-Basin California. Base Imagery: 2019 UAV Ortho-photomosaic overlain on portions of the 2014 1m LiDAR DEM derived hillshade.

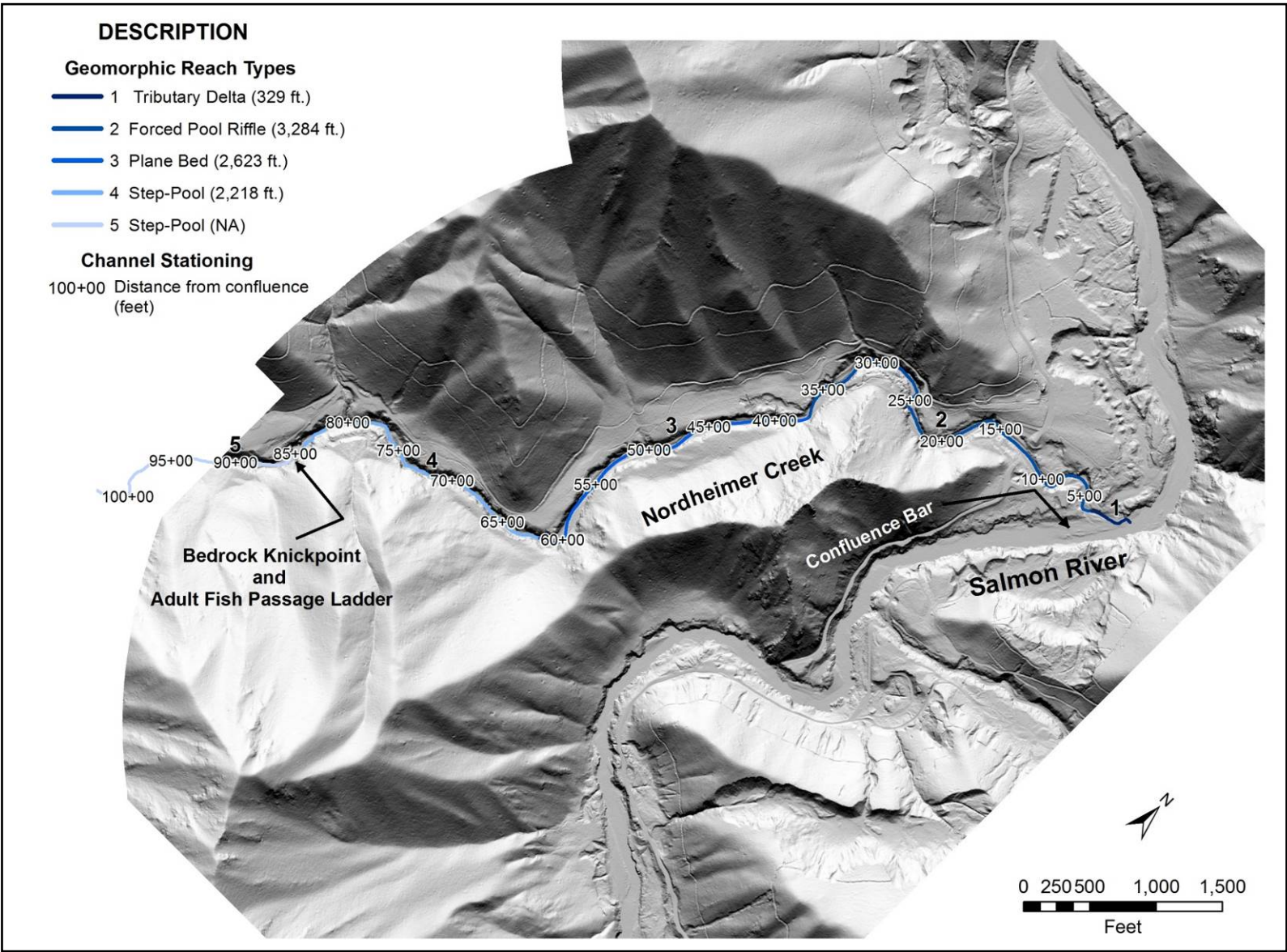


Figure 1b. Project Overview Map showing geomorphic reach types, channel stationing, and key features for lower Nordheimer Creek, Salmon River Sub-Basin California. Base Imagery: Portions of the 2014 1m LiDAR DEM derived hillshade.

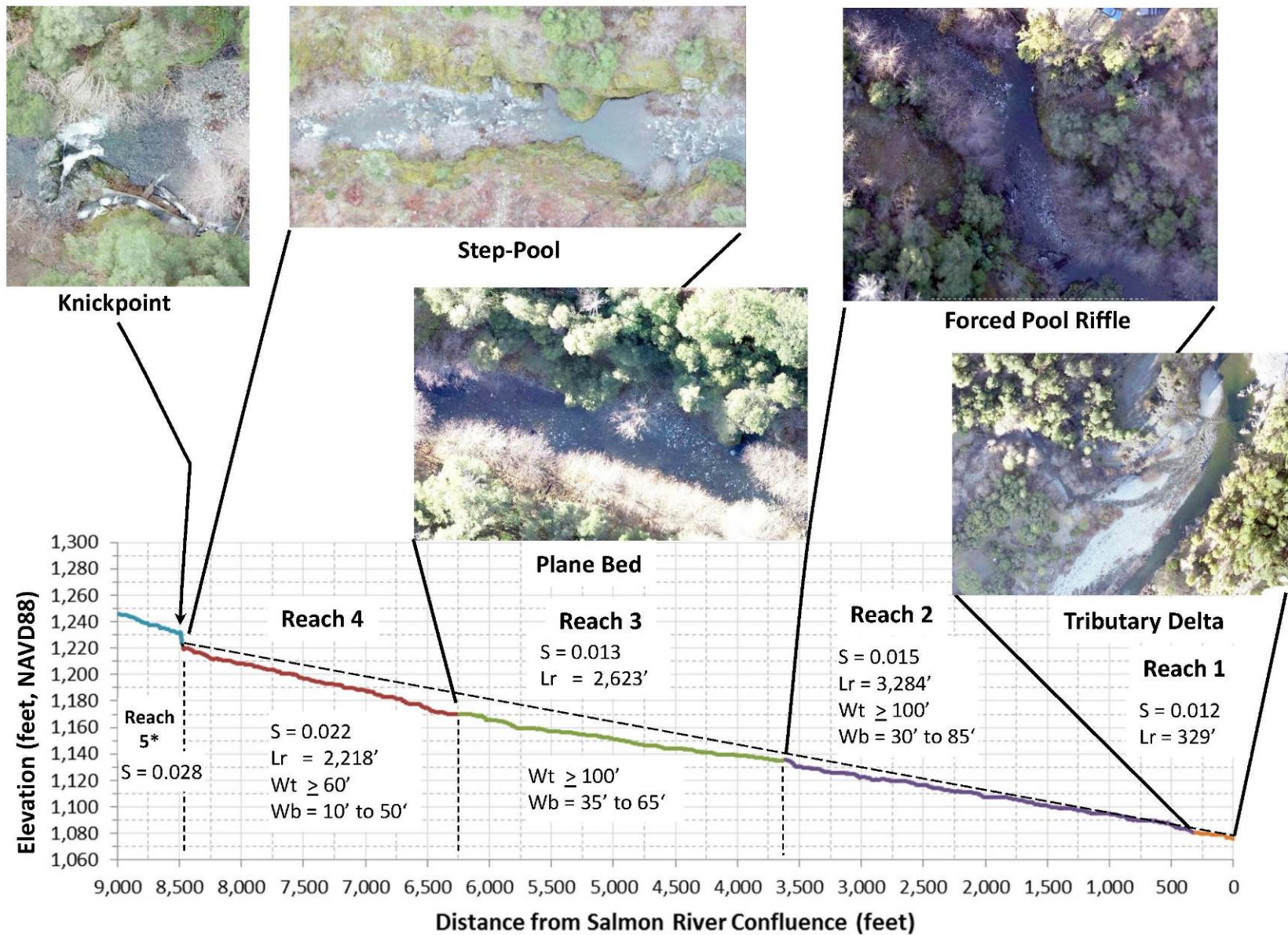
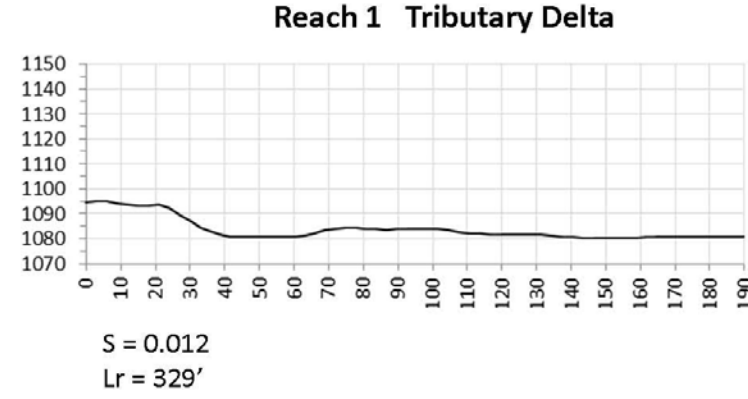
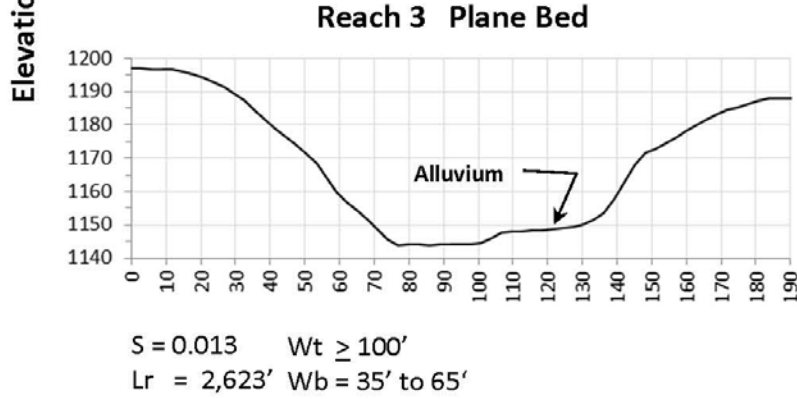
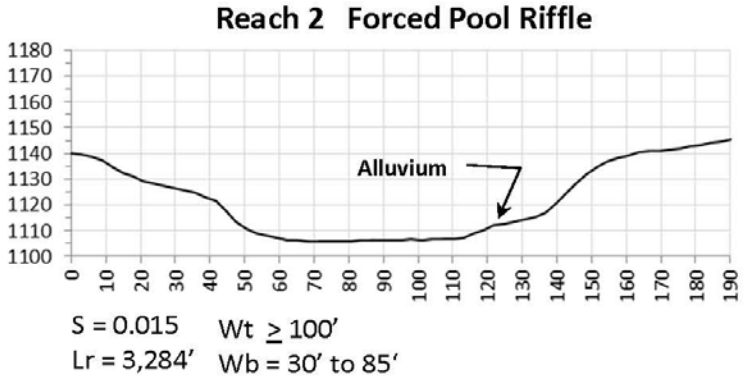
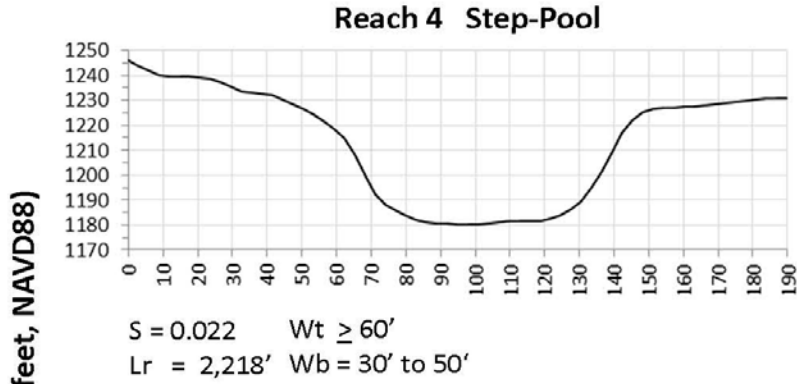


Figure 2. LiDAR DEM longitudinal profile with geomorphic reach designations and channel stationing for the lower 1.9 miles of Nordheimer Creek, Salmon River Sub-Basin California. Physical attribute definitions are shown in Figure 3.



Distance (feet)

Definitions:
 S = channel slope Wt = channel top width
 Lr = reach length Wb = channel bottom width

Figure 3. LiDAR DEM derived channel cross-sections and physical attributes for Reaches 1 through 4 in the lower 1.9 miles of Nordheimer Creek, Salmon River Sub-Basin California.

Geotechnical Conditions

Geotechnical assessments were conducted at the Nordheimer Confluence Bar and along the lower 1.8 miles of Nordheimer Creek. The objective of these assessments was to characterize geotechnical conditions to inform this and future design phases. Design critical information included obtaining descriptions of surface and subsurface particle sizes, depth to bedrock, locating potential equipment access routes, and to generally assess project opportunities and constraints.

Nordheimer Confluence Bar

On October 25, 2018 a geotechnical assessment was conducted on the Nordheimer Confluence Bar (Figures 1 and 4). Four test pits were excavated and backfilled the same day using a 12,000 lb Kubota KX057-4 Excavator (Figure 5). Pits 1 and 2 were located along the left bank of the Salmon River, near the transition between the active bar and the lightly vegetated floodprone surface. The location for Pits 1 and 2 were chosen to potentially intercept shallow bedrock and to establish groundwater monitoring wells that would be less vulnerable to damage by bedload and floating materials. Pit 3 was located adjacent to the left edge of water of the Salmon River at the time of the assessment. The purpose of Pit 3 was to determine if there was lateral continuity in subsurface materials identified in Pits 1 and 2. Pit 4 was located on the downstream end of the Confluence Bar adjacent to the bedrock wall that forms the left bank of Nordheimer Creek. Pit 4 was located to potentially intercept shallow bedrock and describe the subsurface materials on the Confluence Fan.

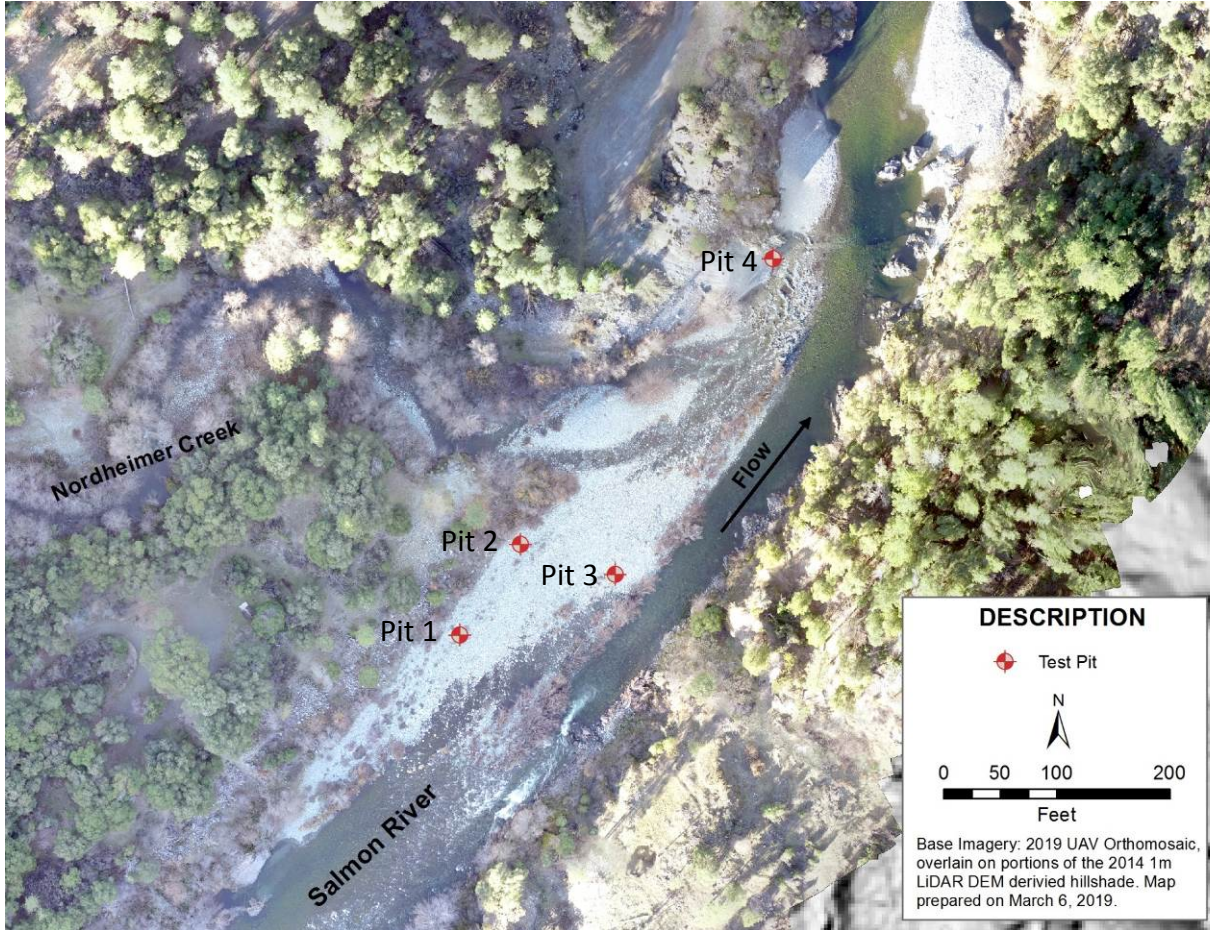


Figure 4. Location map of subsurface test pits on the Nordheimer Confluence Bar, Salmon River Sub-Basin, California.



Figure 5. Photograph showing a Kubota Excavator excavating Pit 1 on the Nordheimer Confluence Bar, Salmon River Sub-Basin, California.

Key Findings

The Nordheimer Confluence Bar surface was covered by a 2 to 3 foot thick coarse lag deposit comprised of cobbles and boulders. The bar surface was underlain by multiple depositional units comprised of gravels and sands that averaged from 1 to 2 feet in thickness. The gravel and sand units were found to extend to at least 10 feet below ground surface. A photo log of the stratigraphy at Pit 1 is provided as Figure 6, and is representative of conditions found at Pits 2 and 3. Depths of Pits 1, 2 and 3 were limited by stability of the trench walls under the presence of shallow groundwater. The depth at Pit 4 was less than 3 feet due to the presence of shallow groundwater. The boring logs from the Nordheimer Creek Bridge Plan added additional information in support of the key findings of this assessment. A simplified geologic cross-section for the Nordheimer Confluence Bar based on combined information from data collected in the field and published sources is provided as Figure 7.

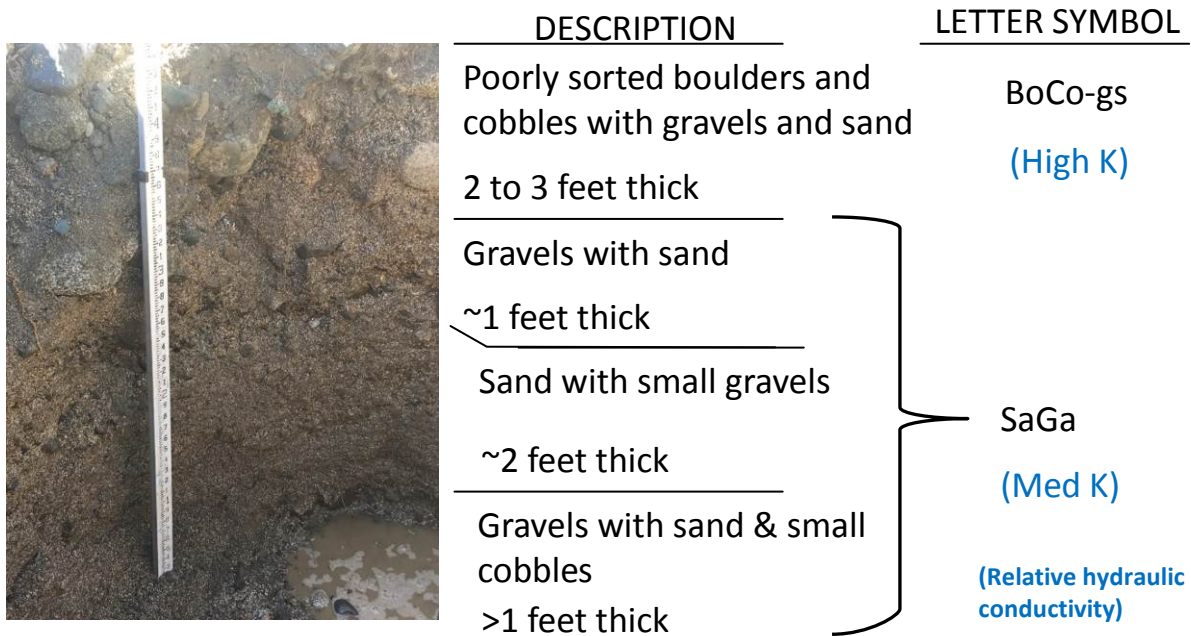


Figure 6. Photo-log of Test Pit 1, Nordheimer Confluence Bar Salmon River Sub-Basin, California. Note presence of groundwater at the bottom of the pit.

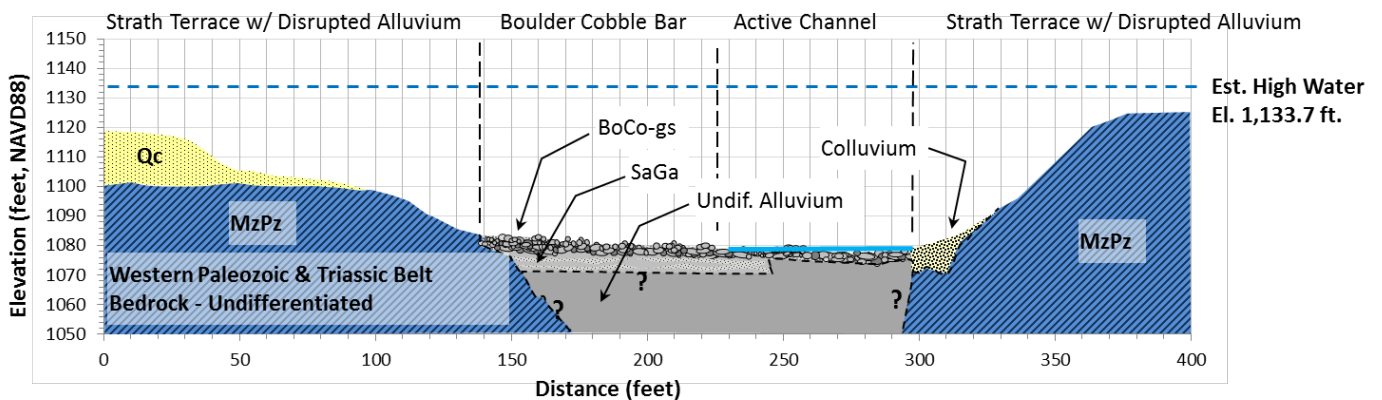


Figure 7. Simplified geologic cross-section for the Nordheimer Confluence Bar, Salmon River Sub-Basin, California.

Lower Nordheimer Creek

A reconnaissance level geotechnical survey was conducted along the lower 1.8 miles of Nordheimer on August 3, 2019. The purpose of this survey was to characterize design-relevant channel conditions that included information regarding construction access and feasibility with sufficient detail to develop restoration designs at the 30% level. Data collection included visual characterization of dominant streambed sediment sizes and bed architecture, mapping the location of in-channel bedrock exposures, measured and visual estimates of residual pool depths and riparian tree diameter classes, and assessing potential equipment access routes and limitations. Feature attributes and locations were recorded on a series of twelve maps that covered a portion of the field area at a scale of 1:500. This scale provided sufficient detail that the location of mapped features could be accurately transferred into the project Geographic Information System (GIS) for further analysis. Refer to Figure 1 for reach designations and channel stationing mentioned below.

Key Findings

- 1. Channel Sediment and Bed Architecture.** The streambed was predominantly covered by a lag deposit comprised of imbricated and interlocked boulders and cobbles. Clusters of large cobbles and boulder ribs were common within reaches with step-pool morphology (Reach 4 and 5). Large cobble clusters were also present in the downstream reaches but with a reduced frequency. Particle interlocking and imbrication was most notable in Reach 3, where the bed exhibited a cobble pavement throughout the reach. Spawning size gravels were in limited supply and tended to occur at the lateral margins of pool tailouts, on the lee side of canyon wall undulations, and to a lesser degree in association with the few pieces of live and dead wood located in the active channel. Reach 5 appeared to have the best retention and distribution of spawning size gravels. However, less than 1200 feet of Reach 5 was surveyed during this evaluation. So conditions upstream of that point have not been well characterized at this time.

Step-pools, boulder ribs and particle clusters are indicators of high energy systems that form by infrequent, large magnitude flood events with recurrence intervals that can exceed 50-year events (Grant, 1990; and O'Connor, 1986). Particle interlocking and imbrication indicates the bed has developed resistance to particle entrainment and scour (Bunte and Abt 2001).

These observations, in combination with those described in finding 2 (below), illustrate the generally unlimited transport capacity for coarse sediment and low temporary storage capacity for gravels and wood that are characteristics of bedrock dominated river systems (McBain and Trush, 2004). The increased storage and coverage of spawning size gravel in Reach 5 may indicate a slug of gravel size sediment is moving through the system in association with the most recent large flood event that occurred in 2006 (Figure 8). Episodic pulses of gravel slugs may partially explain the spatially transitory distribution of spawning redds discussed on page 23.

2. Bedrock and Large Boulder Controls. Bedrock was exposed at the surface of the streambed at several locations between stations 67+00 and 87+50 (Reaches 4 and 5). Depth to bedrock, inferred from measured residual pool depths, indicates streambed cover sediments range in thickness from a maximum of 10 to 12 feet to an average of between 4 to 6.5 feet. Analysis of channel cross-sections derived from the 2014 LiDAR Bare Earth DEM and the Nordheimer Bridge Plan supports field observations that less than 4 feet of alluvium overlays weathered bedrock within the active channel in the vicinity of the bridge. Large boulders (> 3 feet in diameter) were observed on the bed surface and exposed below the bed surface within deeper pools throughout the survey reach. The largest boulder identified in the survey was located at station 89+00 and had an intermediate axis dimension of about 19 feet. Overall, bed surface material sizes decreased in the downstream direction.

Collectively, these observations indicate bedrock or large boulders (> 3 feet dia) will likely be encountered at shallow depths beneath the streambed. For design purposes, wood embedment within the streambed should be limited to depths no greater than 6 feet to be conservative. Designs that rely on wood embedment for stability may need to have location or architecture contingencies, or have multiple redundancies for anchorage to deal with the uncertainty of where bedrock or large boulders may be encountered during construction. This consideration is especially important if a design flow greater than a 10-year event and a factor of safety greater than 1.5 are specified.

3. Riparian trees. Riparian trees growing within the Nordheimer Canyon were primarily white alder and are present in three general diameter classes (measured at breast height (dbh)):

Large – trees with a dbh greater than about 1.7 feet,

Medium – trees with a dbh that ranged from approximately 0.5 to 1 feet, and

Small – trees with a dbh less than 0.5 feet.

Large riparian trees were infrequent and were typically found growing on top of alluvial deposits with the top surfaces ranging in height from 2 to 8 feet above the active channel bed. Air photo evidence suggests the larger trees began to establish shortly after the 1964 flood. Medium size trees were found in greater numbers and typically occurred on the face and upper surfaces of older deposits that have been reworked since the 1964 flood, and on relatively younger alluvium. Small trees were found to occur opportunistically where site conditions allowed.

Designs will be able to take advantage of riparian trees as resisting elements at several locations along the creek. However, based on prior experience trees used for this purpose should have a dbh greater than 0.8 feet. Other selection criteria include condition of the bole and attachment characteristics of the rootwad and substrate. Some of the riparian trees in medium size class have a pistol-butt morphology. These trees may not be suitable for use as a resisting element.

4. Alluvial Deposits. The more persistent and larger alluvial deposits lie within narrow compartments formed by undulations, expansion zones and meanders within the bedrock canyon walls. Near vertical streambank exposures showed the older features were comprised of a mixture that was primarily cobbles and boulders and a smaller fraction of gravels and sands. The larger boulders exposed in these deposits had an intermediate axis of about 2 feet. The top of these surfaces ranged in height from about 2 to 8 feet above the active channel bed. Portions of some of these deposits appear to have been reworked as evidenced by riparian trees of the various size classes occupying different areas of the deposit.

Some of these deposits may provide opportunities to embed logs. However, without additional investigation, it will be unknown until the time of construction if oversized boulders or shallow bedrock exists within the subsurface.

Designs that rely on wood embedment in the alluvial streambanks for stability may need to have location or architecture contingencies, or have multiple redundancies for anchorage to deal with the uncertainty of encountering bedrock or large boulders during construction. This consideration is especially important if a design flow greater than a 10-year event and a factor of safety greater than 1.5 are specified.

5. Stream Flow Conditions. During the time of this survey stream flow recorded at the Salmon River gage at Somes Bar (USGS 11522500) showed the discharge was relatively stable throughout the day at approximately 311 cfs. Scaling this discharge by drainage area ratio (see below) indicates that flow in Nordheimer would be approximately 13 cfs.

At this discharge flowing water covered the bed of the active channel. For a majority of the 1.8 mile survey reach the width of active channel equaled or nearly equaled the width of the valley floor.

Designs that rely on the use of heavy equipment in the active channel will need to include BMPs that mitigate potential impacts for working in the wet. Some excavations may be problematic due to the absence dry ground.

6. Equipment Access and Limitations

Spiderhoe type equipment will have at least one location where it can access each of the five reaches. Overall, access to Reach 5 and 4 appears to be the most difficult due the height and near vertical slope of the canyon walls that bound the creek in these reaches. For safety and aesthetic purposes the bedrock constriction located at 66+40 in Reach 4 should be considered as a no passage location for heavy equipment. Access conditions generally improve in the downstream direction as illustrated by the cross-sections shown in Figure 3.

Hydrology

Flood and Large Landslide History

Several exceptionally large flood events have occurred on the Salmon River during the period of record for the gage at this location (Figure 8). Flood events with recurrence intervals greater than a 25-year event occurred during the 1955, 1965, 1974, 1997, and 2006 water years. Landslide episodes were known to have accompanied many of these floods, with the landslide sediment delivery during calendar years 1964 and 1972 being particularly notable (De la Fuente and Haessig, 1993). De la Fuente and Haessig (1993) also reported that “The combination of landslide episodes and flood conditions resulted in major channel alterations throughout the watershed”.

One landslide of particular note is the Bloomer Landslide which is located just downstream of the project area. This slide was triggered during the 1964 Flood (1965 WY), had an estimated delivery volume of 1.4 million yds³ and temporally dammed the Salmon River (De la Fuente and Haessig, 1993). Field and digital evidence (LiDAR DEM, and aerial and ground based photos) evaluated for this project suggests the landslide dam induced a backwater that caused a significant amount of sediment to be deposited well upstream of the slide and into the project area.

Field observations and aerial imagery indicate floods with a 25-year recurrence interval and greater can reset riparian and sediment storage conditions within the lower portions of the project area.

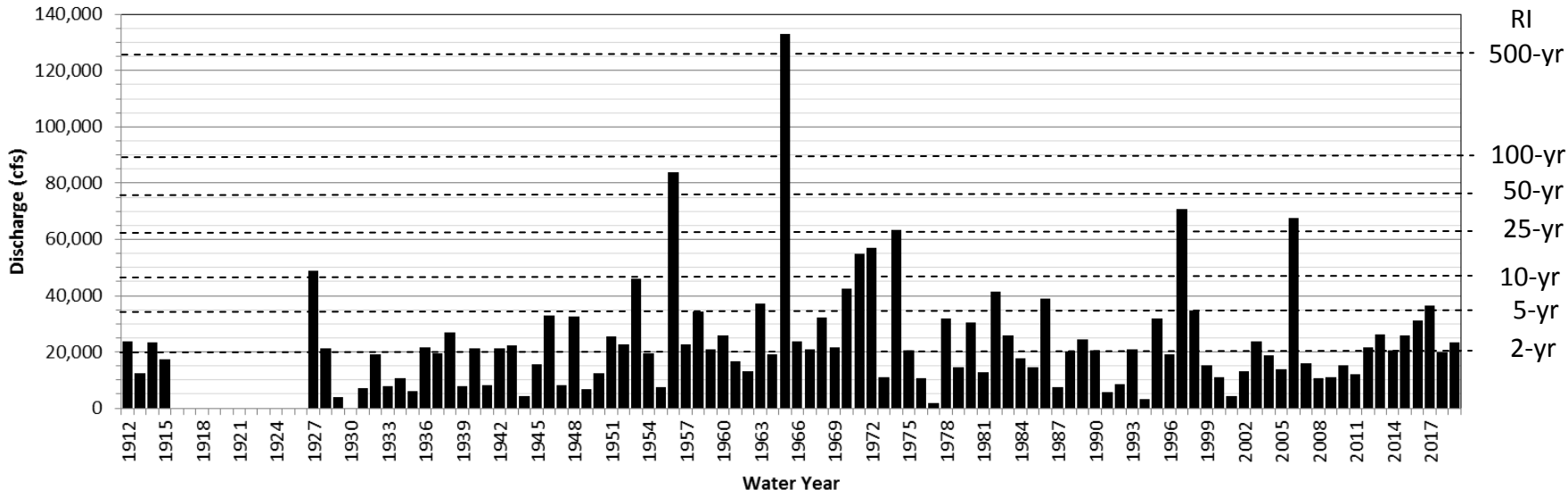


Figure 8. Annual flood peaks for the Salmon River at Somes Bar (USGS 11522500) for the period of record; with recurrence intervals for standard discharge events are shown. Note: the water year designation used herein follows the USGS protocol which defines it as the 12-month period October 1, for any given year through September 30, of the following year.

Design Hydrology

Nordheimer Creek lacks stream flow data with a sufficient period of record to calculate flood recurrence statistics. Due to this data gap an analysis of annual flood records from several nearby gaged watersheds and hydrographic data from a temporary gage placed in lower Nordheimer Creek was used to identify a reasonable proxy for design purposes. This analysis required a multi-step process that is summarized in the sections below.

STEP 1: Water Year 2018 Discharge Estimates for Nordheimer Creek

An automatic stage recorder was installed in lower Nordheimer Creek at the beginning of the 2018 Water Year (WY). A peak flow of 800 cfs for the water year was estimated using Mannings Equation, the recorded peak flow depth, and channel geometry and roughness conditions exhibited at the site. A stage rating curve for the record was generated using the NRCS XS Analyzer (NRCS 2015). A comparison of Nordheimer Creek and the Salmon River hydrographs for the period the temporary gage was operated is shown in Figure 9.

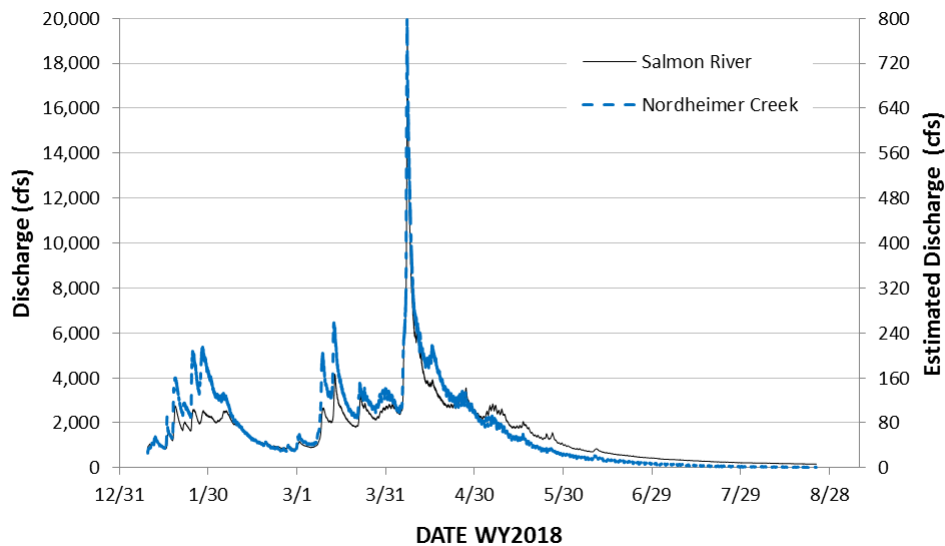


Figure 9. Hydrograph comparison of Nordheimer Creek with Salmon River gage at Somes Bar (USGS 11522500) for a portion of water year 2018.

STEP 2: Comparison of Unit Area Runoff for Nordheimer Creek with Regional USGS Stream Gages

Unit area runoff values for the 2018 WY peak event at the long-term gages shown in Table 2 were compared with the WY event in Nordheimer Creek. This comparison showed the WY2018 unit area runoff values for the Salmon River and Trinity River above Coffee Creek gages closely approximated the estimate for Nordheimer Creek and suggests the RI for Nordheimer Creek was close to a 2-year event (Table 2).

Data for the Salmon River gage was selected for the next step of analysis because it had the closest similarity in hydrograph pattern and synchronicity, unit area runoff, underlying geology, and geographic proximity with Nordheimer Creek compared to the other drainages.

Table 2. Comparison of peak flow events and unit area runoff for nearby USGS gages and lower Nordheimer Creek for Water Year 2018.

Drainage Name	Drainage Area (mi ²)	Water Year 2018 Peak Discharge ¹ (cfs)	Water Year 2018 Peak RI (yrs)	Water Year 2018 Peak Unit Discharge (cfs)
Nordheimer Creek	31	800	na	25.7
Salmon River	751	19800	2.1	26.4
Indian Creek	120	2490	1.12	20.8
Trinity River abv Coffee Creek	143	3610	1.42	25.2
Rush Creek	22.3	684	2.25	30.7
Scott River	653	3850	1.4	5.9

Notes: 1) peak flow values where preliminary and subject to revision by the USGS.

STEP 3: Evaluation of Flood Recurrence Estimators

Flood recurrence intervals for Nordheimer Creek were calculated using: 1) drainage area ratio (DAR) scaling (i.e. $Q_u = (A_u/A_g)$), 2) scaling using Equation 1 from Waananen and Crippen (1977) (W&C), and 3) the regional regression equations implemented in the USGS online application StreamStats (Gotvald et al. 2012).

Equation 1 from Waananen and Crippen (1977) is given

$$\text{by: } Q_u = Q_g(A_u/A_g)^b$$

Where: Q_u = ungaged discharge

Q_g = gaged discharge

A_u = ungaged drainage area

A_g = gaged drainage area

b = regional scaling exponents in Table 1 of Waananen and Crippen (1977).

Recurrence interval (RI) estimates calculated by DAR scaling were 788 cfs for the 2-yr and 3109 cfs for the 50-yr RI flood. The 2-yr RI DAR estimate closely approximates the temporary gage estimate of 800 cfs, and was 30 to 41 percent lower than the estimates produced by the W&C method for the 2-yr and 50-yr RI flood, respectively. RI estimates from StreamStats were 90 to 64 percent greater than those given by the W&C method for the 2- and 50-yr RI estimates, respectively. StreamStats output also showed the standard error of prediction of 58.6 percent for the 2-yr flood (2820 cfs) and 42.7 percent for the 50-yr flood (9140 cfs). This analysis indicates the W&C method provides RI estimates that range between those produced by simple DAR scaling and StreamStats (Table 3).

Table 3. Comparison of flood frequency estimators for Nordheimer Creek, Salmon River Sub-Basin, California.

Method	Flood Recurrence Interval (years)				
	2	5	10	25	50
	Discharge (cfs)				
1 - DAR	788	1,406	1,885	2,560	3,109
2 - W&C	1,071	2,016	2,764	3,826	4,705
3 - StreamStats	2,820	4,760	6,120	7,850	9,140
Average	1,560	2,727	3,590	4,745	5,651
Percent Difference 1&2	30	36	38	40	41
Percent Difference 2&3	90	81	76	69	64
Percent Difference 2&Avg	37	30	26	21	18

Key Findings

Based on the preceding evaluation flood-frequency statistics for this project were derived by scaling the annual peak flood values for the Salmon River (USGS #11522500) using Equation 1 from Waananen and Crippen (1977). Design-relevant flood statistics for Nordheimer Creek are provided in (Table 4).

Table 4. Design-relevant flood frequency statistics for Nordheimer Creek, Salmon River Sub-Basin, California.

Nordheimer Creek Estimated Design Flows	Peak Flow Recurrence Interval (year)					
	2	5	10	25	50	100
	Discharge (cfs)					
	1,071	2,016	2,764	3,826	4,705	5,662

Water Temperature

Analysis by Stillwater Sciences (2018) shows at least three distinct stream temperature reaches are present within the Nordheimer Creek project area: A) the reach upstream of the confluence where mainstem stream water temperatures can exceed 22° C, B) the Nordheimer confluence reach where cooler water is present within the Reach 1 and 2 of Nordheimer Creek and sustained at the confluence pool, and C) in the reach of the mainstem located downstream of the confluence (Figures 10 and 11).

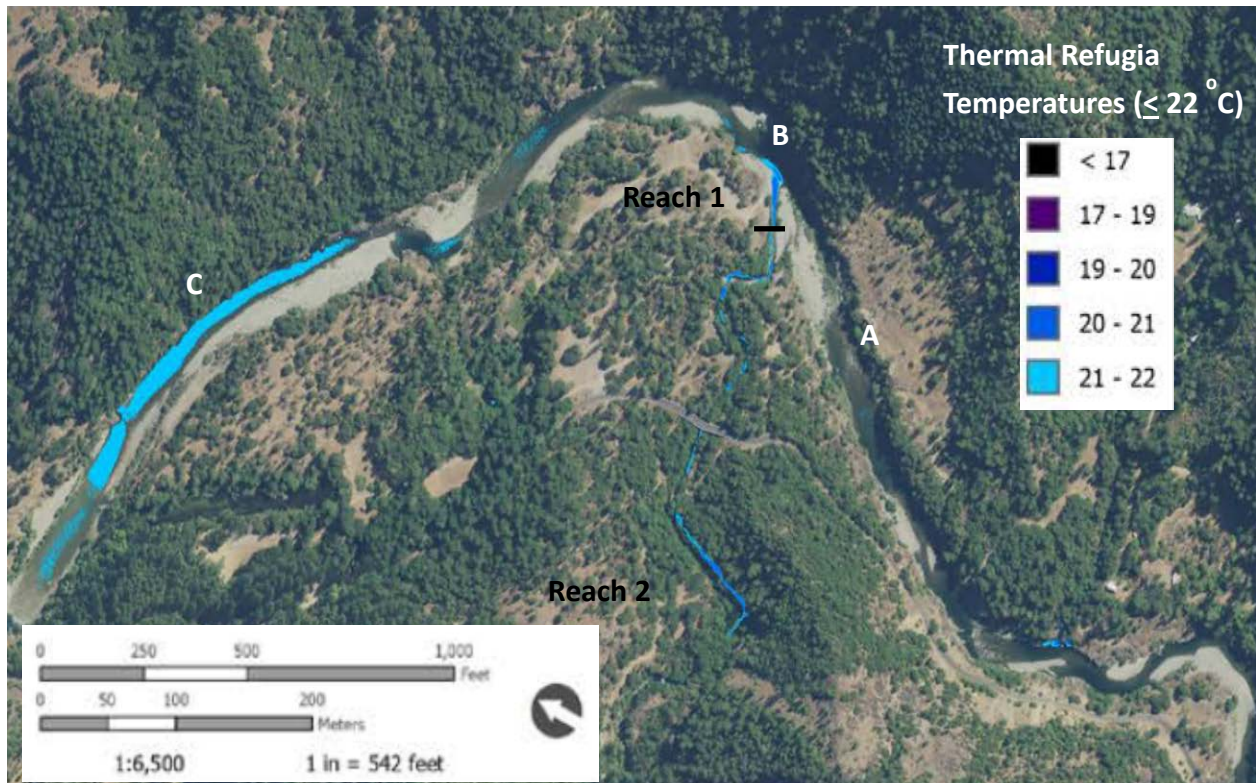


Figure 10. Thermal refugia for a portion of Nordheimer Creek and the Salmon River, California. Figure adapted from Stillwater Sciences (2019), used here with permission.

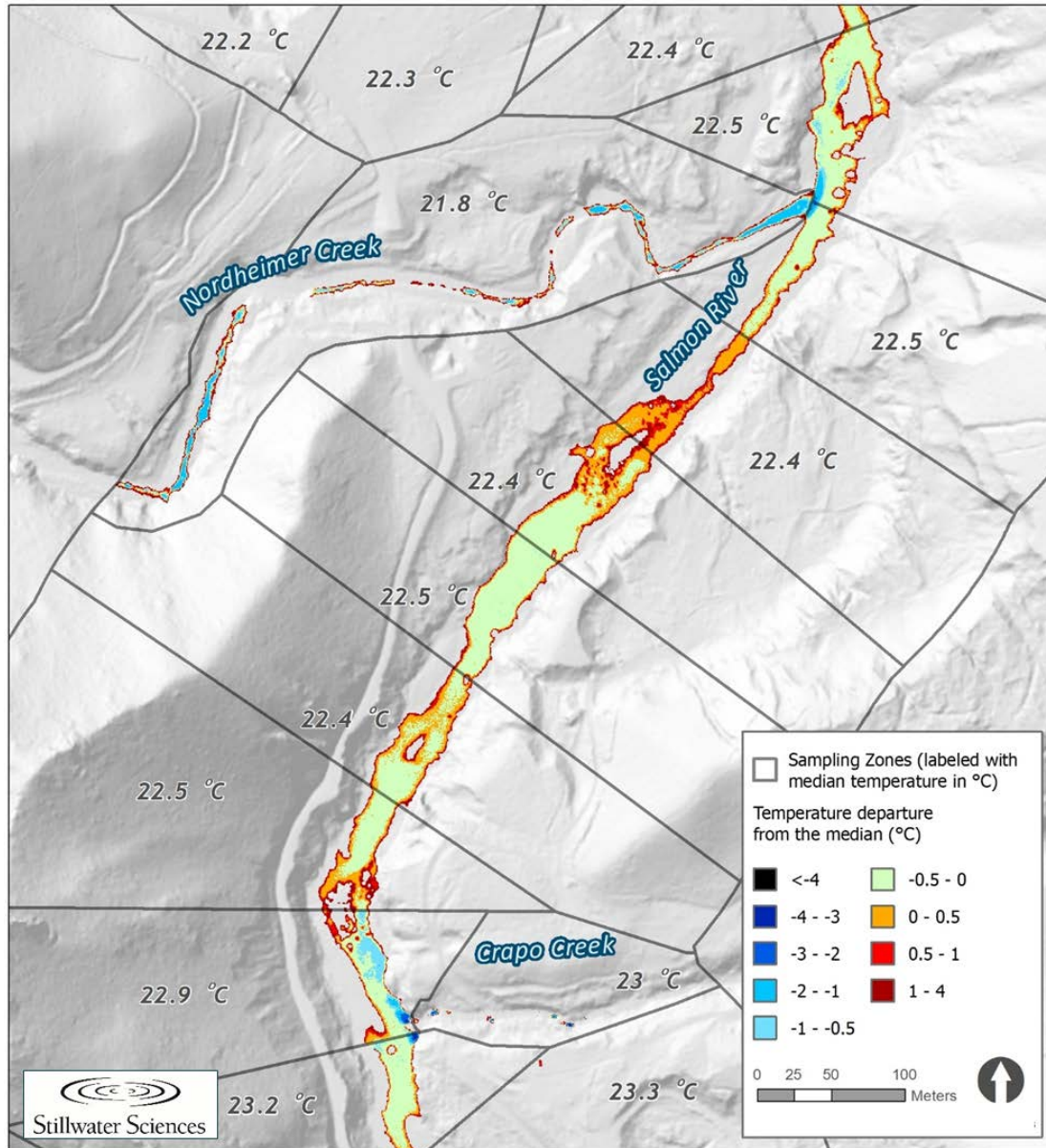


Figure 11. Stream temperature departures from the median for a portion of Nordheimer Creek and the Salmon River, California. Figure from Stillwater Sciences (2019), used here with permission.

Stream temperature is a function of streambed composition, water depth, riparian cover, and the amount and intensity of solar isolation, among other factors (Brown, 1969; Caissie and Luce, 2017). Large cobble (> 0.8 feet diameter) dominated streambeds with shallow water depths tend to store and conduct heat as long as the bed is warmer than the stream water. Bed conduction can cause maximum stream temperatures to occur later in the day, possibly into the evening hours. Research by Ward (2011) shows that hyporheic water can be forced to the surface when it encounters fine grained sediments with a low hydraulic conductivity at depth. This phenomenon can exacerbate the heating effect when deeper and cooler hyporheic water is driven upwards and forced to interact with warmer water at the surface.

Key Findings

The sediment architecture (with cobbles and boulders on the surface that overlay lower hydraulic conductivity sediments at depth), absence of riparian cover, and southerly aspect appear to be key factors that exacerbate water temperature conditions at the Nordheimer Confluence Bar.

Riparian vegetation would greatly improve habitat, modify the depositional environment, and potentially help attenuate stream water temperatures at this location. However, the surface layer of large cobble and boulders and high shear stress during floods on the Salmon River will continue to limit natural colonization of riparian cover on the bar unless actions are taken to change this negative feedback loop.

Salmon Redd Counts and Spatial Distribution

SRRC staff, USFS staff, CDFW, tribal personnel, and volunteers have conducted salmon spawner surveys within the lower 1.9 miles (3.1 km) of Nordheimer Creek for a total of 6 years since 2000. Table 5 shows the number of redds by survey year, and geomorphic reach breaks determined by this project. During the field surveys a unique identification number and survey date was recorded for each redd observed. Redd locations were determined by GPS or mapped at the time of the survey and entered in to a GIS database by USFS staff at a later time. Redd survey data was provided for this project by Maija Meneks, Klamath Forest District Biologist (Meneks, M. pers com. 2019). Additional redd survey data may on file with the SRRC in hardcopy format but was not available for this report (Greenberg, K. and M. Van Scoyoc pers. com. 2019)

The interpretive value of the redd data for Reach 1 and 5 must factor the following considerations: i) poor spawning conditions are typical in Reach 1, and ii) inconsistent survey intensity in Reach 5. Reach 1 data indicate redds were present in 2017 and 2018 and were absent or not observed in previous years. Reach 1 is located at the confluence of Nordheimer Creek and the Salmon River and subject to extreme flow patterns (high and low flows) and episodic sedimentation. We hypothesize that spawning does not regularly occur in this reach or has limited success for these reasons. Reach 5 is located upstream of a bedrock knickpoint that can be a fish passage barrier during low flow conditions. The USFS installed a fish ladder at this location sometime between 1987 and 1989 (Greenberg, K, and M. Van Scoyoc pers. com. 2019). Data show adult fish were able to spawn in the lower portions of Reach 5 during Water Years 2013, 2014 and 2015. However, because high stream flows can make wading unsafe or obscure redd visibility the reach length surveyed has varied from year to year (Meneks pers com 2019).

Key Findings

The pattern of redd counts in lower Nordheimer Creek, shown in Figure 12, suggests forced pool-riffle, plane-bed and step pool morphologies support a similar number of spawning fish. However, when analyzed as redd density (number of redds divided by reach length) Reach 4, with a step- pool morphology appears to support more spawning (Table 5b and Figure 13). The step-pool morphology in Reach 4 provides deep pools in proximity to pool-tailouts that appear to hold spawning gravels of good quality and in moderate quantities. These two conditions are key habitat components needed for successful holding and spawning by salmonids, especially Spring Chinook.

Table 5. Redd count data for the lower 1.9 miles of Nordheimer Creek, Salmon River Sub-Basin, California.

5a) Number of redds by channel type

Geomorphic Reach Type	Reach No	Reach Length	Reach Length	Redd Count						
		(ft)	(km)	2000	2013	2014	2015	2017	2018	Total
Confluence delta	1	329	0.10					1	2	3
Forced pool-riffle	2	3284	1.00	9	8	20	3	4	2	46
Plane-bed	3	2623	0.80	9	8	6	4	5	8	40
Step-pool	4	2218	0.68	4	6	13	7	7	1	38
Step-pool ¹	5	550	0.17		4	7	1			12

5b) Redd density by channel type

Geomorphic Reach Type	Reach No	Reach Length	Reach Length	Density (Redds/km)						
		(ft)	(km)	2000	2013	2014	2015	2017	2018	Total
Confluence delta	1	329	0.10					10	20	30
Forced pool-riffle	2	3284	1.00	9	8	20	3	4	2	46
Plane-bed	3	2623	0.80	11	10	8	5	6	10	50
Step-pool	4	2218	0.68	6	9	19	10	10	1	56
Step-pool ¹	5	550	0.17		24	42	6			72

Notes: 1) The length for reach 5 was estimated based redd locations displayed in GIS and is not representative of the geomorphic reach length because it most likely extends beyond the mappable limits of the LiDAR DEM and UAV imagery.

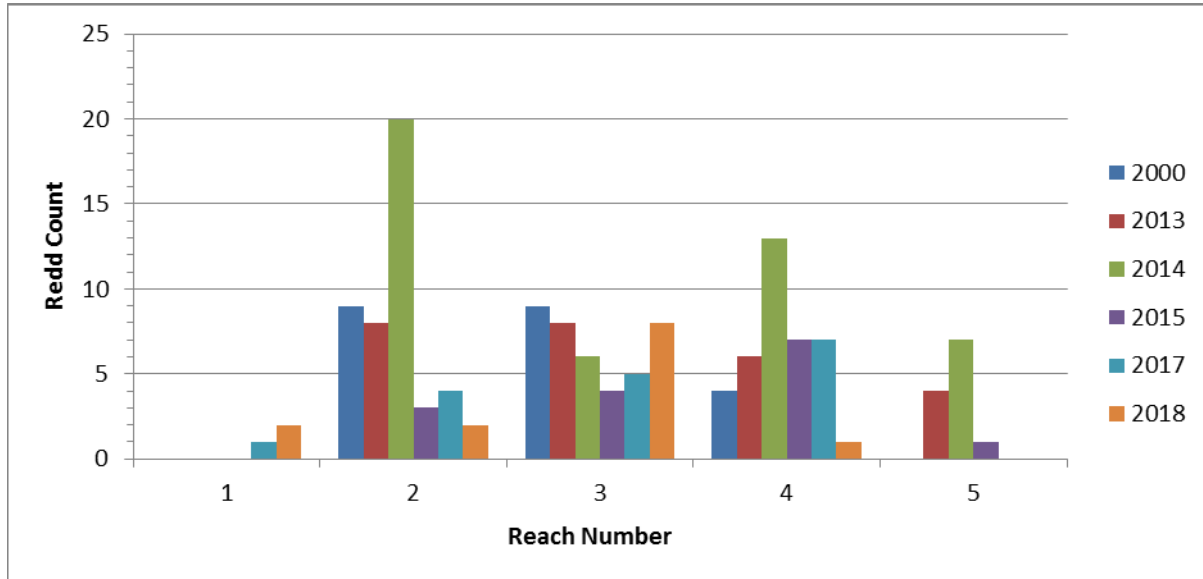


Figure 12. Number of redds surveyed by reach number within the lower 1.9 miles of Nordheimer Creek, Salmon River Sub-Basin, California.

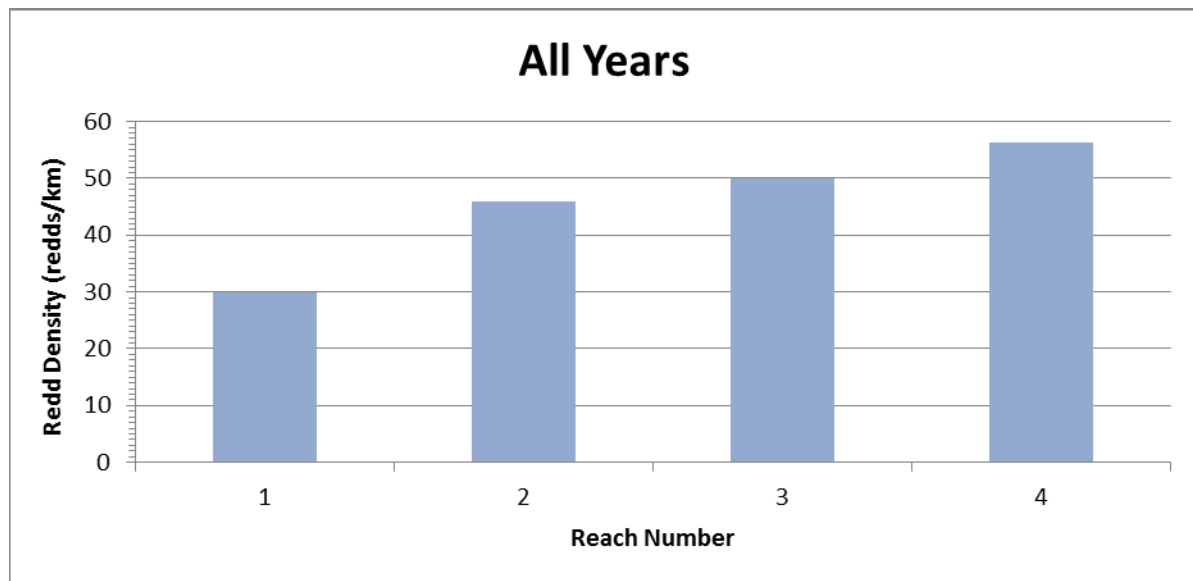


Figure 13. Redd density by reach number within the lower 1.9 miles of Nordheimer Creek, Salmon River Sub-Basin, California.

Infrastructure

Human infrastructure is located at several locations within the project area. Impact avoidance and minimization strategies will need to be considered and implemented during the design and construction phases of the project. The following is a preliminary list of observed structures with suggested actions to be taken as the design process proceeds:

1. The water wheel located on the left bank of the channel at station 96+20. This structure appears that it will be inundated during high water events. Impacts from mobile wood during flood events could damage the structure. However, the fact that it has persisted for what appears to be more than 10-years suggests that it may be out of harm's way.
Action Item: Information is needed on whether or not this is a historic landscape feature and the level of concern of the owners regarding potential damage.
2. The fish ladder located on the right bank at station 85+40. This structure is regularly inundated and subject to damage from bedload and mobile wood during high water events. However, the fact that it has persisted for what appears to be more than 20-years suggests that it is designed sufficiently to handle the impacts.
Action Items: Information is needed on whether or not this is a historic landscape feature and the level of concern of the owners regarding potential damage from impacts from mobile wood. Additionally, a future project is recommended to determine if enhancements to increase fish passage success and reduce maintenance are possible.
3. Domestic Water Intakes located along the left bank at various locations between stations 80+00 and 96+20. These structures likely have a low replacement cost, are regularly inundated, and appear to be the most vulnerable to damage from bedload and mobile wood during high water events.
Action Items: Communication with the owners regarding potential damage and identification of who would be responsible for potential repair costs is recommended.
4. Nordheimer Bridge has piers located on both banks of the active channel. Analysis of data from the bridge plan and 2014 LiDAR DEM provides the following information:
 - The span between piers is approximately 87 ft.
 - The low chord elevation is approximately 5 feet above the high water surface elevation determined under 1966 conditions.
 - Approximately 12.7 ft. of channel incision has occurred at this location over the 48-year period from 1966 to 2014.**Action Item:** The design will need to consider wood passage risks and appropriate design alternatives to avoid or minimize potential impacts to the bridge.

RESTORATION OPPORTUNITIES, CONSTRAINTS & RECOMENDATIONS

Nordheimer Tributary Delta and Confluence Bar - Reach 1

The range of restoration options evaluated for Reach 1 includes the following:

Option 1 – No Action.

Option 2 – Induce a large scour pool along the bedrock wall upstream of the existing confluence pool to improve fish access in to the Nordheimer watershed. This preliminary concept considered installation of a Bar Apex Jam and other roughness features to partition the mainstem in to two flow paths. The design would direct the river left split flow to create and maintain the desired scour pool.

Option 3 – Increase riparian habitat and sediment routing and storage efficiencies along the left bank of the mainstem.

Option 2 was discussed as a potential preferred design at the proposal field review and initial meetings with CDFW grant manager Mark Elfgren. After a review of stream temperature conditions and completion of the geotechnical assessment it was recognized this option could be counterproductive to the goal to maximize and enhance cold water habitats. This is because a bar apex jam could promote greater mixing of warmer mainstem water with cooler water emanating from Nordheimer Creek. The geotechnical assessment also showed that with the gravels and sands in the subsurface significant countermeasures would be required to defend a bar apex jam from scour at this location. Thus, the cost/benefit ratio for a bar apex jam would be high because construction costs to defend a large wood structure from scour would be high relative to the potential benefits.

Recommendations

Based on these considerations Option 3 is recommended for this site. Option 3 would involve installation of an array of willow baffles and roughness jams to enhance processes that will build a riparian zone along the bar on river left. See Sheet 1 and 1 in Appendix C for conceptual design examples.

Features in this option would be designed to work together to achieve short- and longer-term objectives to:

- Immediately create a low velocity zone along the left bank of the mainstem to support juvenile and adult fish needs during low to moderate flood events.
- Immediately improve passage conditions for juvenile salmonid use of habitats within the Nordheimer watershed by enhancing evolving site conditions that appear to be promoting a dominate channel on the left margin of the confluence delta.
- Develop a riparian zone in the long-term by increasing roughness that will trap and retain fine sediment and fluviatile plant propagules and wood.
- Promote processes that improve the input of cooler Nordheimer Creek water into the confluence pool.

Costs for this option will range from \$40,000 to \$70,000, depending on material costs and design complexity.

Nordheimer Creek - Reach 2 thru 5

A palate of restoration options is possible for lower Nordheimer Creek. These options can be mixed and matched based on reach level opportunities and constraints to balance meeting project goals and objectives, with future restoration priorities and available funding:

- Option 1 – No Action.***
- Option 2 – Wood Loading***
- Option 3 – Large Boulder Placements***
- Option 4 – Grading***

Option 1 – No Action

A no action option could be determined for the entire project area or as exclusion zones for selected locations to protect existing conditions from disturbance by ground-based heavy equipment or where treatments are less likely to meet project goals and objectives.

Option 2 – Wood Loading

The most cost efficient and process-based approach to increase wood loading in Nordheimer Creek will be with a Helicopter. A walking excavator, commonly referred to as a Spiderhoe, could be used to adjust wood position once a Helicopter or Yarder/Yoder delivers the prescribed wood to the streambed. The use of ground-based equipment will have additional impacts compared to a project that relies on a Helicopter only approach.

The advantage to using a Spiderhoe is that it provides a more economical way to fine tune wood placements which could increase the likelihood of meeting the project objectives, compared to a Helicopter only option. Given the greater visibility and ability to articulate individual logs, a Spiderhoe can weave and wedge wood into existing riparian trees and against boulders and bedrock where a Helicopter may not. The advantage the Helicopter has is it can place larger wood pieces, both in length and weight, compared to a Spiderhoe. Ultimately, larger wood may be more stable than wood scale to a Spiderhoe's capabilities in this setting. If required, added stability for individual logs and wood jams may be possible with the application of fasteners and ballast. Adding ballast by embedding logs in the streambank and placing locally derived boulders (< 3 feet dia) would be well suited for a Spiderhoe. However, these additional measures may not be effective because sediment transport and hydraulic forces will likely rapidly degrade fasteners by abrasion and weaken logs through impacts from bedload movement and torque at floods with a 10-year recurrence interval or greater.

A key consideration for the use of ground-based equipment and anchorage is whether the added cost to secure logs can meet the project objectives more effectively than using unanchored wood.

Preliminary estimates show costs will range from about \$1,000 to \$2,500 per log installed, depending on log size, haul costs and the installation method used. Initial desktop and field assessment work indicates large diameter rootwad logs with lengths greater than bankfull width and complex channel spanning wood jams (with at least 7 logs) will be needed to achieve desired geomorphic effects. Refer to the Sheets 2 through 5 in Appendix C for preliminary concepts and specifications.

Based on this information the cost for geomorphically effective wood jams will likely range from about \$8,000 to \$30,000 per jam, with the lower cost for the Helicopter option and the higher cost for the Spiderhoe assisted option. This preliminary analysis suggests the cost to constructed wood jams with a Spiderhoe will be at least 3.75 times greater than a Helicopter only approach. Or that a Helicopter only option would be able to place 3.75 times as much wood for the same cost.

Preliminary numerical modeling of wood jam stability (i.e. 1-D hydraulics, mobility, and force balance analysis) indicates unanchored wood will likely become mobile at floods with a 10-year recurrence interval or less, which is greater than the flow needed to mobilize most spawning size gravels. Design calculations for a simple log structure showed a significant amount of ballast would be required to achieve a Factor of Safety (FoS) greater than 1.5 for a 25-year flood event. The value of the FoS calculation is made relevant when evidence from past floods is considered. In the case of Nordheimer Creek, field evidence from this project, and Del a Fuente and Haessig, (1993), indicate that infrequent large magnitude floods in this range tend to be valley re-setting events for this creek. So, while a design tied to a 25-year flood RI may be appropriate where infrastructure is concerned, it may not be cost effective or appropriate if imported ballast rock or cable is needed to achieve the target FoS.

Option 3 – Large Boulder Placements

Large boulders with mean diameters that range in size from 3 to 6 feet could be used to induce scour pools, and add complexity and stability to constructed wood jams. Large boulder placements would have a longer design life compared to wood in the canyon setting. Boulders at the lower end of this size range will be at the maximum capacity for locally available Spiderhoes to move. Boulders in the upper size range will be at the lift capacity for the largest regionally available Helicopter. The effectiveness of this option could be tested in a phase one project by using boulders sourced locally and/or using boulders encountered during construction. Reach 3 is the suggested location to test this treatment option given the lack of pools and immobile bed conditions.

Option 4 – Grading

Portions of the alluvial compartments within Reach 2 and 3 could be modified by grading to create inset floodplains and in-channel habitats that would inundate over a wider range of flows compared to existing conditions. This option has the potential to reduce stream velocities and shear stress within the treatment area and to provide a source of spawning gravels. This option would require removal of existing riparian vegetation and possibly building alluvial storage features along the canyon sidewalls or using a large conveyor or some other equipment to remove excess sediment from the canyon. This type of treatment is at the upper capacity of a Spiderhoe and would be expensive to implement.

Recommendations

Based on the considerations presented herein FGS recommends creating designs that can be implemented in a phased and experimental approach. Where the initial designs and implementation strategy provide opportunities to test and adapt future work based on the lessons learned from previous phases.

For the first phase of restoration FGS generally agrees with the comments received during the kickoff meeting and written recommendations provided by Bob Pagliuco and Don Flickinger (NOAA Fisheries) with the following refinements:

Reach 2 – Construct 2 wood jams using implementation approach 3 or 4, and 3 to 4 simple wood placements using implementation approach 1 or 2.

Reach 3 – Construct at least 3 large wood jams (see Sheet 5 in Appendix C) for example concept) using implementation approach 3 or 4, and 3 to 4 simple wood placements using implementation approach 1 or 2.

Reach 3 is also the prime candidate for large boulder placements and grading alluvial deposits.

Reach 4 and 5 – Add mobile wood that targets the best habitat enhancement opportunities using implementation approach 1 or 2.

The primary objective of these jams will be to i) provide immediate velocity and cover habitats for juvenile and adult salmon during low to moderate flows, ii) provide an opportunity to test gravel storage capabilities of jams with different architecture, and for jams in Reach 2 and 3, iii) act as a catcher's mitt for mobile wood placed in Reach 4 and 5.

A revised summary of the key opportunities and constraints based on implementation approach for lower Nordheimer is provided in Table 6.

Conceptual design sheets for the willow baffles and wood jams are provided in Appendix C.

Table 6. Key opportunities, constraints based on implementation approach for the lower Nordheimer Creek, Salmon River Sub-Basin, California.

Implementation Approach	Opportunities	Constraints	Permit & Safety Considerations
1. Helicopter.	This option has the potential to place the greatest amount of wood over the largest area at the lowest cost.	Wood placements may be subject to movement at flows with 10-yr RIs or less, best to use tree length wood to increase piece and jam stability.	This option would likely have the least amount of permit constraints, least impact on fish and wildlife, and low risk to infrastructure due to lack of log to log fasteners.
2. Helicopter with hand crew assistance to adjust wood positioning and add fasteners.	Similar to 1.	This option would not significantly decrease wood mobility at flood events with RIs > 10-yrs. Bedload transport would likely degrade biodegradable rope or cable.	Similar to 1 with some increases in impacts to fish and wildlife related to hand crews and risk to infrastructure increases when log to log fasteners are used because of increases in the length and racking potential.
3. Helicopter with Spiderhoe assistance to adjust wood positioning, and add fasteners and ballast where needed.	Reach 1 thru 4 are accessible to Spiderhoe type equipment. Use of ground based equipment will improve the ability to weave logs into riparian trees and other natural resisting elements, and use wood materials that can be easily transported over public roadways.	Lower coverage area, and increased cost per log placed compared to 1 and 2. Shorter logs may be more mobile without adequate placement techniques.	Increased impacts to fish and wildlife related to ground-based equipment use. Increased risk to infrastructure if log to log fasteners are used without ballast.
4. Helicopter with Spiderhoe assistance to adjust wood position, add anchorage and embed wood.	Access and use of wood materials like 3. Potential to embed wood in streamside alluvial deposits in Reach 1 thru 3.	Similar to 3 with added costs per log installed. High probability to encounter shallow bedrock and large boulders in the subsurface will require contingency designs.	Limited availability of dry areas to temporarily store excavated materials will require additional water quality management efforts.
5. Yarder &/or Yoder with Spiderhoe assist.	Use to winch in standing trees from above the canyon walls and deliver wood for Spiderhoe placement.	Could have a large disturbance footprint relative to the number of logs placed.	Added BMPs and permits for ground and noise disturbances compared to other options

A summary of key opportunities and constraints based on reach type within lower Nordheimer Creek is provided in Table 7.

Table 7. Key opportunities and constraints based on reach type for a portion of the lower Nordheimer Creek, Salmon River Sub-Basin, California.

Reach Number	Reach Type	Opportunities	Constraints
2	Forced Pool-Riffle	Alluvial compartments provide stream bank embedment options. Riparian trees provide options to wedge unanchored and tethered wood. Has preexisting pool features to enhance.	Reach is subject to frequent backwater effects that can aid wood mobility.
3	Plane Bed	Alluvial compartments more frequent and pools less frequent than Reach 2. A combination of wood loading, boulder placements and grading should be considered for this reach.	Streambed conditions appear to be resistant to the scour and deformation needed for pool formation.
4	Step-Pool	Preexisting pool features to enhance.	Poor wood retention capacity due to high shear stress and limited wedge points within the reach due to near vertical canyon walls.
5	Step-Pool	Preexisting spawning gravel and pool features to enhance.	Fish passage barrier at downstream end of reach.

A description of anchorage options discussed in this report is provided in Table 8.

Table 8. Description of anchorage options.

Anchorage Options	Description
Unanchored	Wood is placed in channel without additional anchors
Wedge and weave	Wood is wedged or woven into natural and constructed features including: existing riparian trees, gaps and ridges formed by large boulders and bedrock, and embedded posts and jams.
Fasteners	Biodegradable rope or steel cable used to fasten key logs together and to existing riparian trees and embedded posts.
Rock Collars	Biodegradable rope or cable attached to boulders to create a holdfast. Boulder size will be specified to meet design criteria.
Local Boulders	Locally sourced boulders used as ballast and roughness elements.

SUMMARY OF SRRC AND TECHNICAL ADVISORY COMMITTEE INPUT

Kickoff Meeting Summary

In general, the advisory committee supported the objective to place large wood that would improve gravel retention in Nordheimer and to allow wood to be unanchored if possible.

Written comments from Bob Pagliuco, NOAA Fisheries, recommended the following: 1) Nordheimer Creek - use a combination of Yarder, Helicopter with heavy equipment support to finish wood placements without excavation, and Helicopter with hand crew support; 2) Nordheimer Confluence Bar - use heavy equipment to place woody material to create habitat features unless the mobilization, equipment rental, rehab and risk of LWD mobilization (threatening infrastructure) outweigh the costs of using choppers and on the ground hand crews; 3) Upper reaches of Nordheimer Creek – Use Helicopter and ground crews to minimize disturbance and load the reach with bigger logs that can not necessarily be driven on that crazy narrow road.

Written comments from Don Flickinger, NOAA Fisheries, included the following key recommendations: 1) load up Reach 3 with as much untethered large wood as seems appropriate. Observe the response and adaptively move forward with the information gained to treat Reach 2; and 2) use treatments of modest cost such as willow baffles and roughness elements along river left of the Salmon to improve benefits of cold water inputs from Nordheimer on the mainstream.

A list meeting participants is provided in Appendix A.

General Comments and Questions during the meeting

Maija – Spawning data is available from USFS.

Toz – Are there any opportunities to store gravel in Nordheimer?

The answer was yes with details discussed during the meeting.

Toz – Is there a point to just loading wood in the upper reach and letting it sort itself out and find a home?

Toz – Does the fish ladder located at the downstream extent of reach 5 need to be protected from possible damage that could be inflicted by mobile wood or wood stranded on the ladder?

Toz – Can we avoid anchoring all together?

Maija – There is a history of this system chewing up cable and boulder anchoring.

Mel – We need to keep in mind that CDFW would likely require some anchoring and jam stability but we can possibly look for funding from a different source to allow unanchored structures

Comments Regarding Confluence Bar Treatments:

Toz – expressed concern over the cost effectiveness of taking any action on the mainstem.

Maija – recommended to consider cost for NEPA permitting related to any action for restoration on the confluence bar and to determine the extra possible costs and challenges to the USFS and NEPA process.

Mel – indicated that fish access and improving conditions at the mouth of Nordheimer is part of the main focus the project.

Permit Considerations

- Timing of implementation will need to respect Spring Chinook activities.
- Turbidity and streambed impacts and possible BMPs.
- Fueling in the active channel and possible BMPs
- Keeping project footprint under 5 acres to meet Categorical Exemption requirements within CEQA.
- Heritage Resources (bring in at 30%)

65% Design Questions

- What are the TAC's considerations and recommendations for a target flood recurrence interval for design?
- What is the TAC's position regarding the use of anchored versus unanchored wood?
- What are the TAC's considerations and recommendations on the use of embedded wood jams versus to Helicopter placed wood?
- What are the TAC's considerations and recommendations regarding the preferred option(s) for restoration treatments at: 1) the confluence bar, and 2) lower Nordheimer Creek?

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PERSONAL COMMUNICATIONS

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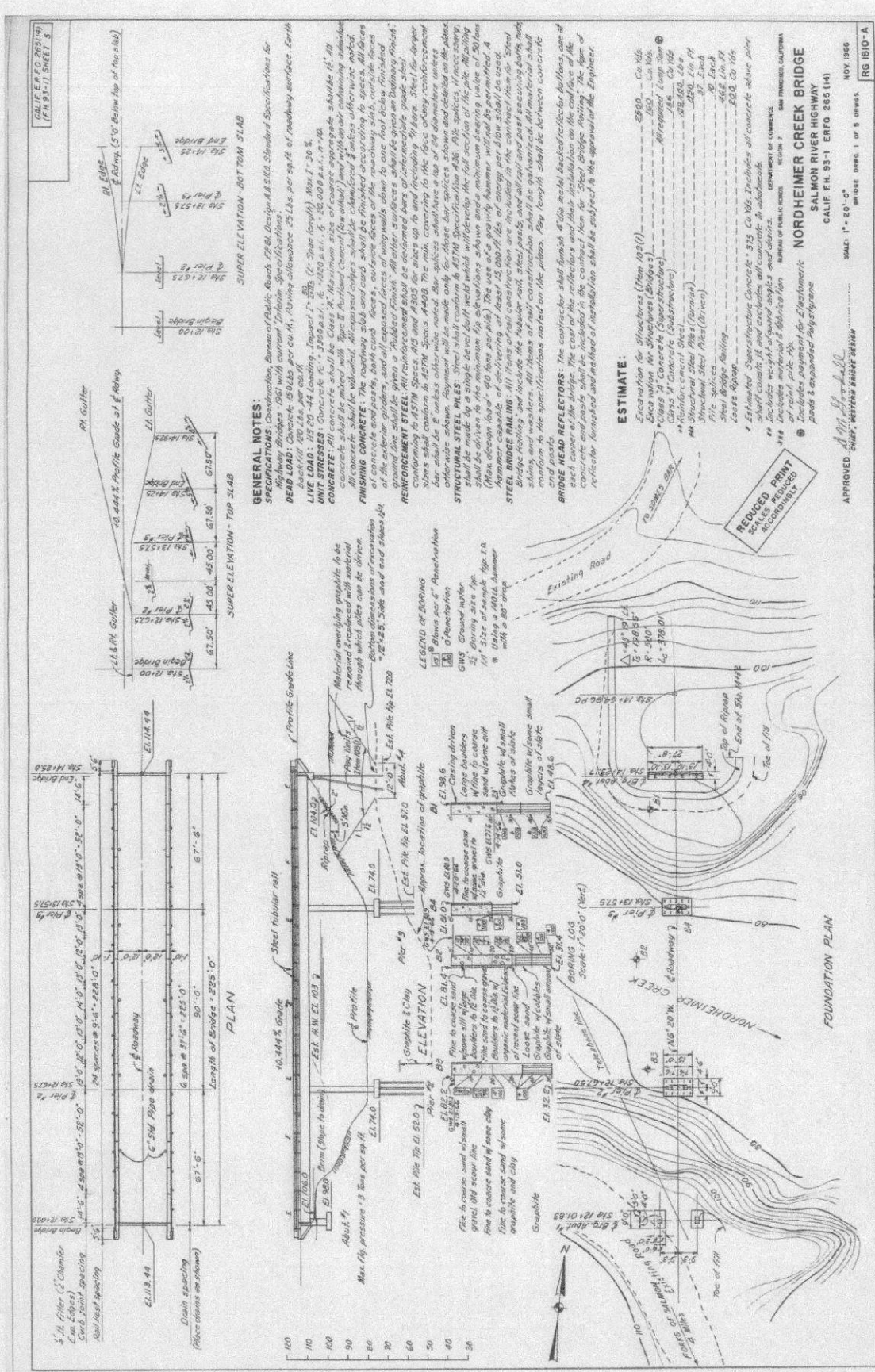
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See Appendix B for a copy of the plan.

APPENDIX A. KICKOFF MEETING PARTICIPANTS

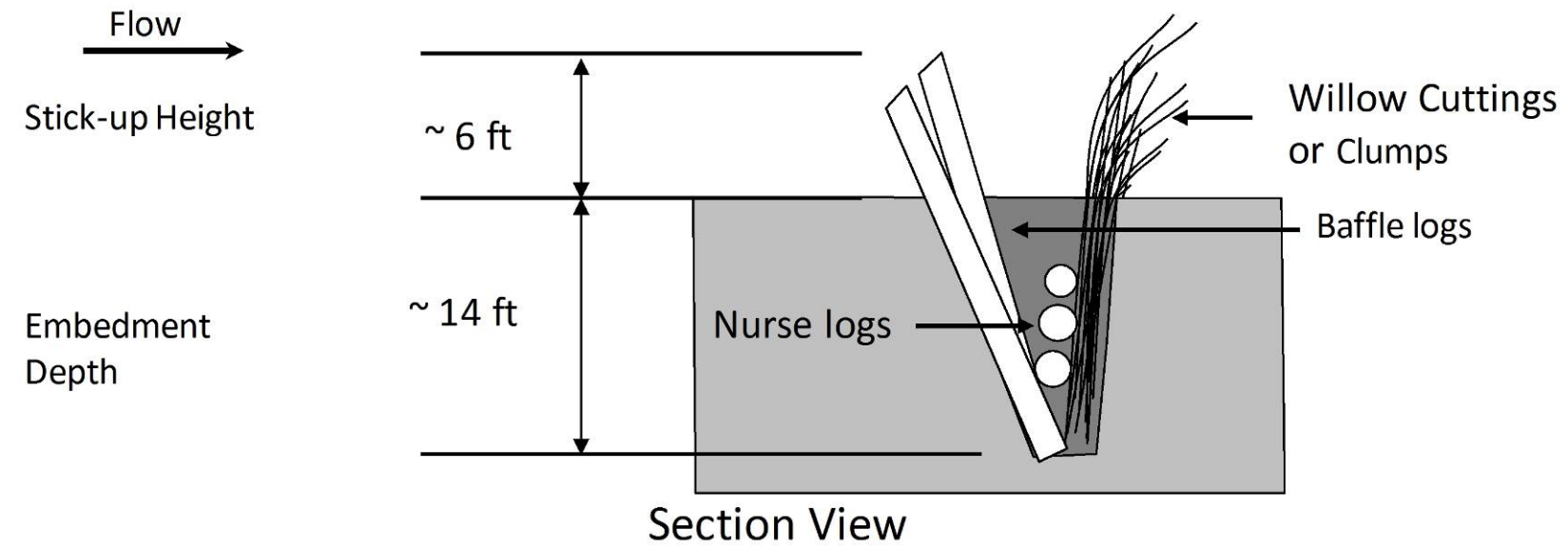
NAME	AFFILIATION
Mark Elfgren	California Fish and Wildlife
Don Flickinger	NOAA Fisheries West Coast Region
Amy Fingerle	Salmon River Restoration Council
Rocco Fiori	Fiori GeoSciences
Whelan Gilkerson	Merkel and Associates, Inc.
Karuna Greenberg	Salmon River Restoration Council
Maija Meneks	US Forest Service
Chris Moore	W.E.E.D.S
Toz Soto	Karuk Tribe
Melissa Van Scoyoc	Salmon River Restoration Council
Jennifer Silveira	Salmon River Restoration Council, Board Member

APPENDIX B. NORDHEIMER BRIDGE PLAN



APPENDIX C. CONCEPTUAL DESIGNS

WILLOW BAFFLE TYPICAL DESIGN



PHOTOGRAPH EXAMPLES

CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

SALMON RIVER RESTORATION COUNCIL
NORDHEIMER CREEK RESTORATION PROJECT

WILLOW BAFFLE TYPICAL DESIGN

Project Name

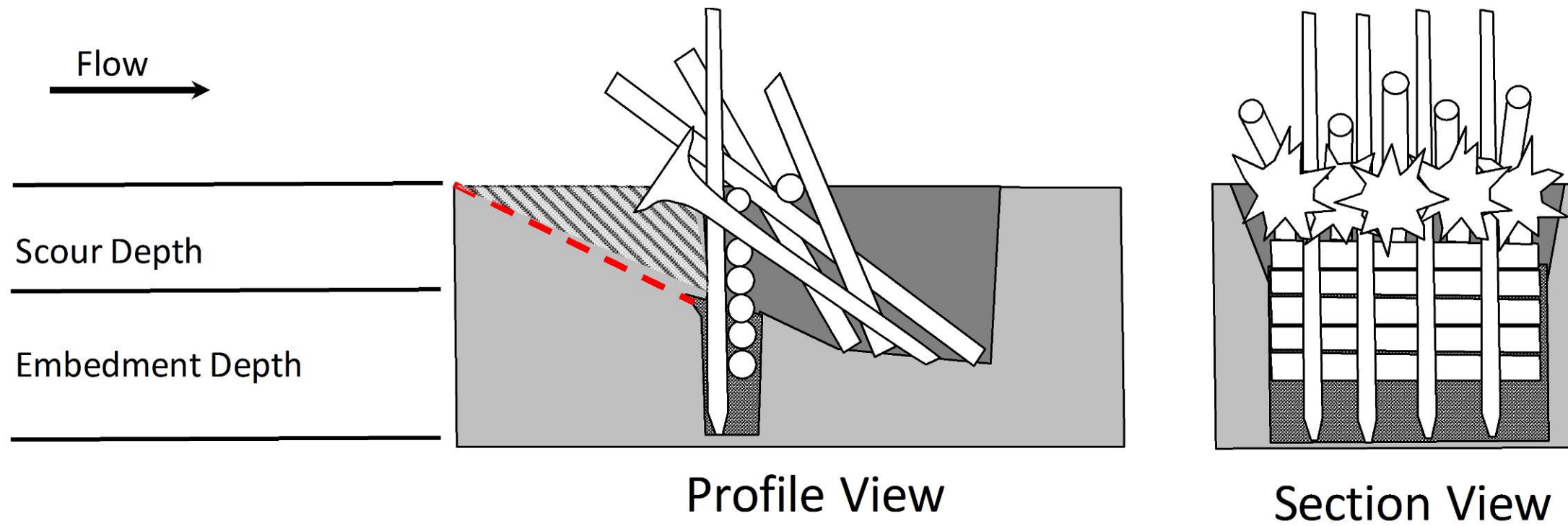
Sheet Title

Prepared by/Date
FGS
JULY 2019

Sheet Number

1 of 5

BAR ROUGHNESS JAM TYPICAL DESIGN



PHOTOGRAPH EXAMPLES

CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

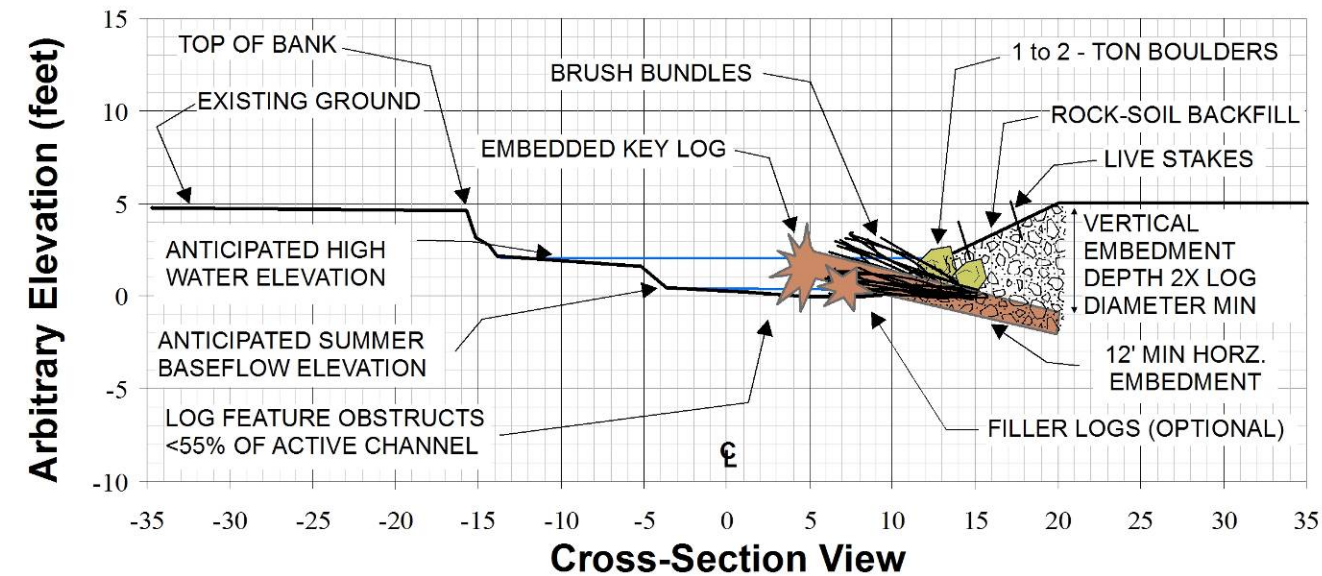
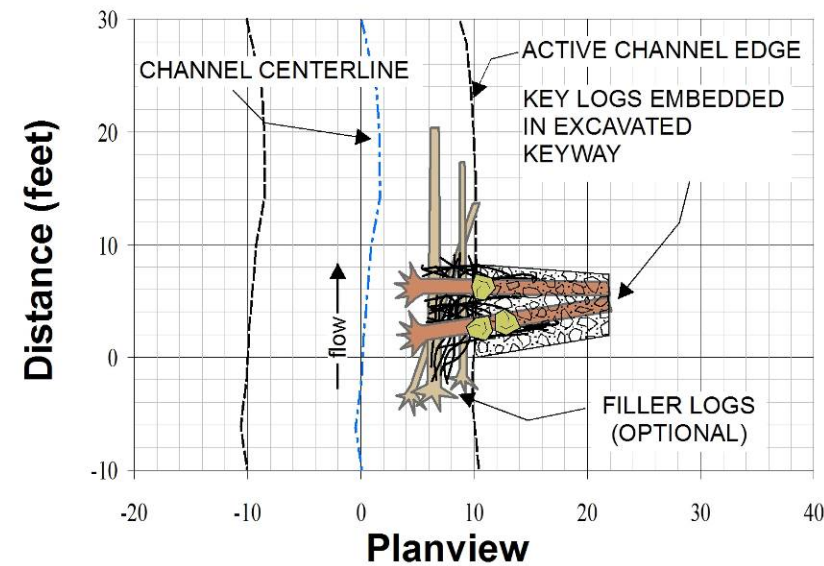
Project Name
SALMON RIVER RESTORATION COUNCIL
NORDHEIMER CREEK RESTORATION PROJECT

Sheet Title
BAR ROUGHNESS JAM TYPICAL DESIGN

Prepared by/Date
FGS
JULY 2019

Sheet Number
2 of 5

STREAMSIDE WOOD JAM TYPICAL DETAILS



NOTES GENERAL

Constructed wood jams will be comprised of a grouping of key logs, filler logs, brush bundles, live stakes and native earth materials used as backfill and ballast following the basic architecture shown. The actual number and size of wood pieces, log orientation and ballast materials used will be field fit by the designer to optimize habitat benefits with site conditions and permitted feature dimensions and quantities at the time of construction.

DETAILS

1. Key logs will be placed in an excavated trench (keyway) and backfilled with a mixture of native rock, soils and large boulders. Key logs will be placed in the keyway so the small end of the log will be 18" to 24" lower than the rootwad end (see cross-section).
2. Brush Bundles will be placed in the keyway and anchored by the large wood and ballast material. At least 50% of the bundle length will be above ground to provide fine scale habitat.
3. Filler logs will be positioned on the streambed prior to placement of key logs or woven into gaps formed by logs and the streambed. Filler logs will be held in place by hydraulic forces pinning them against the streambed and key logs.
4. Live stakes (e.g. willow, cottonwood and alder) will be incorporated into the backfill material.

Distance (feet)

KEY LOGS



Specifications: DBH 20" minimum. Length 20' minimum, measured from root collar to small end. Key logs will have an intact rootwad attached. Contractor to exercise care to maintain rootwad structure to the greatest extent possible.

FILLER LOGS



Specifications: Avg Dia 10" minimum. Length 12' minimum. Filler logs will include a combination of poles and logs with an attached rootwad.

LARGE BOULDERS



Specifications: A minimum of one 2-Ton or two 1-Ton boulders shall be placed to bear directly on each key log used. At the direction of the Designer, additional boulders may be used to increase feature stability and complexity.

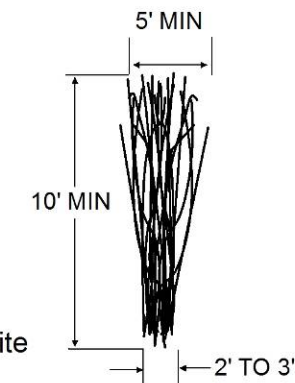
ROCK-SOIL BACKFILL



Specifications: Native earth materials will be comprised of 50% rock fragments >4" DIA and 50% fines. Designer may adjust rock:soil ratio by 20% based on available materials on site.

BRUSH BUNDLES

Specifications: Live branches and slash will be grouped in bundles to conform with the general dimensions shown. Willow clumps with attached roots will be used when available. Species will include willow, cottonwood, alder and native conifers depending on site availability. Bundles will be placed to maximize volume and extent of fine scale complexity.



CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

SALMON RIVER RESTORATION COUNCIL
NORDHEIMER CREEK RESTORATION PROJECT
STREAMSIDE WOOD JAM TYPICAL DETAILS

Project Name

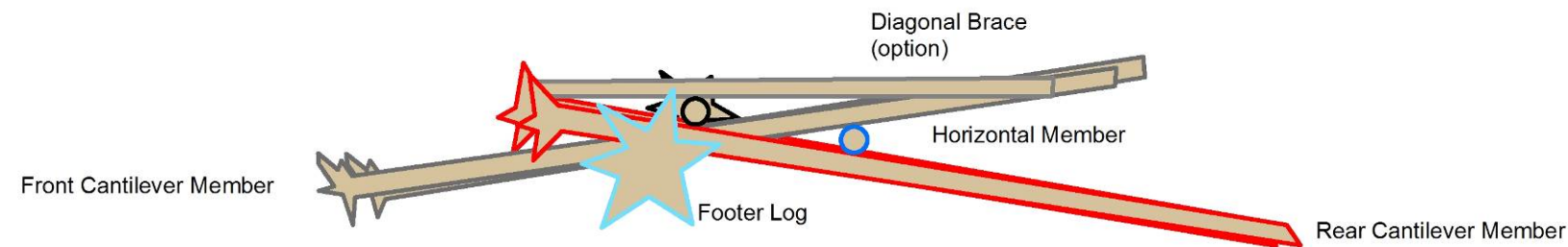
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Prepared by/Date
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JULY 2019

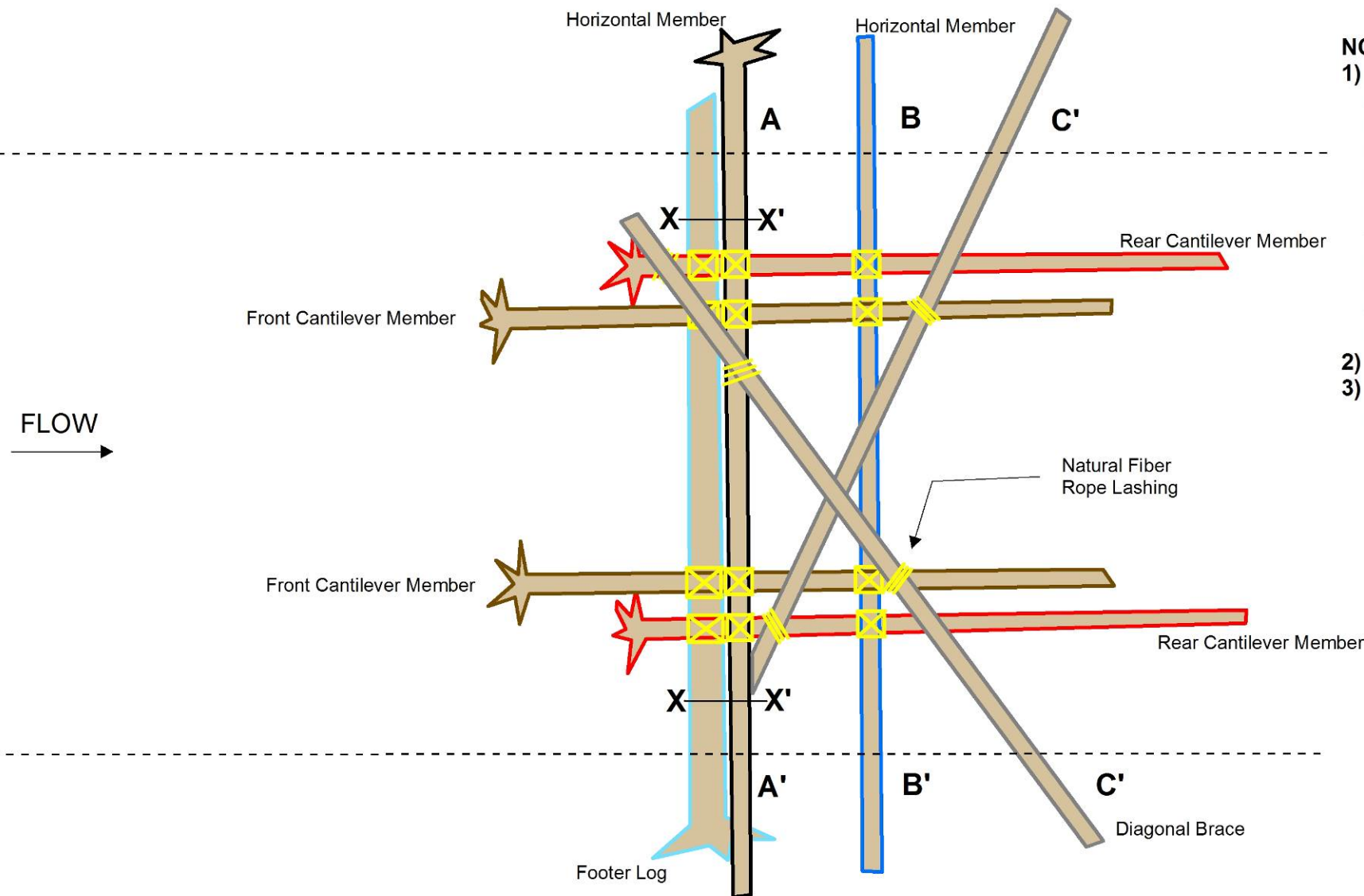
Sheet Number

3 of 5

CANTILEVER WOOD JAM TYPICAL DETAILS



Cross-Section View



NOTES:

- 1) Resisting Elements
 - a) Streambank embedment or wedging against bedrock or riparian tree(s) at points A, B and C.
 - b) Lashing key members together at points indicated by yellow lines.
 - c) Rock collars placed as shown at X to X' or other suitable locations.
 - d) Resisting elements will be adaptively applied by the designer at the time of construction to achieve the design Factor of Safety based on site conditions and available materials.
- 2) Natural fiber rope is not shown in cross-section view.
- 3) See Sheet 5 for additional details.

CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

Planview

Project Name
SALMON RIVER RESTORATION COUNCIL
NORDHEIMER CREEK RESTORATION PROJECT

Sheet Title
CANTILEVER WOOD JAM TYPICAL DETAILS

Prepared by/Date
FGS
JULY 2019

Sheet Number
4 of 5

CANTILEVER WOOD JAM SPECIFICATIONS & NOTES

MATERIAL SPECIFICATIONS

KEY LOGS

FOOTER LOGS



Specifications: DBH 24" minimum. Log length scaled to bankfull flow width (35' avg). Footer logs will have an intact rootwad attached.

CANTILEVER & HORIZONTAL MEMBERS



Specifications: Avg Dia 20" minimum. Length 35' to 40'. Cantilever members are logs with an attached rootwad.

BRACES



Specifications: Braces will be pole logs with an 20" Avg Dia minimum and Avg Length of 20'.

DESIGN NOTES

GENERAL

The designs presented herein represent basic wood jam architecture. Jams will be comprised of natural materials that will disaggregate &/or degrade overtime. The exception to the natural materials specification will be when the option to use rock collars as a restraint option is employed (see specification section). rock collars will be used where the designer determines restraint redundancy is needed, typically for woven jams. The actual number and size of wood pieces, log orientation and ballast materials used will be field fit by the designer, or designer's representative(s), to optimize habitat benefits with site conditions and permitted feature dimensions and quantities at the time of construction. However, when field fitting to optimize habitat benefits several combinations are possible, including the use of addition logs and slash. Contractors will be directed to exercise care to maintain rootwad structure to the greatest extent possible.

LARGE BOULDERS & ROCK COLLARS



Specifications: Large boulders (one to two tons) may be placed to bear directly on key logs, may be applied in combinations to increase feature stability and complexity and rock collar assemblies may also be used when added ballast is needed.

Rock Collars will be comprised of two large boulders linked together with a sufficient length of 5/8" steel cable so both boulders will be in contact with, or are embedded in the ground with the cable crossing over the log to hold it in place. Cable will be secured to each boulder following CDFW Restoration Manual specifications.

SLASH

Specifications: Slash will be comprised of tree boles, limbs, branches and leaves from native species including alder, live oak, willow, and conifers depending on site availability.

NATURAL FIBER ROPE

Specifications: Natural fiber rope (NFR) Min 0.5" Dia will be used to fasten key logs together. The purpose of the NFR will be to increase wood jam stability and will be used at the direction of the designer.

CANTILEVER WOOD JAM

Cantilever jams will be comprised of a grouping of footer, cantilever, horizontal, and brace logs. Natural fibre rope, large boulders and rock collars will be used to lash logs together and as ballast following the basic architecture shown.

DETAILS

1. Footer logs will be placed on the streambed perpendicular to the dominant flow direction.
2. Cantilever, horizontal and brace members will be placed in the maner shown in the drawing or as directed by the designer or designer's representative(s).
3. Slash may be placed along the upstream face of the jam, wedged under the cantilever members to increase feature complexity.

CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

SALMON RIVER RESTORATION COUNCIL NORDHEIMER CREEK RESTORATION PROJECT	
Project Name	CANTILEVER WOOD JAM SPECIFICATIONS & NOTES
Prepared by/Date FGS JULY 2019	
Sheet Number 5 of 5	

APPENDIX D
(OPINION OF PROBABLE COST)

Appendix D – Opinion of Probable Cost - Nordheimer Creek Habitat Enhancement Design

90% Design - Opinion of Probable Costs		PROJECT TOTALS	
GRANTEE: Salmon River Restoration Council			
PROJECT: Nordheimer Creek Habitat Enhancement Design Project			
PREPARED BY: WG, RL, and CM			
PART I MATERIALS & WORK UNITS			
ITEM	CPU/HR	AMT	COST
Whole logs w/rootwads (Douglas fir or Cedar)	\$ 1,300	176	\$ 228,800
Slash harvested/delivered to site (CY)	\$ 60	182	\$10,920
Live willow stake collection (per stake)	\$ 6	1000	\$6,000
Threaded Rebar & Fasteners (LF)	\$ 7	490	\$3,430
Cable (LF)	\$ 7	50	\$350
Install Willows (CY/LF)	\$ 25	50	\$1,250
Install Anchor	\$ 90	98	\$8,820
TOTAL MATERIAL & WORK UNIT COSTS			\$259,570
PART II EQUIPMENT & LABOR COSTS			
ITEM	CPU/HR	AMT	COST
EXCAVATOR	\$ 280	63	\$ 17,640
LOADER	\$ 200	20	\$ 4,000
HELICOPTER	\$ 14,000	12	\$ 168,000
SPIDER HOE	\$ 350	80	\$ 28,000
WORK TRUCK	\$ 180	102	\$ 18,360
DUMP TRUCK	\$ 200	4	\$ 800
LABORER	\$ 90	171	\$ 15,390
CONSTRUCTION OVERSIGHT	\$ 130	230	\$ 29,900
COMPLIANCE MONITORING (WQ 30%)	\$ 130	60	\$ 7,800
HELICOPTER MOBILIZATION	\$ 60,000	1	\$ 60,000
EXCAVATOR MOBILIZATION	\$ 6,970	1	\$ 6,970
LOADER MOBILIZATION	\$ 6,970	1	\$ 6,970
SPIDER HOE MOBILIZATION	\$ 6,970	1	\$ 6,970
WQ MULTIMETER/TURBIDIMETER RENTAL	\$ 195	18	\$ 3,510
SMALL EQUIPMENT RENTAL (WATER PUMP/HOLE HOG/LASER LEVEL)	\$ 75	30	\$ 2,250
PER DIEM	\$ 149	43	\$ 6,407
MILEAGE	\$0.56	2720	\$ 1,523
TOTAL EQUIPMENT AND LABOR COSTS			\$ 384,490
SUBTOTAL PROJECT COSTS			\$ 644,060
10% CONTINGENCY COSTS			\$ 64,406
GRAND TOTAL PROJECT COSTS			\$ 708,466

Assumptions:

- 1) Costs do not include grant administration, permitting, post project monitoring or reporting
- 2) Heavy equipment hours include operator and fuel, and are based on current local average private sector prevailing wage rates
- 3) WQ compliance monitoring assumed to be 30% of construction oversight time or not less than 1 hour, whichever is less (to account for before, during and after construction compliance monitoring)
- 4) Helicopter production estimated tree placement rate at 10-12 trees/hour
- 5) A 10% contingency is included for unforeseen circumstances including but not limited to: equipment rate and material cost increases, field adjustments during construction, and potential natural disasters (e.g., wildfires) limiting contractor availability or extending project timelines

APPENDIX E
(SPECIAL PROVISIONS)

NORDHEIMER CREEK HABITAT ENHANCEMENT DESIGN PROJECT

SP – SPECIAL PROVISIONS

1. REFERENCE DOCUMENTATION

- 1.1. Reference Documentation shall be the latest edition, including amendments and published updates, issued prior to the date of advertisement for bids or the date of request for quotations, of the following:
 - 1.1.1. 2009 California Stormwater BMP Handbook issued by the California Stormwater Quality Association (CASQA).
 - 1.1.2. California State Transportation Agency (Caltrans) Standard Specifications 2018. Within these special provisions, reference to Caltrans specifications is given as Caltrans followed by the section number. In conflicts between Caltrans Specifications and these Special Provisions, the Special Provisions shall govern.

2. OWNER AND EASEMENTS

- 2.1. The entire project area is located within the Klamath National Forest (KNF) and managed by the U.S. Forest Service (USFS). All work shall be located on public land or on easements to be provided by the Owner(s). The contractor shall confine operations at all times within the limits of the project area as defined by the Plans or on easements provided by the Owner(s). Any repairs or restoration outside of these limited areas, required due to the contractor's carelessness, shall be made with no compensation allowed.
- 2.2. The Contractor shall coordinate any staging, parking and access to the work sites with the Owner and Project Manager (SRRC).

3. CONFLICTS IN DIMENSIONING

- 3.1. In case of conflict between dimensions shown on the Plans or detail drawing(s) and those in the specifications, the dimensions on the Plans shall govern. If the conflict is other than dimensions, the specifications shall govern.

4. PRE-CONSTRUCTION CONFERENCE

- 4.1. A pre-construction conference will be scheduled after the Project Manager's receipt of the Contractor's schedule. The Contractor shall submit to the Project Manager (PM) a schedule including the following:
 - 4.1.1. A schedule illustrating in bar chart or tabular form the anticipated commencement date and duration of each of the major work tasks prior to the pre-construction conference.
 - 4.1.2. The schedule should address the phasing of construction in a manner that will provide good project coordination. The Contractor will be required to update or modify the written construction schedule as necessary to accurately reflect the rate and progress on the project.

Appendix E – Special Provisions - Nordheimer Creek Habitat Enhancement Design Project

4.1.3. A list of planned equipment and any extraordinary measures (access road construction, mats etc.) planned to ensure efficient dewatering and construction given the soils and soil moisture conditions anticipated.

4.2. The conference will be held with the PM (SRRC), Contractor, Owner Representatives, Design Representatives, and other parties involved in the project. Materials, material sources, construction methods, and scheduling will be reviewed and any questions or procedures will be clarified.

5. INCIDENTAL WORK

5.1. Items of work for which no pay items are included in the bid proposal shall be considered as incidental expense and no separate payment will be made therefore. Incidental items include, but are not limited to the following:

5.1.1. Maintaining access to work sites

5.1.2. Street sweeping as necessary to control sediment tracking onto any paved roadway

5.1.3. Protection of trees and utilities during construction

5.1.4. Off-site disposal of excess construction materials, as necessary

5.1.5. Billboards for display of permits, posters and other required documents

5.1.6. Restoration or replacement of culverts or other drainage courses or structures other than those shown on the Plans

5.1.7. Removal and restoration of signs

5.1.8. Trimming and pruning or replacement of trees and roots damaged within work areas

5.1.9. Dust and noise control

5.1.10. Construction safety fencing, as necessary

5.1.11. Traffic Control fencing, barriers, and signage

5.1.12. Maintenance, protection, replacement and/or restoration of poles and utilities

6. MOBILIZATION

6.1. Mobilization shall be performed in accordance with the provisions of Caltrans Section 8, and the following:

6.1.1. Mobilization shall be measured and paid for under item Mobilization at the contract lump sum price, which shall be compensation in full for all labors, materials, and equipment necessary to complete the work as specified

6.1.2. The Contractor shall submit an itemized list of mobilization costs. This list shall include staging, access, traffic control, construction management and equipment mobilization costs.

7. TRAFFIC CONTROL

7.1. The Contractor shall follow general traffic control guidelines set forth in Caltrans Section 12.

Appendix E – Special Provisions - Nordheimer Creek Habitat Enhancement Design Project

- 7.2. The Contractor shall employ extraordinary measures to ensure safety of the public and to ensure unrestricted vehicle and/or pedestrian ingress and egress of visitors, through traffic, and emergency vehicles. This includes treatment such as the following;
 - 7.2.1. Based on the above, maintaining site closures during construction and minimizing dust and noise in the area.
 - 7.2.2. Temporary signage using 6” letters black/orange is required at all roadway closure points and all other access points to the project area.
 - 7.2.3. Temporary fencing around the grading and stream restoration work occurring within 100ft of trail, parking, or other park facilities is required.
 - 7.2.4. Law enforcement support as required.
- 7.3. Traffic Control shall be measured and paid for under item Mobilization.

8. CLEARING AND GRUBBING

- 8.1. The Contractor shall follow general clearing and grubbing guidelines set forth in Caltrans Section 17-2.
- 8.2. The Contractor shall employ measures to ensure that all clearing and grubbing activities are limited to the area of construction as follows:
 - 8.2.1. Within the footprint of the constructed stream habitat structures and necessary access routes clearing and grubbing shall be minimized to the extent necessary, but sufficient to safely maintain equipment access and construct the habitat structures.
 - 8.2.2. All materials resulting from clearing and grubbing shall become the property of the owner’s representative (SRRC) as directed by the owner. Salvaged organic matter shall be either utilized as small to medium sized woody debris and slash for use in the stream habitat structures, or will be used as ground mulch as directed by the Plans and/or the PM.
 - 8.2.3. Trees not within the area of construction, limits of disturbance, and area of conversion shall be protected.
 - 8.2.4. All trees to be removed/salvaged within the area to be restored will be removed by a licensed timber operator and/or a licensed general engineering contractor.
 - 8.2.5. Salvaged trees shall be large wood pieces removed from within the project footprint that are deemed acceptable for reuse in project construction by the owner's representative.
- 8.3. Clearing and Grubbing shall be measured and paid for under item Clearing/Grubbing at the contract lump sum price, which shall be compensation in full for all labors, materials, and equipment necessary to complete the work as specified

9. EARTHWORK

- 9.1. All earthwork work shall be performed in accordance with the provisions of Caltrans Section 19 and these provisions.
- 9.2. Items 12. Channel and Riparian Restoration include earthwork that shall be measured and paid per this item.

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- 9.3. The Contractor shall utilize on-site soil reuse. Any necessary permits needed to dispose of excess off-site shall be secured by the Contractor at his/her expense. The Contractor shall submit a disposal plan at the pre-construction meeting which specifies how he/she will dispose of any soil, concrete rubble, bituminous rubble, solid rock, tree/shrub debris and any other displaced/disposed items to be removed off-site.
- 9.4. No separate classification shall exist for muck excavation. Soft or saturated soils to be reused shall be stockpiled on site for drying in such a manner to minimize drying time. Erosion control measures must be implemented to prevent soil loss from stockpiles. The contractor is advised of the following:
 - 9.4.1. The contractor shall use extraordinary measures and specialized equipment necessary to work efficiently given the soils and moisture conditions.
 - 9.4.2. Prevention of invasive species infestation: Prior to earthwork, planting or seeding, all personnel must ensure that equipment, clothing and footwear is clean and free of seeds. Equipment and personnel may be subject to inspection prior to site entry.
- 9.5. Earthwork shall be measured and paid for under item Earthwork at the contract lump sum price, which shall be compensation in full for all labors, materials, and equipment necessary to complete the work as specified.

10. **EROSION CONTROL**

- 10.1. Description
 - 10.1.1. Erosion Control shall be performed in accordance with these provisions and the provisions of Caltrans Sections 13 and 21, and CASQA BMP Manual except as modified below:
 - a. The Contractor is advised that payment for furnishing and installing temporary erosion control set forth in the foregoing area is for the initial installation and removal only. Any replacement components as may be necessary to maintain the temporary erosion control devices in a functional condition, to the satisfaction of the PM, during the tenure of this Contract shall be furnished, installed, maintained, and removed at the Contractor's expense.
 - b. The Contractor shall be responsible for the removal of temporary erosion control devices once the project is completed as directed by the PM.
 - c. Erosion Control shall conform to all applicable requirements of the project permits. The price bid for erosion control shall include compensation for all maintenance required to conform to permits.
- 10.2. Materials
 - 10.2.1. Material specifications for seed shall follow those in Section 13 of these Special Provisions.
 - 10.2.2. Mulch shall be seedless straw mulch according to Caltrans Sections 13, 20 and 21.
- 10.3. Construction requirements

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10.3.1. Installation of any seed shall follow Section 13 of these Special Provisions.

10.3.2. Any necessary straw mulch shall be applied at 2 tons (4000lb) per acre.

10.4. Measurement and Payment

10.4.1. *Erosion Control* – Work for this item shall include site prep, layout, and application as shown according to Caltrans Section 13, permits, the Plans and Special Provisions. This item includes supplying all materials, equipment, labor and incidentals to complete this work. Measurement and payment at the contract lump sum price.

11. **DEWATERING**

11.1. Description

11.1.1. Dewatering will be required for parts of this project. All dewatering shall follow these special provisions and the provisions of Caltrans Sections 13 and 19. The contractor is advised of the following:

- a. The entire area is subject to constant surface and groundwater flow.
- b. As part of the base bid, the Contractor is responsible for diverting streamflow into constructed dewatering channels and for maintaining that diversion.

11.1.2. Streamflow will be diverted into a single dewatering channel. This channel must be maintained and monitored to prevent sedimentation caused by bank erosion. Any bank erosion areas must be immediately repaired with erosion control fabric as necessary.

11.1.3. Pumping: It may be necessary to provide damming and pumping of streamflow during active construction (eg. structure placement, willow baffles). Temporary damming should be accomplished through installation of sandbags, wrapped jersey barriers or other approved method.

11.1.4. In situ dewatering: It may be necessary to provide dewatering of localized construction areas where the work area must be kept relatively dry.

11.1.5. Fish rescue: Fish shall be rescued from residual pools following any diversion of streamflow that will dewater the main channel. Fish must be collected by a Qualified Biologist.

11.2. Materials

11.2.1. Material specifications for any erosion control blanket shall follow those in Section 10 of these Special Provisions.

11.3. Construction requirements

11.3.1. The Contractor shall complete dewatering to the satisfaction of the PM.

11.3.2. Provide and remove all equipment necessary for dewatering including, but not limited to, wells, well points, sumps, temporary pipelines for water disposal, rock or gravel placement, barrier placement or any combination. Provide dewatering systems with sufficient pumping equipment and machinery in good working condition and provide at all times, competent workmen for the operation of the systems. Keep adequate standby equipment available at all times to insure continuous and efficient dewatering and maintenance of dewatering operation.

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- 11.3.3. Contractor shall not discharge groundwater directly to existing drainageways, culverts or sanitary systems without permission from the Owner and PM. The Contractor may be responsible for installation, operation, and maintenance of a flow measurement device, subject to approval of the Owner and PM.
- 11.3.4. Contractor shall not drain water into work built.
- 11.3.5. Contractor shall filter water using an approved method (suitable holding basins and bale check systems etc.) to remove sand and fine-sized soil particles before disposal into any drainage system.
- 11.3.6. Provide drainage for the site grading at all times. Divert surface runoff from excavations and trenches
- 11.3.7. Contractor shall provide and maintain standby pumping equipment on the job site.
- 11.3.8. Contractor is responsible for controlling discharge rate and effect of the dewatering system.
- 11.3.9. Diversion of the main channel stream may be required at times. Any diversion structure shall be constructed and maintained in such a manner as to not allow erosion in accordance with these Special Provisions.
- 11.3.10. If needed, provide a mat system or clean coarse granular working mat as required to provide a stable working base for construction equipment and to facilitate construction. Any other granular material needed for drainage shall be in addition to the working base provided.
- 11.3.11. Prevent flotation by maintaining a positive and continuous removal of water. Contractor is responsible and liable for all damages which may result from failure to adequately keep excavations and trenches dewatered.
- 11.3.12. Adequately space well points or wells (if used) to provide the necessary dewatering. Sand-pack or by other means to prevent pumping of fine sands or silts from the subsurface. Continuously check to ensure that the subsurface soil is not being removed by the dewatering operation.

11.4. Measurement and payment

- 11.4.1. Dewatering: Work for this item shall include, but not be limited to, site prep, dewatering channel integration, in-situ dewatering, maintenance, diversion, pumping, damming and sediment control as shown within the Plans and Special Provisions. This item includes supplying all materials, equipment, labor and incidentals to complete this work. Measurement and payment shall be for Dewatering at the contract lump sum price.

12. CHANNEL AND RIPARIAN RESTORATION

12.1. Description

- 12.1.1. *Common excavation for channel restoration (willow baffles)* – Work under this section includes earthwork such as grading, excavation and fill for channel restoration. The work includes all operations in connection with grading, channel excavation, and common fill placement for construction of the willow baffles.

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12.1.2. *Installation of Large Woody Material (LWM)* - Work under this section includes the installation of logs and logs with roots, any of which may be also noted in the plans and specification as LWM. Work shall require placing LWM on streambanks and in the streambed using a “fit in the field” approach as directed by the Project Engineering Geologist (PEG) and PM.

12.2. Materials

12.2.1. Large Woody Material (LWM)

- a. Logs and rootwads, and logs without rootwads *not already supplied by the Owner* shall be Incense Cedar or Douglas Fir at least 40 feet in length measured from base to top and the diameter at breast height shall be a minimum of 18 inches. Any deviation in size, species or quality must be pre- approved by the PEG and PM. Logs and rootwads should be cleaned of secondary branches and include only the main trunk and any associated forks. LWM should be recently harvested or in a 100% rot free condition, free of fungus, disease, or pests that could contaminate site or infect existing or planted live trees.
- b. The total number of logs and rootwads to be installed is estimated in the bid item list.

12.2.2. Fully Threaded Rod Anchoring: Threaded rod used in securing woody material shall be 1-inch diameter galvanized steel threaded rod with square washers and double heavy hex nuts.

12.2.3. Cable and Clamps: Cable used in securing woody material shall be 3/8 inch galvanized steel core cable with a minimum nominal tensile capacity of 12 tons. Cable clamps shall be galvanized steel and shall meet the performance requirements of federal specification FF-c-450 Type 1 Class 1. Cable clamps shall be Crosby Clips, “G-450” or approved equivalent.

12.3. Submittals

12.3.1. Large Woody Material: The Contractor shall submit tree species, type (root wad or log) length and diameter information to the PEG and PM prior to delivery.

12.4. Construction Requirements

12.4.1. *Common excavation for willow baffles* - Supply all materials, labor, tools, and equipment to perform channel/riparian restoration excavation as shown in the plans and described in these specifications. Excavation shall be in accordance with the provisions of Caltrans Section 19 and the requirements listed below.

- a. Excavate to the lines and elevations indicated on the plans. Excavation beyond the lines and elevations indicated on the plans is considered incidental.
- b. Common fill material shall be sorted such that the best material for baffle backfill is stockpiled for reuse (determined by PEG). Salvaged material must be approved by the PEG.
- c. Care should be taken to avoid damage to existing trees and structures on-site during earthwork.

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- d. Material not stockpiled or used elsewhere on-site shall be disposed of off site by the contractor.
 - e. Protection of structures: Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
 - f. Shoring: As necessary, shore, sheet pile, slope, or brace excavations to prevent them from collapsing. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
 - g. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging excavated areas. Maintain excavations where equipment support pads or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify PEG and PM. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
 - h. Perform all shaping of the sub grade to the elevations, lines and grades, as shown in the plans. The finished sub grade shall be approved by the PEG prior to placement of any backfill material including organic debris, willow cuttings or alluvial backfill.
 - i. Do not carry the excavation for the sub grade deeper than the elevation shown. The Contractor shall bear all costs for correcting over excavated areas.
 - j. Fill shall be compacted in 8-12 inch layers using the Quality Compaction (Visual Inspection) Method
 - k. Any abandoned infrastructure uncovered in excavation must be removed as directed by the PEG and PM.
- 12.4.2. *Installation of Large Woody Material (LWM)*
- a. Installation of LWM shall require placing logs on streambanks and in the streambed using a “fit in the field” approach as directed by the PEG. Logs will be installed individually or in groups. Logs shall be anchored by threaded bar/cabling and/or bracing/weaving against or through live trees according to the direction of the PEG. Disturbed ground shall be seeded and mulched.
 - b. To facilitate efficient movement of logs, the contractor shall provide a tracked hydraulic excavator and/or a spider crawler excavator with a *hydraulic thumb* attachment.

12.4.3. *Layout and Grades*

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- a. Benchmarks: The Contractor shall maintain and/or reestablish benchmarks and survey monuments necessary for the work and as shown in the Contract Documents or found to exist on the site to provide a base reference for the construction. Replace any which may become destroyed or disturbed.

12.4.4. *Microtopography*

- a. The intent of final grading shall not be to create a uniformly flat surface. Final grading of the willow baffle surfaces will include the creation of humps and depressions of varying size and depth, deviating no more than +/- 1.0 feet from the grades shown in the plans. These variations will be directed in the field and are not depicted in the plans.

12.5. Measurement and Payment

12.5.1. *Common Excavation for Willow Baffles* - Work for this item shall include, but is not necessarily limited to excavation and construction of willow baffles, transport and disposal of excess material, backfill, and compaction as shown within the Plans and Special Provisions. This item includes supplying all materials, equipment, labor and incidentals to complete this work. Measurement and payment under item Earthwork at the contract lump sum price. Salvaged material placement, reworking, erosion control and stabilization shall be considered incidental to the work.

12.5.2. *Layout and grades* – All work for detailed layout and grades including detailed surveying shall be considered incidental to the work. This does not include any staking to be performed by the Owner.

12.5.3. *Large Woody Material (installed)* – All work under large woody material shall be measured and paid for at the contract price per installed piece (log, root wad, or stump). All materials, equipment, labor and supplies shall be incidental to this work. Excavation, backfilling, grading, mulching, and hauling and disposal of surplus materials associated with placement of LWM shall be incidental to this work.

12.5.4. *Large Woody Material (delivered)* – All work under delivered large woody material shall be measured and paid for at the contract price per installed piece (log, root wad, or stump). All materials, equipment, labor and supplies shall be incidental to this work. Excavation, cutting, loading, and hauling of LWM shall be incidental to this work.

12.6. Quality Control and Assurance

12.6.1. Quality Control

- a. The Contractor shall verify that all grades have been met to the elevations shown in the plans and specifications.
- b. The Contractor shall verify that imported materials meet the Specifications for their intended use.
- c. The Contractor shall verify that compacted in-place materials are compacted to the satisfaction of the PEG.
- d. The Contractor shall verify that all anchoring of LWM structures has been completed to the satisfaction of the PEG.

12.6.2. Quality Assurance

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- a. The Owner will inspect final conditions with the Contractor to ensure construction is completed according to plans and specifications.
- b. Owner may inspect channel restoration prior to and after installation to assure proper fabrication, alignment, and quality. Work that does not meet Specifications shall be redone at no cost to the Owner.
- c. The Contractor shall be responsible for the stability of and necessary embankments prior to acceptance and shall repair any portions that have failed.

13. **RIPARIAN REVEGETATION**

13.1. Description

- 13.1.1. Due to the varied distribution of the project sites within this work area, planting composition will be determined by a Qualified Biologist (QB), as part of a Final Implementation Proposal. The QB will develop a Revegetation Plan (RP) prior to implementing revegetation work following construction.
- 13.1.2. Work includes, but is not limited to the following activities: purchasing, storage, revegetation and monitoring of seed native stock as defined in the RP. The work shall be performed according to requirements contained in these Plans, or as directed by the QB. This work will consist of supplying and sourcing all materials, labor, tools, and equipment to reestablish a riparian and/or wetland communities within bare and disturbed areas.
- 13.1.3. An Invasive Species Prevention Plan (ISPP) will be developed as part of the final Implementation proposal. This ISPP will document all invasive vegetation species present in and around the project area, the associated eradication methods, and subsequent monitoring.
- 13.1.4. All planting and seeding activities shall be in accordance with the special provisions below and with Caltrans Sections 5, 17, and 20.
- 13.1.5. Referenced Standards:
 - a. California Riparian Habitat Restoration Handbook.
 - b. Disinfection Protocols for Field Activities.
 - c. American Standard for Nursery Stock (ASNS).
 - d. Natural Resource Conservation Service California eVegGuide.
 - e. California Natural Diversity Database (CNDDDB).

13.2. Materials

- 13.2.1. All plant species sourced will be native in origin and sourced when appropriate from an ecologically similar site.
- 13.2.2. Native Plants Stock
 - a. A delivery plan for native plant materials will be prepared by the QB in conjunction with the Contractor.
 - b. Once the plants are delivered, the revegetation efforts will be the responsibility of the QB and the Contractor. Individual plant viability will be evaluated pre-implementation to insure survivability.
 - c. Any adjustments or substitutions in plant species, sizes, container types, or quantities

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shall be pre-approved in writing by the QB.

13.2.3. Live stakes:

- a. Live stake plant material general specifications shall be in accordance with the special provisions, the reference standards as stated in section 1.1.4, and of Caltrans July 2019 Construction Manual Sections 20-23.
- b. Live stake cuttings will be collected and soaked for a minimum of seven days to increase viability.
- c. Live stake materials must be sourced from native species and should be obtained in or around the project area in coordination with the QB.
- d. Any adjustments or substitutions in live stake species, sizes, or quantities shall be pre-approved in writing by the QB.

APPENDIX F
(TAC MEETING NOTES AND RESPONSE TO COMMENTS)

Nordheimer Habitat Enhancement Project
Draft 65% Basis of Design Memorandum
[Design Team Response to Comments in red text]

Technical Advisory Team Comments

May 12, 2021

Comments from Salmon River Restoration Council (SRRC)

SRRC is very pleased with the proposed design. We really like the full variety of types of treatments proposed so we can test these types of treatments for use in future projects. We like the willow baffles placement at the mouth of the tributary as well as the denuded stream bar at the upstream end of reach two.

SRRC is very supportive of the use of accelerated recruitment of live oak along the channel. This could be very beneficial, the oaks provide immediate cover and may stay in place better during high flow events, as compared to Douglas fir, as anecdotally observed by the Watershed Research and Training Center and Yurok Tribe's South Fork Trinity River 2019 large wood loading project.

SRRC agrees with the technical advisory team discussion during the May 10th meeting, that where possible structures should be placed well into the stream channel (i.e., aggressively) as long as appropriate anchoring is still feasible. Observations from Knownothing and Methodist Creek LWD placement indicate that the structures could be placed further into the stream channel due to the new normal trend of extreme drought. SRRC understands that climate change has resulting in more extreme weather events. Recent observations indicate we are likely to have drought years, in the interest of maximizes habitat benefits from these types of projects we now lean more toward aggressive placement of structures, knowing they are at higher risk for movement in extreme storm events. We feel that it is worth risk to provide immediate habitat benefits of cover, large wood recruitment, and scour even during drought years, rather than wait for high flow events to create habitat conditions using the hydraulics of the stream system.

Design team response:

The design team agrees with these observations and it is the full intent of the designs to accomplish these stated goals. The current conceptual designs in plan-view show all bank-based structures projecting at least 1/3 to 1/2 way into the active channel section. During implementation, structures will be "field fit" to ensure they are aggressively engaged with the active, low-flow channel.

SRRC agrees with the technical advisory team discussion during the May 10th meeting to include a number of unanchored, large wood pieces placed with heavy equipment or helicopter should be included as an additional opportunity with this project. If the opportunity is available SRRC will include this as an additional phase to be added either during, or after, this proposed design implementation. A maximum number of whole trees should be included with estimated purchase, delivery, and implementation costs using a helicopter. An alternative maximum number of cut logs, with or without rootwads, should be included as well; to placed using heavy equipment and include estimated purchase, delivery, and implementation costs. Site placement should be described as being placed throughout

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

reaches 2 and 3, and field fit depending on quantities and materials available. Add 1-2 paragraphs to BODM Section 8 describing this added task. CDFW suggested adding potentially 1/3 more large wood pieces as whole trees, begin with evaluating this quantity and adjust as appropriate to the project conditions. CDFW recommended a minimum size of 1' diameter, 25 foot logs.

Design team response:

The design team agrees and to accommodate this request we have incorporated a new proposed design element (section 8.2.4 *Unanchored Helicopter Wood Loading*), where approximately 30-35% additional key logs are proposed to proportionately be distributed throughout reaches 2 and 3. This element of the project is intended to bridge the gap between the installation of anchored/secured LWM jams needed to help entrain woody material transported during high flow events and the time anticipated for maturation and subsequent availability of sufficient trees to support natural recruitment of woody material to the channel.

SRRC agrees with CDFW recommendation during May 10th meeting to add alder accelerated recruitment to site 55+00 – 56+00 only if there would be limited loss of shade providing trees to the stream channel (as recommended by USFS).

Design team response:

Prior to implementation the design team will coordinate with SRRC, USFWS, USFS and CDFW to evaluate which specific trees will be suitable for accelerated recruitment, without impacting riparian shading conditions within the stream corridor.

In the final designs include the reach number and north arrow on site specific sheets. The north arrow will help identify shade in relation to the structure placement and construction disturbance.

Design team response:

Reach number has since been added to the title block in the lower portion of the conceptual design sheets. A north arrow also exists in the lower left portion of the title block. In addition, a sentence has been added to section 8.2.3 of the BODM stating "*All conceptual design figures presented are oriented with true north facing up*", to help eliminate any confusion.

Include slash quantities and costs in opinion of probable costs. SRRC can provide cost estimates.

Design team response:

Small and medium woody material/slash quantities have been added to the *Site Material and Equipment Needs* table within each conceptual design sheet. Costs for these materials have also been included in the opinion of probable costs.

Comments from Technical Advisory Team (SRRC response in bold)

Comments from Don Flickinger (NOAA Fisheries West Coast Region, Klamath Branch, CA North Coast Office) speaking for Technical Advisory Team NOAA participants:

I think the project is shaping up great, identifying how to build the proposed instream structures securely but as inexpensively as possible, emphasizing Reaches 3 and 2.

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

SRRC agrees with this comment. With the addition of including reach 1 brush baffles.

Here are the main supplemental suggestions that I think were generally emphasized [in the meeting].

At least some of the primary instream structures should be placed lower (more "aggressively"), to allow for their hydrologic effect(s) even at low flows (remembering experiences from the Methodist and Knownothing projects);

Design team response:

Same response as above directed to SRRC.

The design team agrees with these observations and it is the full intent of the designs to accomplish these stated goals. The current conceptual designs in plan-view show all bank-based structures projecting at least 1/3 to ½ way into the active channel section. During implementation, structures will be "field fit" to ensure they are aggressively engaged with the active, low-flow channel.

SRRC agrees with this comment as described in our comments above.

Small and mid-sized material (logs and/or brush bundles) should be added to the primary instream structures, where possible, to provide habitat sooner in case we don't get elevated flows for awhile;

This is a component of the structure design. SRRC recommends emphasizing on conceptual design sheets, typical design details, and technical specifications the addition of small wood into all structures.

Design team response:

Small and medium woody material/slash quantities have been added to the *Site Material and Equipment Needs* table within each conceptual design sheet. Costs for these materials have also been included in the opinion of probable costs. In addition, the typical design detail sheets have incorporated specifications for including these materials into the structures (see Appendix B; Typical Design Sheets C3 and C4).

and

Coordinate with the KNF to secure large wood (including logs with root wads), from future salvage and hazard tree projects, that can be placed at identified locations along Nordheimer in the future...to either stand alone or be recruited at project structures if mobilized.

SRRC is working on this.

I like the buried willow design for the Nordheimer-Salmon confluence zone. If these work/persist, they might be placed at 100s of locations to jump start river bar recovery.

SRRC agrees with this statement.

Comments from Maija Meneks District Fish Biologist, Klamath National Forest, Salmon-Scott Ranger District):

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

I do not have any specific comments. Anything I may have commented upon came up today during the conference call. I do like the idea of keeping the option open (within an "X" year timeframe from the NEPA signatures) to allow additional helicopter (unsecured) wood loading in the future, given material and funding availability, once you are finished with your initial structures. If there is time to add it to the designs, I don't know given your end-of-May timeline; but even if it doesn't make it into Nordheimer, it would be something to think about for a future project.

SRRC agrees with adding the additional unsecured wood to the project as described in comments above.

Design team response:

Same response as above directed to SRRC.

The design team agrees and to accommodate this request we have incorporated a new proposed design element (section 8.2.4 *Unanchored Helicopter Wood Loading*), where approximately 30-35% additional key logs are proposed to proportionately be distributed throughout reaches 2 and 3. This element of the project is intended to bridge the gap between the installation of anchored/secured LWM jams needed to help entrain woody material transported during high flow events and the time anticipated for maturation and subsequent availability of sufficient trees to support natural recruitment of woody material to the channel.

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

Agenda

1. Introductions (10:00-10:15)

Whelan can lead introductions unless Mel wants to. We can play this by ear.

Participants:

Name	Agency	Initials
Whelan G	Merkel & Associates	WG
Randy L	PWA	RL
Chris M	Moore WEEDS	CMM
Mel V S	SRRC	MVS
Bonnie B	SRRC	B
Maija M	USFS (District Biologist)	MM
Marjorie C	CDFW (Senior Hydraulic Engineer)	MC
Lyra C	SRRC	LC
Karuna G	SRRC	KG
Stefan D	SRRC	S
Don F	NMFS NOAA representing Bob P	DF
Toz S	Karuk Fisheries	TS
Serena D	USFWS (Fisheries Biologist)	SD
Sophie P	SRRF (Fisheries Coordinator)	SP

2. Project Overview (10:15-10:25)

Whelan will present an overview of the project (drawn from background narrative. This will transition right into section 3 below, where we talk about the 30% design leading to our site assessment).

NOTES:

- Review of existing comments from the TAC from the 30% BOD and the departure of Rocco F the new design team decided to revise the approach to meet he original design goals of wood loading for habitat enhancement
- Project Goals
 - Improve access
 - Improve coldwater habitat and access for salmonids
 - Increases retention and facilitate gravel sorting

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

- Increase pool frequency
- *Increased frequency of large wood accumulations by installing unanchored key pieces of LWM (additional goal added by TAC)*
- Methods
 - review of remote sensing data from 30% BOD
 - Historic data review
 - aerial and fish data
 - Evaluation of Lidar and UAV data to make preliminary site selection prior to field reconnaissance and site development
- Project Overview
 - treatment will take place from station 64+00 down to 3+00
 - Equipment access is broken into a upstream and downstream based on ease of access
 - Upstream is heli/spider and DNS is excavator
 - Fish observation
 - Data from USFS and SRRC
 - 2015 was a peak of spawning based on the data and have been on a decline since
 - spawning appears to be concentrated on reach 3 and 4 with some in reach 2 and 5 to a lower extent
 - Transient gravel pulses of gravel may be a factor of the way spawning is happening (RF 30% BOD)
 - Utilized the LiDar and UAV in the field to ground truth the Bankfull width and depth
 - Sites where selected based on ability to meet the FRGP criteria of anchored or unanchored wood while also balancing the need to achieve maximum benefit and channel effects

3. Methods for developing 65% Basis of Design Report and Plans (10:25-10:30)

Whelan will kick this off by talking about the collection of UAV orthoimagery, integration of LiDAR data, providing detailed planning-level information>>followed by in-stream site assessment (site access, channel dimensions and geomorphic characteristics>>photopoint and GPS data collection basics of information collected).

Chris will pick up from here and talk about the process of site selection and criteria for feature designs, and this will transition into section 4 below.

NOTES:

-

4. Site-by-site review of proposed project features (10:30-11:00)

Chris will lead the first part of this section with Randy or Whelan jumping in to provide support as needed (10:30-10:50)

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

Randy will provide an overview of typical designs and specifications, and introduce the forthcoming appendix sections to be submitted with the 90% BODM (10:50 – 11:00)

5. Group discussion of proposed features (11:00 – 12:00)

Everybody participates

General comments and discussion notes:

- **MC and DF** Add more small medium wood to the sites to increase immediate habitat diversity
- **MC** would like to see sites loaded up with wood to increase complexity
- **KG** making sure we are keeping in mind that the new normal of lower flows and making sure that the structures are aggressive enough to engage the lower flows that are happening more commonly
- **TS** Would like to see largest wood to be placed as possible and if your going to do wood loading then “go big or don’t do it”. Also emphasized a primary goal should be to increase spawning sized gravel retention since there is very limited winter rearing habitat.
 - Adding larger structures that affect the channel gradient
- **MM** USFS does not have any limitation on the volume of wood in the system and
- **MC** What is the availability of wood supply for this project
 - **MVS** SRRC is working to add NEPA to allow to tree tipping on USFS that would allow for larger logs and root wads to be harvested
 - **MM** Bear country tree tipping is a provision that is allowable
 - In general the hope that tee tipping will be allowable Salmon and Scott river within Klamath National Forest
 - **MC** wondering that with the well spaced out structures what if we have a contingency plan to add more lose wood and leave it unanchored to add in more wood
 - **TS** agrees that adding more sites and structures that are unanchored
 - **MVS** would this need to be engineered and could be field fit?
 - **MC** idea build in some anchored structure and add all sizes of wood to increase complexity, Utilize the structures and then add complexity of larger structures
 - **TS** the recruitment of whole trees are lacking due to logging, fire and LWD removal from the channel. Its been salvage logged to the point that there is nothing much left behind to recruit to the channel
 - **MC** how to write in the contingency of heli wood loading of large wood
 - **RL** add supplemental wood loading component that could be added throughout the channel to provide increased recruitment throughout the system. This material will add to and bolster the existing structure size/complexity.

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

- **MC** recommends that we have a clear identified approach about how to select location for adding the additional logs through heli wood loading. Unanchored, field fit, wherever access is feasible.
- **MM** General area is NF Salmon River between Forks and Little NF, then going south up Blue/Picayune Ridge and continuing that general line to Cecilville through Negro, Indian, Black Bear, ect drainages. Farthest downstream is some WUI work around Forks.
- **TS** would like to see us adding flexibility to add more and increase the complexity
- **WG** keeping in mind the larger context of the watershed and makes sure we are getting something implemented so that we can start the habitat enhancement.
- **MC** funding perspective these structures are good but there could be 1/3 more large wood to really get the best cost benefit
 - we don't need to limit the size class of the additional wood but can apply any wood that meets the LWD criteria (1' dia 25' L)
 - work thought the design with the addition of 1/3 more unanchored wood
 - At the development of an implementation proposal she advised us to meet with **MC** and **Trevor T** to work out the best approach to achieve funding and navigate the FRGP LWD size for unanchored wood
- **MM** appreciated the site by site walk through of the project designs
- **TS** Watershed burned, then salvage logged, not much recruitment potential-Need to add a lot of wood to the system.
- **TS** Nordheimer is summer rearing and winter spawning habitat but not winter rearing, also really important Steelhead stream
- **MC** More and large wood as a supplemental task design element

Site and Reach specific notes:

Reach 4:

- 64+00
 - **MC** Add medium and small woody debris
 - **DF** what is the intended function of the spanning log?
 - **CM** Extending pool, sorting gravel, retain mobile wood

Reach 3:

- 61+00
 -
- 57+00
 -
- 55+00
 - **MC** add alder to add roughness utilize the riparian vegetation that is taken out through construction to increase the roughness and complexity
 - **MC** would like to see this site really loaded up with wood
 - **DF** also emphasized to add smaller woody material to structures
 - **MM** Don't forget shade (removal may affect)
- 51+00
 - **DF** Add in smaller wood/brush in case we don't get much flow for several years?
 - **CM** Will make sure we incorporate a sm/med wood component in BOD
- 47+00
 - **KG** Canyon Live oak that were identified would be good candidate to add, longevity, lots of

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

roughness

- 45+00
 -
- 43+00

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

-
- 39+00
-
- 38+00
-

Reach 2

- 36+00
-
- 32+00
-
- 30+00
-
- 21+00
-
- 11+00
 - **MC** likes the site design and the approach

Reach 1

- 3+00
 - **Bonnie and Maija** commented that the split flow happened between 2015/2016 and it was not beneficial to the fish. It was also the last real high water year (need to check hydrograph on this)

**Nordheimer Creek Habitat Restoration Design
90% Phase Technical Advisory Committee Meeting Notes**

Monday, May 24th, 2021
1:00 pm – 3:00 pm

Agenda

1. Introductions

Name	Agency/Organization	Initials
Whelan G	Merkel & Associates	WG
Randy Lew	PWA	RL
Chris Moore	WEEDS	CMM
Mel Van Scoyoc	SRRC	MVS
Bonnie	SRRC	B
Marjorie Caisley	CDFW (senior hydraulic engineer)	MC
Karuna G	SRRC	KG
Don Flickenger	NMFS NOAA representing Bob P	DF
Toz Soto	Karuk Fisheries	TS
Sophie Price	SRRF (fisheries coordinator)	SP
Stefan Dosch	SRRC	SD
Mark Elfgren	CDFW	ME
Jake Shannon	NCRWQCB	JS

2. Overview of 65% BODM TAC comments received
(See Response to 65% TAC Comments, Appendix F)
3. Response to 65% TAC comments and changes incorporated in the 90% BODM
4. (See Response to 65% TAC Comments, Appendix F)
5. Answer questions

DF Do we have experience with how willow baffles perform under high flow regimes?

APPENDIX F (TAC MEETING NOTES AND RESPONSE TO COMMENTS)

CM Have experience on the North Fork but these features haven't seen high flows yet. Willow baffles performed well in Bull Creek and Terwer Creek. Having added element of coarser wood helps retain mobile wood. Willow and brush should be able to lay out as opposed to being scoured or undermined.

6. Group discussion

- a. WG provided a detailed review of comments provided by TAC from our 65% Design BOD
- b. The cost benefit analysis for the deployment of a helicopter on this project lead us to proposing a single phase implementation of the 16 anchored sites and 60 unanchored key log placements throughout reaches 2 and 3 and potentially extending further upstream within reaches 4 and 5.
- c. The Design Team has determined to maintain the Key piece criteria for all unanchored wood sites.
 - i. **MC** did not want the key piece criteria to be a limitation to adding the more mobile wood to the design. She is supportive of using the key piece size criteria to maintain consistency with CDFW/FRGP guidelines. **MVS** followed up by mentioning that Prop 1 funding for implementation would allow more flexibility for wood size.
- d. **TS** 65% Comments captured well. He suggested that we find ways to reduce the cost of logs by sourcing salvage, partnering with existing harvests, and other hazard trees
 - i. **TS** : MKWC is working on a project in Red Cap and they are designing to procure trees from the fire damage areas
Fire Salvage and there could be a partnership with SRRRC and MKWC to help reduce helicopter costs
- e. **MC** is asking what are wood loading volume metric per 100 meters is compared to the recovery plans for Nordheimer
 - i. She asked if we are in the "Good vs Very Good" based on the recovery metric
 - ii. She is not having sticker shock
 - iii. 9 pieces per 100 meter based on the existing proposed design
 - iv. If we assume unanchored heliwood loading occurs from station 65+00 (lower end of reach 4) down to the confluence (1.2 stream miles/1931 meters), we will end up with 10-11 key pieces per 100m based on a total of 176 Key logs. Table 4-15 in the SONCC Recovery Plan (NOAA 2014) suggests greater than 3 key pieces per 100m is a 'very good' indicator, so implementing the proposed design would put lower Nordheimer Creek into the 'Very Good' status. Extending the proposed unanchored heliwood loading efforts further upstream into (reaches 4 and 5) would still result in the treated reaches achieving 'very good' status for Key piece criteria.
- f. Design Team is not excluding wood loading in reach 4 and 5 but it was not directly identified in the designs which emphasize reaches 2 and 3.
- g. **MVS** The fish ladder is a TBD issue that will need to be addressed with the USFS in the future but it is not part of the current design
 - i. **KG-SRRRC** is not opposed to it being improved and maintained but it would need to be considered as a possible infrastructure to be taken into consideration.
 - ii. **TS**-plan to proceed like the fish ladder is not going to be there. The ladder may or may not be maintained or improved due to the potential biological impacts of having the ladder in place in the next 10 years.
- h. Carbon sequestration benefits from placement of wood into streams as opposed to letting dead or dying trees burn in the next big fire could be an ancillary benefit to the project.