Cooper Mill Creek Fish Passage Improvement Project Designs

Final Progress Report
PSFMC Grant No. 19-61G

Submitted to:
Pacific States Marine Fisheries Commission
205 Spokane Street, Suite 100
Portland, OR 97202

Submitted by:
North Coast Coho Project
Trout Unlimited
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Contract Term: September 17, 2018 through September 30, 2019
Reporting Period: September 17, 2018 through September 30, 2019

Project Objectives:
The objective of this project is to develop preliminary site characterizations that will guide the basis of design report, alternatives analysis, and final engineered designs for the *Cooper Mill Fish Passage Improvement Design Project (CMFPP)*.

Project Location:
The project location is in the Yager Creek watershed, a large sub-watershed of the Van Duzen River, which drains into the Eel River 13 miles upstream with its confluence with the Pacific Ocean in northern California. Cooper Mill Creek is a 3.9 mi. sub-watershed of Yager Creek. The mouth of Cooper Mill Creek is located approximately 2.5 mi upstream of the Yager Creek/Van Duzen River confluence.

The project primarily targets two identified fish barriers on Cooper Mill Creek on property managed by Humboldt Redwood Company (HRC). The locations of the barriers are noted on as the “grade control structure” at the Cooper Mill Creek/Yager Creek confluence and the “concrete sill” approximately 2,500 ft. upstream from the confluence.

The project designs intend to improve fish passage for all life stages of salmonids. Cooper Mill Creek is an important anadromous fish-bearing tributary of Yager Creek and contains 3.0 miles of anadromous stream habitat. Its cold perennial flows may provide high quality summer rearing habitat, as well as winter refugia during high flow events on Yager Creek.

Project Team:
Trout Unlimited (TU): Grantee and Project Manager
Pacific Watershed Associates (PWA)
Humboldt Redwood Company (HRC)

Work Summary:

Grant Administration: Trout Unlimited worked with its partners to secure subcontractor agreements, coordinate site visits, facilitate meetings, and to develop and submit invoices and reports.

Project kickoff meeting – September 6, 2019. Attended by the CDFW grant manager, CDFW Senior Hydraulic Engineer, consultants from PWA, the fisheries biologist for HRC, and Trout Unlimited. Meeting minutes are attached.

The majority of the work completed under this grant was included a characterization of the subsurface stratigraphy, geomorphic mapping, a longitudinal channel profile survey, and a fish passage assessment. Specifically, the project's contracted deliverables included:

1. Geomorphic mapping of the project area and substrate characterization.
2. Conduct a topographic survey map and long profile with cross-sections
3. Characterization of the subsurface stratigraphy
4. Development of a technical memorandum (Att.A) outlining the physical site characteristics

In addition to the above stated deliverables, the technical memorandum includes

1. a characterization of the water surface elevations through the winter months,
2. a detailed survey of the two fish barrier sites and initial HECRAS hydraulic modeling results,
3. an evaluation of the fish barriers; and,
4. a summary of the distribution of fish within lower Cooper Mill Creek and Yager Creek as observed during the fall of 2019.

Final Budget
Cooper Mill Fish Passage Improvement Project Design
Grant Agreement: 19-61G

	Fish Passage Forum Award	Amount Expended	Total Project Cost
A. PERSONNEL SERVICES			
TU Project Management and Coordination	$4,320.00	$4,313.42	$6.58
Staff Benefits @ 43%*	$1,857.60	$1,854.76	$2.84
TOTAL PERSONNEL SERVICES	**$6,177.60**	**$6,168.18**	**$9.42**
B. OPERATING EXPENSES			
Subcontractors			
Engineering Consultant	$47,413.10	$47,412.93	$0.17
Fisheries Consultant	$2,500.00	$0.00	$2,500.00
Subtotal of Subcontractors	**$49,913.10**	**$47,412.93**	**$2,500.17**
Other Operating Expenses			
TU Travel	$621.30	$621.18	$0.12
TU Supplies	$50.00	$50.00	$0.00
Subtotal Other Operating Expenses	**$671.30**	**$671.18**	**$0.12**
TOTAL OPERATING EXPENSES	**$50,584.40**	**$48,084.11**	**$98,668.51**
C. SUBTOTALS & INDIRECT CHARGES			
Subtotal A+B (Personnel + Operating)	$56,762.00	$54,252.29	$111,014.29
Requested Indirect Amount (15.89%)	$9,019.48	$8,620.67	$9,019.48
D. GRAND TOTAL	***$65,782.00***	***$62,872.96***	***$2,909.04***

Figure 1 Boulder Weir Structure at confluence of Cooper Mill and Yager Creek. March 2017

Figure 3 Boulder Weir Structure at confluence of Cooper Mill and Yager Creek. February 2016

Figure 2 Boulder Weir Structure - March 2017

Figure 4 Boulder Weir Structure - February 2016

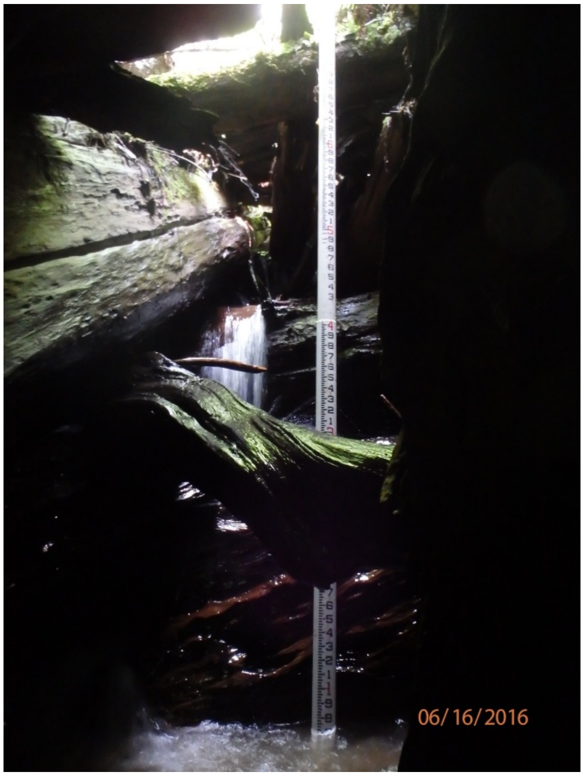

Figure 5 Cooper Mill Crk LDA - CDFW Stream Inventory (2016)

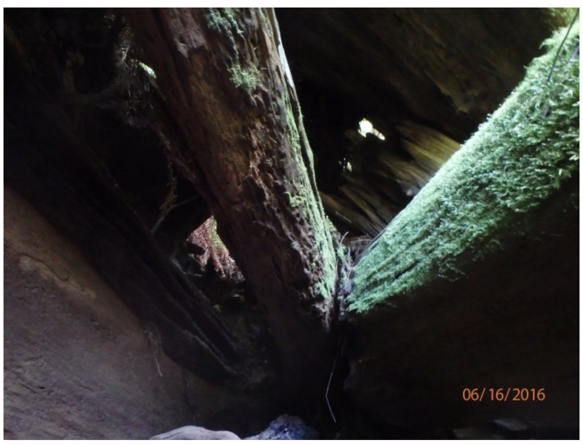

Figure 6 Cooper Mill Crk LDA - CDFW Stream Inventory (2016)

Figure 7 Cooper Mill Crk LDA- CDFW Stream Inventory (2016)

Figure 8 Cooper Mill Crk Remnant Sill; HRC water drafting site (June 2016)

Figure 9 Cooper Mill Crk Failing rip rap banks (March 2016)

Figure 10 Cooper Mill Crk Remnant concrete bridge crossing abutments (March 2016)

Figure 11 Cooper Mill Crk Remnant cables (March 2016)

Figure 12 Cooper Mill Crk Remnant legacy road cribbing (March 2016)

Figure 13 Cooper Mill Crk Remnant legacy road cribbing (March 2016)

Final Report 19-61G
Attachment A

Physical Characterization for the Cooper Mill Fish Passage Improvement Design Project

(PSMFC Grant No. 19-61G, PSMFC Job No. 1072A.19)
Sept 30, 2019

Prepared for:
Pacific States Marine Fisheries Commission

Trout Unlimited
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1 INTRODUCTION AND BACKGROUND

The *Cooper Mill Fish Passage Improvement Design Project (CMFPP)* is located in the Yager Creek watershed, a large sub-watershed of the Van Duzen River, which drains into the Eel River 13 miles upstream with its confluence with the Pacific Ocean in northern California (Map 1). Cooper Mill Creek is a 3.9 mi.^{2} sub-watershed of Yager Creek. The mouth of Cooper Mill Creek is located approximately 2.5 mi upstream of the Yager Creek/Van Duzen River confluence. The project primarily targets two identified fish barriers on Cooper Mills Creek on property managed by Humboldt Redwood Company (HRC) (Map 2). The locations of the barriers are noted on Map 2 as the "grade control structure" at the Cooper Mill Creek/Yager Creek confluence and the "concrete sill" approximately 2,500 ft. upstream from the confluence.

The long term objective of the *CMFPP* is to develop final engineered designs that are focused on enhancing instream habitat and improving fish migration for all life cycles of Coho and other Salmonids. The objective of this step in the design process, and the focus of this report, is to characterize the physical and biological site conditions within the lower Cooper Mill Creek area. This data will be used to inform the design process of the two previously identified partial fish barriers on Cooper Mill Creek; 1) the boulder step weir structure at the mouth of Cooper Mill Creek (*CMFPP Site 1*), and 2) a concrete weir located approximately 0.5 mi. upstream (*CMFPP Site 2*), associated with an old water diversion. The data presented in this report will also facilitate the identification and design of habitat enhancement opportunities within the lower Cooper Mill stream reaches and provide the fundamental elements of a basis of design report for the final engineering plans.

Funding to carry out the initial site characterization was secured by Trout Unlimited in November 2018 through a Pacific States Marine Fisheries Commission (PSMFC) grant # 19-61G. The results of the PSMFC grant (presented in this report) will be used to inform a second grant from the California Department of Fish and Wildlife (CDFW) fisheries restoration grant program (FRGP agreement No. P1810520). Collectively, these two grant projects will result in a 100% design for fish passage and habitat enhancement within the anadromous portions of the Cooper Mill watershed. Trout Unlimited contracted with Pacific Watershed Associates, Inc. to characterize the physical and local geomorphic conditions within the project area and to carry out a biological assessment of both fish barriers. This report summarizes the results of these preliminary investigations and surveys, in support the larger FRGP design project.

2 SCOPE OF WORK

The scope of this report is based on the initial grant funding through the PSMFC and was limited to a characterization of the subsurface stratigraphy, geomorphic mapping, a long channel profile survey, and a fish passage assessment. Specifically, the projects contracted deliverables included:

(1) Geomorphic mapping of the project area and substrate characterization.

(2) Conduct a topographic survey map and long profile with cross-sections

(3) Characterization of the subsurface stratigraphy

(4) Development of a technical memorandum outlining the physical site characteristics

In addition to the above stated deliverables, we include (1) a characterization of the water surface elevations through the winter months, (2) a detailed survey of the two fish barrier sites and initial HEC-RAS hydraulic modeling results, (3) an evaluation of the fish barriers, and (4) a summary of the distribution of fish within lower Cooper Mill Creek and Yager Creek as observed during the fall of 2019.

3 GEOLOGIC AND GEOMORPHIC SETTING

The *CMFPP* area lies within the greater regional geomorphic Coast Ranges province (CGS, 2002). The Coast Ranges lie between the Pacific Ocean and the Klamath Mountains, west to east, and from the Oregon/California border to the Transverse Ranges near Point Conception, north to south. The northern Coast Ranges, in the project area are characterized by northwest trending valleys, mountain ranges and fault complexes associated with the on-land portion of the accretionary prism of the Cascadia subduction zone (Clark and Carver, 1992) and the northward migration of the Mendocino Triple Junction.

The geology of the surrounding Cooper Mill watershed contains rock groups ranging from recent alluvial and colluvial deposits to older fractured rocks of the Yager Formation (Early Tertiary) (McLaughlin et al, 2000)(Map 3). Hard rock, composed of sedimentary units of the Yager Formation, is relatively common in the Cooper Mill watershed, but is primarily confined to the middle section of Watershed. It is significantly more common in the Yager Creek watershed where it is exposed in the more confined valley reaches (Map 3). The majority of the geologic units exposed within the watershed are the relatively softer sedimentary units of the Neogene Wildcat Formation (QTw) (Map 3). Capping the Wildcat formation, within the project area lowland settings, are Pleistocene fluvial terraces and Quaternary fluvial and alluvial sediments (McLaughlin et al, 2000) (Ogle, 1957) (Map 3). Observations of subsurface materials within the project area and exposures in the vicinity of the two sites appear to be consistent with the published map (McLaughlin, et.al., 2000). The geologic contact between the Yager Formation and the Wildcat Formation within the project area is a Pleistocene/Holocene fault. This fault, known as the Yager fault. Another more active fault zone known as the Little Salmon fault zone, is observed S-SW of the project area and exhibits several fault strands throughout the project area (Map 3) The Little Salmon Fault is considered active by the United States Geologic Survey. It is likely that the Yager fault represents and older strand of the fault zone while the Little Salmon Fault represents the younger active strand of the fault zone. Within the project area, the recent Holocene alluvium (Qal) buries the Little Salmon Fault (Map 3).

Except within the upper portion of the Cooper Mill watershed, the project area is blanketed and dominated by Quaternary alluvium from Yager Creek (Map 3). In general the alluvium can be subdivided into two main sections: (1) The historic channel migration and floodplain zone (Map 4) and (2) the developed and disturbed/graded alluvium. In general, the historic channel migration zone occupies the eastern portion of the valley while the disturbed/developed zone occupies the western margin of the valley which is slightly higher in elevation. Map 4 shows the historic channel migration zone. This map was developed by examining air photos from between 1940 and 2000. Within the channel migration zone various river flow paths can be observed in the form of meander scars, abandoned oxbows, high flow channels, and active floodplain (Maps 3 & 4). The Qal areas exhibiting disturbed/developed conditions are mostly confined to the western margin of the valley and are observed as flat graded areas occupied by infrastructure such as roads and buildings to the north of the project area. At the southern end of the project area, the disturbed/developed Qal is observed as graded flats for log decks and agriculture activities.

3.1 Local Quaternary Subsurface Stratigraphy

The stratigraphy was described in several locations along the banks of Cooper Mill Creek as the exposures presented the best opportunity to describe the geologic subsurface substrate (Map 2). Descriptions and drawings of the observed stratigraphy can be found on Figures 1-3. The locally observed stratigraphy is consistent with the interpretations presented on the geologic and geomorphic map. In general the stratigraphy can be observed as a coarse fluvial gravel dominated substrate overlain by brown to light yellowish grey silt deposits. The silt deposits range in thickness from <1 ft. to over 8 ft. thick and tend to be thickest in the upstream portions of the project area (Figures 1-3, Map 2). The gravel dominated units range in thickness throughout the project area, though bed thickness was limited primarily by exposure limitations, rather than bed thickness. These units shift from clast to matrix supported configurations in the downstream-most stratigraphic columns. The downstream-most stratigraphic units exhibit poorly sorted, isolated clasts that range in size from gravels and cobbles up to small boulders over 1 ft. in diameter. The observed stratigraphy is generally interpreted as channel deposited sediment (gravel beds) overlain by floodplain overbank deposits (fine sandy silt beds). The stratigraphy of SC-1, located just upstream of the upper-most boulder weir (Weir #1) at the mouth of Cooper Mill Creek was significantly different than the rest of the stratigraphic columns, primarily based on the range and abundance of different clast sizes (all entombed in a fine grained silty matrix). With the exception of the relatively clean silt cap near the ground surface, and the gravel-rich bed near the base of the exposure, the stratigraphy of the rest of the column exhibited characteristics generally associated with debris flow deposits, or alternatively, possibly could be anthropogenic in nature. Given the geologic setting, we anticipate any geologic substrate encountered during an implementation phase will be consistent with the above described stratigraphy.

3.2 Channel Characteristics

In general, substrate composition varies with stream power and the available (source) materials. Stream power is strongly correlated with channel width and gradient, in addition to other hydraulic responses to channel structure (LWD, anthropogenic structures, etc.). Over the stream reaches surveyed in the project area, average stream gradient does not vary widely and thus, is less of a factor related to substrate distribution.

In the vicinity of the mouth of Cooper Mill Creek, the active channel width of mainstem Yager Creek varies from approximately 60 ft. wide up to approximately 90 ft. wide and represents a relatively high energy environment. The mainstem channel is generally characterized by runs separated by riffles (ranging from discrete riffles, closely spaced series of discrete riffles, or extensive long riffles). Pools are uncommon and are limited to relatively small areas, associated either with the boulder step weir structure at the mouth of Cooper Mill Creek (which projects out into the mainstem Yager channel), or with large boulders in the mainstem channel that create localized hydraulic forces. The mainstem Yager Creek channel substrate is dominated by boulders and cobbles, and contains only relatively minor components of gravel and sand found primarily in pools or in wide or otherwise sheltered areas. The primary rock type is well cemented and hard Yager Formation sandstone and conglomerate.

The active channel width of mainstem Cooper Mill Creek varies from approximately 10 ft. wide in the narrow confined reach between the mouth and the bridge on the mainline road, up to approximately 30 ft. wide at its maximum, though in its wider zones, generally ranges around 20 ft. wide. The channel is, in general, significantly wider in most of the upstream stream reaches, in contrast to the downstream most confined reach. The lower reach is confined both by the nature of its incised channel, as well as the presence of old berms (Artificial fill) lining the right bank associated with grading and manipulation of the historic log deck areas adjacent to the stream.

Where the channel is constricted by natural or anthropogenically created LWD structures (installed by the CCCs), remnant bridge abutments, rip rap armor, or boulder step weirs, the channel has scoured relatively deep pools. Pool depth is primarily related to the degree of constriction (channel width), with maximum summer low flow pool depths approaching 3 – 4 ft. in depth associated with channel widths in the 9 – 10 ft. range. The two exceptions to this, which appear to be strongly influenced by the composition of the substrate exposed in the banks, are the constricted reach between the mouth and the mainline bridge, and the channel immediately adjacent and under the failing bridge between stratigraphy description sites 9 and 10 (Map 2). Based on the stratigraphy observed in these reaches, the channel bed appears to be underlain by relatively large (and hard) substrate, ranging from small boulders, cobbles, and thick gravel beds, which appear to be able to resist the forces exerted by the constricted stream channel. The incised nature of the downstream reach is likely a manifestation of the constricted channel, increased channel grades, and anthropogenic enhancement of the Cooper Mill channel.

The channel substrate in Cooper Mill Creek is generally dominated by small to large gravels with a silty sandy fine component. The channel substrate is significantly larger (cobbles and small boulders) in the two “exceptions” noted above. The Cooper Mill Creek channel is generally characterized by pool/riffles separated by runs. Fines dominate the pools.

4 EXISTING BIOLOGICAL CONDITIONS

A summer low flow assessment was conducted on Cooper Mill Creek on September 11, 2019 by PWA’s Fisheries Biologist, Margo Moorhouse, specific to potential barriers to salmonid migration. One potential barrier location is at the confluence with Yager Creek a series of step-pools controlled by boulder weirs and the other is a concrete sill with flash boards located upstream near the old fish hatchery. Current low flow habitat conditions were assessed specific for salmonid passage, primarily Coho Salmon (*Oncorhynchus kisutch*) and the potential for allowing Sacramento pikeminnow (*Ptychocheilus grandis*) a non-native invasive species access into Cooper Mill. A snorkel survey was conducted in Yager Creek at the Cooper Mill Confluence, in each of the boulder weir step pools and the next two main channel pools upstream, in two pools directly downstream from the concrete sill and two pool upstream from the concrete sill. In addition, water temperatures were taken in Yager Creek and in Cooper Mill Creek along with ambient air temperatures and a pygmy meter was used to measure flows in Cooper Mill Creek. The purpose was to evaluate the fish assemblages with respect to these potential barriers as an evaluation tool for salmonid presence/absence and whether or not Sacramento pikeminnow are occupying Cooper Mill Creek. On September 18, 2019 Humboldt Redwood Company’s (HRC) Fisheries Biologist, Keith Lackey, also conducted a snorkel survey in Cooper Mill Creek and in Yager Creek at the Cooper Mill Creek confluence.

The California Department of Fish and Wildlife (CDFW) conducted an in stream habitat inventory in 2016 which was used to provide some comparative information with respect to the identified potential barriers and fish species occupying Cooper Mill Creek at that time.

4.1 Findings

The flows were below the instrument range for the pygmy meter (less than 0.1 ft/sec) thus no values were obtained.

The boulder weir and step pool habitats were a complete barrier during the September 11 survey. There was no connective flow at the confluence, over the boulder weir (#6) or through interstitial channels between the boulders. Boulder weirs #3 and #5 also lacked flow over the boulders but, there was flow between the boulders visible within the pool below. All the boulder weirs had plunge heights greater than two feet above the water surface elevation with minimal flows spilling over into the pool below. The greatest pool depths in each pool were in between large cobbles and small boulders with only small scour areas within the pools that comprised the "pool". Behind each boulder weir the stored gravels were increasingly more compacted where at weir #1 the embeddedness was averaged at 35% and at the lower most (#6) the embeddedness average was measured at 65%.

At the concrete sill structure, there was vertically no flow passing over the nearly one and a half foot tall structure into a shallow pool below. Upstream fish passage was not possible for salmonids at all life cycle stages under these low flow conditions. The stream channel was completely aggraded behind the structure which extended upstream into a shallow pool.

Temperatures in Yager Creek were measured above, below, and at the confluence of Cooper Mill Creek. All locations yielded a 25.5ºC value with the ambient air temperature also at 25.5ºC. To evaluate interstitial flow through boulder weir #6, temperature was taken between and under the boulders from the Yager Creek side and there was no discernable temperature differential. In Cooper Mill Creek the water temperature was measured in the first step pool upstream from the confluence (between boulder weirs #5 and #6) for a 16.6 ºC and upstream from the concrete sill at 15.5ºC with the Ambient Air temperature of 22ºC.

The snorkel survey findings were relatively comparable between the effort on September 11, 2019 by PWA Fisheries Biologist and the HRC Fisheries Biologists effort on September 18, 2019. Both surveys confirmed there were no Sacramento pikeminnow found in Cooper Mill Creek and that Young of the Year (YOY) and one-plus (1+) trout (*Oncorhynchus mykiss mykiss*) were the most abundant salmonid species observed; there was one YOY coho salmon (*O. kisutch*) identified in a pool downstream from the concrete sill tucked under an overhanging bank in the September 11, 2019 survey. The other notable aquatic species observed during this PWA survey was Crayfish (*Procanbarus clarkii*), larval Pacific Giant Salamanders (*Dicamptodon tenebrosus*) and a sub-adult foothill yellow-legged frog (*Rana boylii*). Yager Creek presented a wider assemblage of fish species in both surveys. Sacramento pikeminnow (*P. grandis)*, California Roach (*Hesperoleucus symmetricus*), Sticklebacks (*Gastroileitis aculeatus*), and YOY and 1+ trout (*O. mykiss*). To be noted, in the PWA survey all trout were found close to the stream bottom and under boulder ledges.

4.2 Discussion

From this snapshot-in-time survey, the boulder weir arrangement and the concrete sill structure are low flow barriers for all salmonid species at all life cycle stages for upstream and downstream movement being that connective flow over the structures is absent. Additionally, these structures present an upstream migration barrier for adults until the flows are either sufficiently high enough in Cooper Mill Creek to flood the boulder weir step pool confluence. However, high velocities could become a hindrance to passage once the weirs become completely inundated unless backwatering occurs simultaneously from Yager Creek. Additionally, the step pools lack the depth and length to afford the area needed for an adult to initiate and sustain a leap over the obstacles heights. These structures will remain as seasonal barriers for juvenile salmonids seeking thermal refuge upstream for over summering rearing. The model clearly demonstrates these passage issues and further investigations need to be made to make recommendations for allowing salmonid access into Cooper Mill Creek for all or the identified life cycle stages.

5 CHANNEL PROFILE AND TOPOGRAPHIC SURVEYS

Total station surveys were conducted to collect profile and bathymetric information at the project site. Data was collected using Leica TCRA 1101 Plus and TOPCON GTS 225 Total Stations. All data was collected in relative elevation with an arbitrary base elevation set at 100 ft. A network of control points was established, providing reference points for subsequent topographic surveys primarily in the areas of interest associated with the two fish barrier sites. Collected survey points include thalweg, right edge of channel, and left edge of channel. The remaining topography presented in this preliminary drawing set is from LiDAR obtained from the The United States Geological Survey (USGS 2019). This LiDAR is made available through USGS via geomorphic and tectonic investigations associated with the Little Salmon Fault system. The LiDAR data exhibits a horizontal resolution of 1 meter. The merging of the survey data and LiDAR was completed using AutoCAD Civil 3D (C3D). Point data from the total station surveys was imported to C3D and breaklines were inserted, the outer boundary was offset 1 foot to create a boundary for merging the surfaces.

Total station point data was used in conjunction with LiDAR data to produce a Triangulated Irregular Network (TIN) surface. From the TIN, surface contours were generated allowing a general overview of the topography of the site. Sheet C-1 in Appendix A depicts the layout and long profile distance markers, in addition to acting as an index map (see red rectangles) representing zoomed in areas depicted in Sheets C-3 and C-5, of the two fish barriers. Sheet C-2 depicts the long profile channel thalweg survey for Cooper Mill Creek, which because of its length (3,100 ft.), had to be split into 3 separate graphics. The confluence of Cooper Mill Creek with Yager Creek (at 0+00 ft.) is depicted in the right-hand side of the top-most image, with distance increasing in the upstream direction (to the left in the graphics).

6 STREAM STAGE MONITORING

Water-level monitoring equipment was installed to provide data in support of the design process. Sheet C-1 in Appendix A depicts the water monitoring locations and their relative elevations for the project site, they are labeled as SP-1 and SP2. Water level and temperature measurement data collection began in early January, 2019 and continues to the present (as of September, 2019). Stream surface water monitoring initially included the installation of 2 staff plates (SP) to measure surface water elevations (Stage). SP-1 was installed in mainstem Yager Creek at the confluence of Cooper Mill Creek, and SP-2 was installed in Cooper Mill Creek approximately 0.2 mi. upstream of the confluence near the old fish hatchery. The staff plates consisted of T-posts installed in locations where they were protected and less likely to be impacted by woody debris in transport and not subjected to supercritical flow. In-stream pressure transducers (PT) were installed at both staff plates. The pressure transducers, including one to measure ambient air pressure, were set to record water depth and temperature at 30 minute intervals. Redundant monitoring took place to manually measure water surface elevations at intervals related to storm events and different stage levels to download PT data in case of device failure or loss. In September, 2019, two more in-stream PT gages were set up to capture additional data moving forward into the next wet weather season. They have not been in place long enough to be relevant for this technical memorandum.

Inspection of the pressure transducer plot for SP-1 (Figure 4, Appendix B), located in mainstem Yager, next to the mouth of Cooper Mill Creek, indicates that the uppermost boulder step weir (Weir #1) was inundated by high flow events over the wet weather season approximately 7 times, though for very brief periods. Note that one of these events happened during a rare high water event that occurred in May, 2019 (typically, high flows occur between December and April). Note that in both May and June of 2019, SP-1 was impacted by sediment deposition inside the pressure transducer guage casing, which caused small vertical “steps” in the data set, which can be observed in Figure 4. The data during this time frame should be adjusted downwards according to the magnitude of the data “steps” to more accurately depict the relative elevation of the water surface.

Inspection of the pressure transducer plot for SP-2 (Figure 5, Appendix B), located in mainstem Cooper Mill Creek, reveals that the water surface fluctuated a maximum of 3.5 ft. from the high water mark (81.1 ft. in late February, 2019), to summer low flow. Note also that at its peak, the water surface roughly corresponds with the foot bridge deck surface elevation (81.1 ft.), which used to serve as an old hatchery diversion structure. This indicates that the water surface may back up behind the foot bridge during the highest flow events (which roughly corresponded to a 2-year storm event). With the exception of some low lying inset floodplains within the active channel, it does not appear that Cooper Mill Creek overtopped its banks during winter high flow events.

7 HYDROLOGY

To determine the appropriate range of flows to consider in the fish passage analysis, the stream hydrology was assessed using historical gage data and flood regression equations. USGS maintained a stream flow and stage monitoring station (USGS Station #11479000) for Yager Creek near Carlotta from October 1953 to September 1972 with a 15 year period of record. Because there is no flow monitoring gage on Cooper Mill Creek a combination of flood regression equations and flow transference methods were used to determine flood flows and fish passage flows for hydraulic assessment.

The data from the USGS gage was used to develop exceedance flows for Yager and Cooper Mill Creeks. For Yager Creek, the flow data was translated downstream from the gage location to the project location at the mouth of Cooper Mill Creek. For Cooper Mill Creek the flow transference method was used to scale the measured flows to a smaller drainage area. Based on the gage data, flood flows typically occur between late December and mid-April.

7.1 Flow Transference

Average daily flow data from the USGS gage was used as the baseline data from which scaled flows for the project site were calculated. The drainage areas for Cooper Mill Creek and Yager Creek at the confluence were obtained from StreamStats. Cooper Mill Creek has a drainage area of 3.9 sq. mi. and Yager Creek at the confluence has a drainage area of 128.4 sq. mi. (Table 1). The results in drainage area ratios of *C*. The gage flows were multiplied by this ratio to obtain the estimated project flows, as shown below.

$$Estimated\ Flow\ (cfs) = Gage\ Flow(cfs) * C$$

Table 1. Basin Characteristic from StreamStats for Yager Creek and Cooper Mill Creek

	Drainage Area (Sq. Mi.)	**Mean Annual Precipitation (in)**	**DA Ratio, *C***
USGS 11479000	127	68.1	--
Yager Creek at Confluence	128.4	68.1	1.01
Cooper Mill Creek	3.9	58.1	0.03

7.2 Flow Duration Curves

A flow duration curve was developed using the measured flows from 1953 to 1972 for Yager Creek. Flow values were sorted in order from highest to lowest and assigned a rank (M) starting with 1 for the highest flow. The probability of exceedance for each flow was calculated using the rank and the total number of days in the flow record (n). The equation below shows how the probabilities were calculated.

$$Probability\ of\ Exceedance = 100 * \frac{M}{n+1}$$

Where,

P = the probability that a given flow will be equaled or exceeded (% of time annually)

M = the ranked position on the listing (dimensionless)

n = the number of events for period of record (dimensionless)

The flow duration curve for Yager Creek at USGS gage 11479000 is shown in Figure . The flows used to construct this curve are average daily flows, therefore a 1.0% exceedance flow can be expected 3.7 times per year (1% of the time).

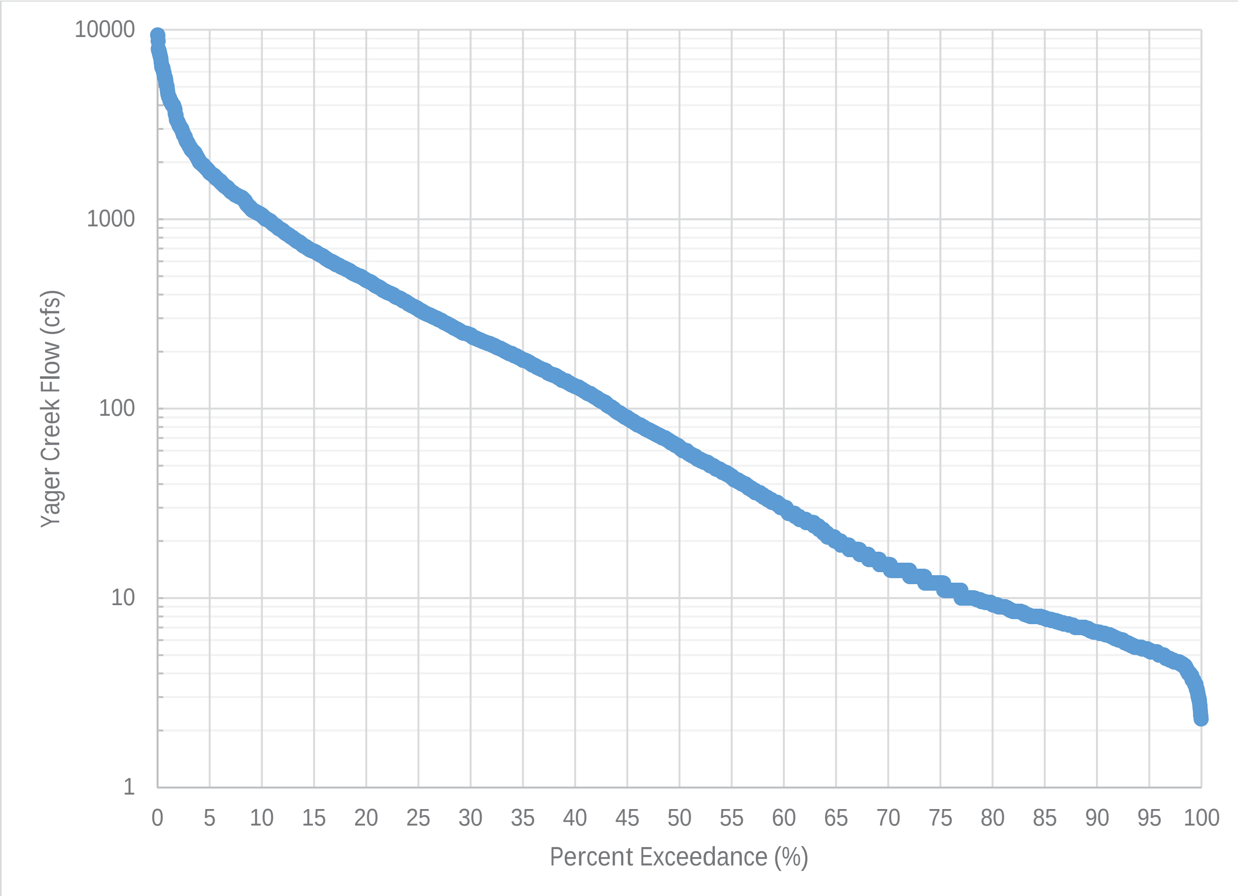

Figure 4. Flow Duration Curve for Yager Creek at USGS gage #11479000

7.3 Fish Passage Flows

To evaluate fish passage in Cooper Mill Creek under existing conditions, channel velocities, depths and water surface differences at each weir were analyzed under the fish passage design flows. Exceedance flows from the gage daily average flow and flow transference, developed for coho based on lifestage were used for this assessment.

Fish passage flows are typically calculated from average daily flows during the target species migration period. The 95 percent annual exceedance probability is commonly used for low flow fish passage and the 5 percent annual exceedance probability is often used for high flow fish passage design (Furniss 2006) and Searcy (1959) recommends a minimum of 10 years of record be used to develop exceedance probability values. However, for this assessment we are looking at assessing the existing barriers in Cooper Mill Creek for passage of adult and juvenile coho throughout the year. Recommended adult coho low and high flow fish passage exceedance flows are the 50% and 1% annual exceedance, whereas juvenile low and high flows are the 95% and 10% exceedance flows (CDFG 2002).

To evaluate the extent to which the current conditions are barriers, passage was assessed under lower and upper fish passage flow for both adult and juvenile coho. Upper fish passage flows are typically used for determining the passage under maximum water velocities, but for the Cooper Mill Creek project it also allows for assessing the system under higher backwater conditions from Yager Creek, thus minimizing water velocities at the mouth of Cooper Mill Creek. Lower fish passage flows can be used to determine minimum water depth through the barriers along with assessing the maximum step height at each weir. The upper and lower fish passage flows as percent annual exceedance flows were applied to both Yager and Cooper Mill Creeks (Table 2). Alternate minimum flows of 3 cfs for adult coho and 1 cfs for juvenile coho are used when estimated values are lower.

Table 2. Upper and lower fish passage flows for Yager and Cooper Mill Creeks.

Species/Lifestage/Threshhold	**% Annual Exceedance**	**Yager Ck Flow (cfs)**	**Cooper Mill Ck Flow (cfs)**	**Alternate Minimum Flow (cfs)**
Coho/Adult/Low	50%	**63**	2	**3**
Coho/Adult/High	1%	**4661**	**142**	3
Coho/Juvenile/Low	95%	**5.4**	0.2	**1**
Coho/Juvenile/High	10%	**1062**	**32**	1

7.4 Peak Floods

Flood quantiles are required to understand the forces exerted on the channel boundaries for future design purposes. To estimate peak floods, we applied the online USGS StreamStats1 program. This analysis was applied to both Cooper Mill Creek and Yager Creek at the Confluence.

Table 3. Flood quantiles at the project site.

Recurrence interval (years)	Cooper Mill Creek ($ft.^3/s$)	Yager Creek ($ft.^3/s$)
2	338	9290
5	624	15600
10	828	20000
25	1100	25600
50	1300	29800
100	1510	34000
500	1970	43100

8 HYDRAULICS

8.1 Hydraulic Model Setup

Survey data and LiDAR were combined with the flow estimates developed from the hydrologic analysis to develop a one-dimensional, steady-state hydraulic model using the U.S. Army Corps of Engineers' HEC-RAS program Version 5.0.62. The program calculates average hydraulic characteristics in each cross section.

Geometric data for the model were first established in AutoCAD Civil 3D and then exported to HEC-RAS. Alignments representing the thalwegs of Cooper Mill and Yager Creeks were drawn through the

1 https://www.usgs.gov/mission-areas/water-resources/science/streamstats-streamflow-statistics-and-spatial-analysis-tools?qt-science_center_objects=0#qt-science_center_objects
2 https://www.hec.usace.army.mil/software/hec-ras/downloads.aspx

TIN model to define the downstream reach lengths between cross sections. Hydraulic cross sections were overlaid onto the surveyed cross sections. A total of 22 cross sections were used for the Cooper Mill Creek reach and 4 cross sections were used for the Yager Creek reach of the model (Figure). Yager Creek was included in the model to represent backwater impacts on Cooper Mill Creek during various flood flow conditions.

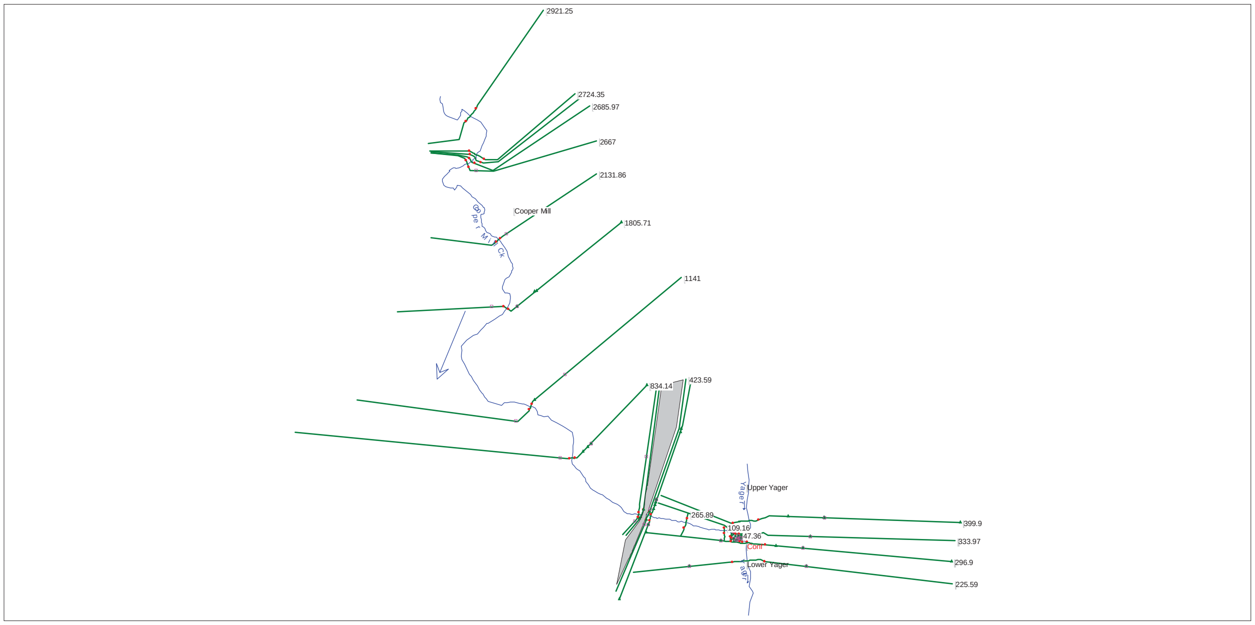

Figure 5. Cross section locations at the Cooper Mill Creek project site. Cross sections for the hydraulic model were located at surveyed cross sections.

Roughness values (Manning’s n) were estimated in every cross section using the method of Arcement and Schneider (1989) which accounts for hydraulic roughness, vegetation, variations in cross sections, and flow obstructions. The roughness values used for the main channels of Cooper Mill and Yager were 0.065 and 0.075 respectively. In the floodplain for both Cooper Mill and Yager Creeks, we specified a value of 0.1. The normal depth of Cooper Mill Creek was set as the upstream boundary condition based on the general slope of 0.015 ft./ft.. The normal depth of Yager Creek was set as the upstream and downstream boundary condition based on the general slope of 0.003 ft./ft.. The active mainline bridge crossing was included in the Cooper Mill reach at station 4+36 (gray zone in Figure 2).

8.2 Model Results and Fish Passage Assessment

The fish passage flows were input into the HEC-RAS existing conditions hydraulic model to determine resultant velocities, depths, water surface drops and evaluate fish passage conditions. This assessment is focused on two project sites:

- Cooper Mill confluence (mouth) which encapsulates the 6 boulder weirs at the mouth of Cooper Mill Creek between stations 0+20 and 0+67, and
- Cooper Mill legacy water diversion (sill) which includes the 3 boulder weirs below and including the concrete sill located between stations 26+67 and 27+24.

The highest velocities modeled at the adult high fish passage flow through the project sites are 3.9 ft./s (mouth) and 6.0 ft./s (sill), and the highest velocities modeled at the juvenile high fish passage flow are 8.3 ft./s (mouth) and 4.0 ft./s (sill). HEC-RAS velocities are an average velocity across the entire cross-section. Thus, higher and lower velocities will occur within a cross-section, especially near the channel bed where turbulent eddies can provide resting areas for fish. The boulder, cobble, and pool channel likely provides frequent velocity breaks where fish may hold and rest during migration. While velocity is typically the concern for fish passage at high flow, depth is usually the critical parameter at low flow. The lowest channel depths modeled at the adult low fish passage flow through the project sites are 0.2 ft. (mouth) and 0.2 ft. (sill), and the lowest juvenile low fish passage flow depths are 0.1 ft. (mouth) and 0.2 ft. (sill). Modeled depths were at their lowest under low flow conditions but grade drops between weirs displayed large differences under both lower and upper passage flows. The maximum jump heights for adult passage flows are 2.5 ft. (mouth) and 1.5 ft. (sill), and for juvenile passage flows, maximum jump heights are 3.8 ft. (mouth) and 1.5 ft. (sill).

Modeled results were compared with documented swimming abilities, depth requirements, and jump heights (CDFW 2013a, CDFG 2002, Thompson 1972). For each lifestage the requirements used for passage assessment are shown in Table 4.

Table 4. Fish passage assessment criteria for coho lifestage.

	Maximum Drop (ft.)	Minimum Depth (ft.)	Maximum Velocity (ft./sec)
coho (adult)	1.0	0.7	8.0
coho (juvenile)	0.5	0.3	4.0

Fish passage is dependent on fish size, swimming and leaping ability as they relate to water depths, water velocities, and grade drops that may hinder or prevent passage. Fish swimming speed also varies by lifestage, swimming mode (e.g. burst or coast), size of the fish, and the duration of the activity. Natural rivers have in-stream roughness elements that create turbulent flow and macroeddies that create variable water velocities, as well as quiescent conditions used as resting habitat. Fish in these conditions can use this variability to aid their movements. Flood conditions also alter depth, velocity, and barrier hydraulics, and can create passable conditions at varying flows. However, the conditions in the computer model do not fully account for microhabitat, interstitial spacing, local turbulence, and changes in velocity across the cross-section. The existing conditions likely have low velocity conditions in boundary layers, interstitial spaces, and backwater areas to provide additional hydraulic diversity to facilitate migration. A more reliable assessment criteria utilizing the hydraulic model is step height or water surface grade drop that demonstrates the jumping requirements between grade controls.

Model results demonstrated that passage through the mouth project site occurred only under Coho adult high fish passage flow conditions. Barriers in the mouth project area were primarily based on jump heights required to clear the majority of the boulder weir structures. Passage assessment at the sill project site demonstrated that there is no passage for either lifestage, at either upper or lower fish passage flows, with the concrete sill being a barrier due to step height.

Hydraulic model results are provided for existing conditions in the mouth and sill project sites in Table 5 and Table 6 respectively.

Table 5. Cooper Mill Creek mouth project site fish passage model assessment results.

Location	Barrier Type	River Station	Species/Lifestage/ Threshhold	Exceedance Flow	Velocity	Max Channel Depth	Water Surface Difference	Results
					(ft/s)	(ft)	(ft)	
Cooper Mill Mouth Near Yager Creek Confluence	Weir 6	0+20	Coho/Adult/Low	50%	1.8	0.2	2.4	BARRIER
			Coho/Adult/High	1%	0.9	9.5	0.4	PASSAGE
			Coho/Juvenile/Low	95%	1.4	0.1	3.8	BARRIER
			Coho/Juvenile/High	10%	0.7	2.9	0.2	PASSAGE
	Weir 5	0+30	Coho/Adult/Low	50%	5.8	2.3	0.3	PASSAGE
			Coho/Adult/High	1%	0.8	11.2	0.0	PASSAGE
			Coho/Juvenile/Low	95%	1.4	2.4	0.5	PASSAGE
			Coho/Juvenile/High	10%	1.1	4.6	0.0	PASSAGE
	Weir 4	0+40	Coho/Adult/Low	50%	2.7	1.9	2.5	BARRIER
			Coho/Adult/High	1%	1.2	8.4	0.0	PASSAGE
			Coho/Juvenile/Low	95%	2.0	1.8	2.3	BARRIER
			Coho/Juvenile/High	10%	8.3	2.3	0.5	BARRIER
	Weir 3	0+47	Coho/Adult/Low	50%	2.0	1.7	2.0	BARRIER
			Coho/Adult/High	1%	1.4	6.2	0.0	PASSAGE
			Coho/Juvenile/Low	95%	1.5	1.6	2.1	BARRIER
			Coho/Juvenile/High	10%	4.1	2.2	2.1	BARRIER
	Weir 2	0+57	Coho/Adult/Low	50%	1.3	1.7	0.3	PASSAGE
			Coho/Adult/High	1%	2.1	5.8	0.0	PASSAGE
			Coho/Juvenile/Low	95%	0.6	1.4	0.1	PASSAGE
			Coho/Juvenile/High	10%	8.3	2.1	0.3	BARRIER
	Weir 1	0+67	Coho/Adult/Low	50%	2.7	0.4	2.2	BARRIER
			Coho/Adult/High	1%	3.9	2.4	0.0	PASSAGE
			Coho/Juvenile/Low	95%	2.1	0.3	2.3	BARRIER
			Coho/Juvenile/High	10%	3.9	1.0	2.3	BARRIER

Table 6. Cooper Mill Ck sill project site fish passage model assessment results.

Location	Barrier Type	River Station	Species/Lifestage/ Threshhold	Exceedance Flow	Velocity	Max Channel Depth	Water Surface Difference	Results
					(ft/s)	(ft)	(ft)	
Cooper Mill at Concrete Sill	Weir 3	26+67	Coho/Adult/Low	50%	1.4	1.0	0.0	PASSAGE
			Coho/Adult/High	1%	2.9	4.1	0.0	PASSAGE
			Coho/Juvenile/Low	95%	1.0	0.7	0.0	PASSAGE
			Coho/Juvenile/High	10%	1.9	2.5	0.0	PASSAGE
	Weir 2	26+86	Coho/Adult/Low	50%	2.7	0.4	1.0	BARRIER
			Coho/Adult/High	1%	3.4	2.7	0.1	PASSAGE
			Coho/Juvenile/Low	95%	2.2	0.2	1.1	BARRIER
			Coho/Juvenile/High	10%	3.0	1.1	0.2	PASSAGE
	Weir 1	27+08	Coho/Adult/Low	50%	1.4	0.3	1.5	BARRIER
			Coho/Adult/High	1%	6.0	1.5	0.3	PASSAGE
			Coho/Juvenile/Low	95%	1.0	0.2	1.5	BARRIER
			Coho/Juvenile/High	10%	4.0	0.7	1.1	BARRIER
	Concrete Sill	27+24	Coho/Adult/Low	50%	2.0	0.2	1.4	BARRIER
			Coho/Adult/High	1%	4.8	1.2	1.2	BARRIER
			Coho/Juvenile/Low	95%	1.3	0.2	1.4	BARRIER
			Coho/Juvenile/High	10%	3.1	0.7	1.5	BARRIER

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Certification and Limitations

This report, entitled Physical Characterization for the Cooper Mill Fish Passage improvement Design Project was prepared by or under the direction of a licensed certified engineering geologist at Pacific Watershed Associates Inc. (PWA), and all information herein is based on data and information collected by PWA staff. The subsurface investigation analysis for the project, as well as engineering design recommendations, were similarly conducted by, or under the responsible charge of, a California licensed professional geologist or certified engineering geologist at PWA.

The characterizations presented in this report are based on a study of inherently limited scope. Observations are qualitative, or semi-quantitative, and confined to surface expressions of limited extent and shallow borings of subsurface materials. Interpretations of problematic geologic and geomorphic constraints and erosion processes are based on the information available at the time of the study, and on the nature, distribution and exposure of existing features.

The characterizations 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 this report should be re-evaluated after a period of no more than three years. It is the responsibility of the project engineer and project proponent to ensure that all recommendations in this report are reviewed and implemented according to the conditions existing at the time of construction. Also, PWA, including the licensed professionals, are not responsible for recommendations implemented outside of their professional oversight. 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:

Thomas H. Leroy, Certified Engineering Geologist # 2593
Pacific Watershed Associates Inc.

Attachments:

Map 1. Project location topographic map for the Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California. .(Back of Report)

Map 2. Project extent, existing site conditions and site specific pertinent features related to the Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California. .(Back of Report)

Map 3. Geologic and geomorphic map of the Cooper Mill Creek Coho Salmon Fish Passage Design Project area, Humboldt County, California. .(Back of Report)

Map 4. Historic channel paths and channel migration zone in the vicinity of the Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California. .(Back of Report)

Table 7. Basin Characteristic from StreamStats for Yager Ck and Cooper Mill Creek

Table 8. Upper and lower fish passage flows for Yager and Cooper Mill Creeks.

Table 9. Flood quantiles at the project site.

Table 10. Fish passage assessment criteria for coho lifestage.

Table 11. Cooper Mill Ck mouth project site fish passage model assessment results.

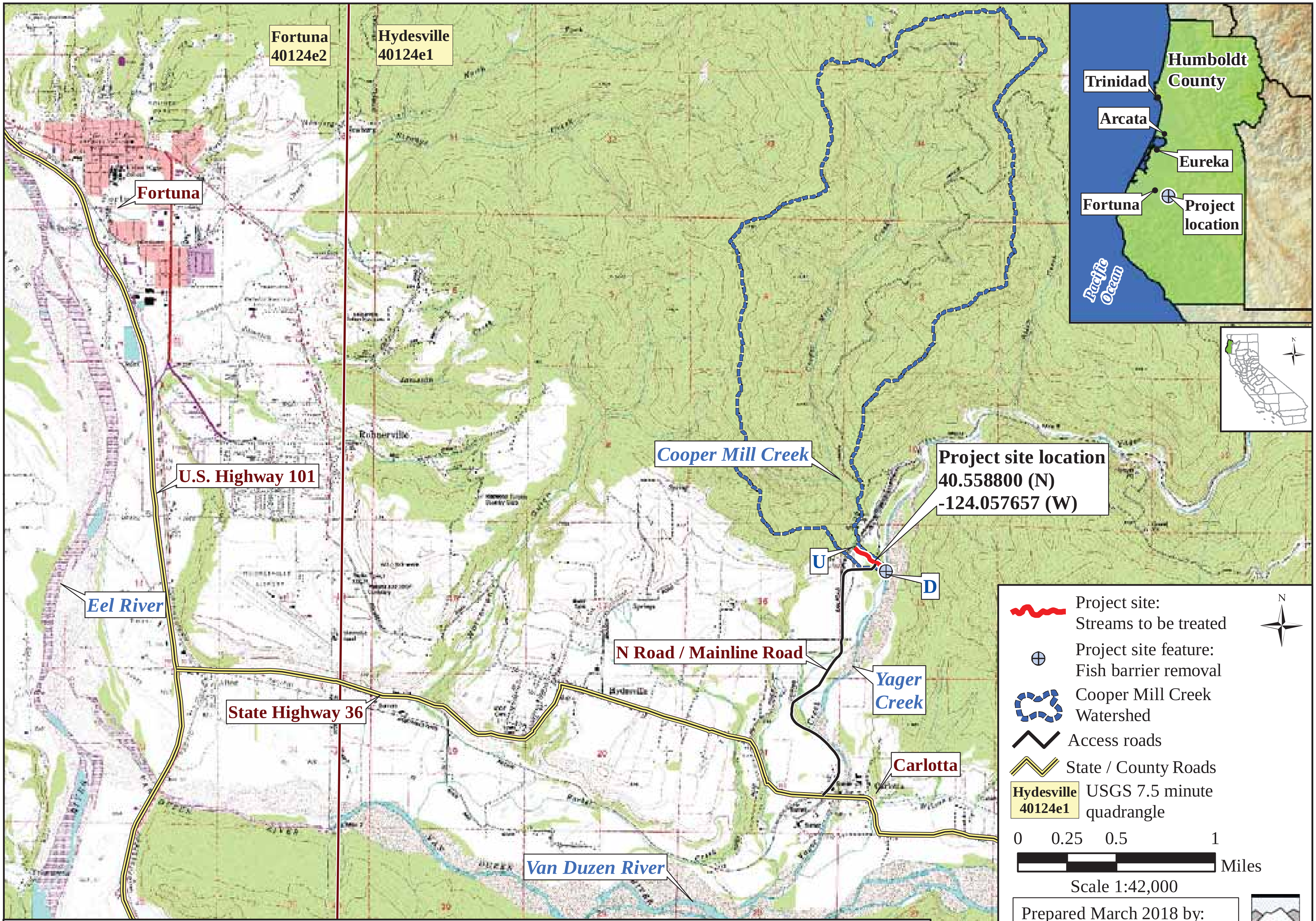
Table 12. Cooper Mill Ck sill project site fish passage model assessment results.

Figures 1-3. Typical subsurface stratigraphy of the Cooper Mill Fish passage design project vicinity, Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California.(Back of Report)

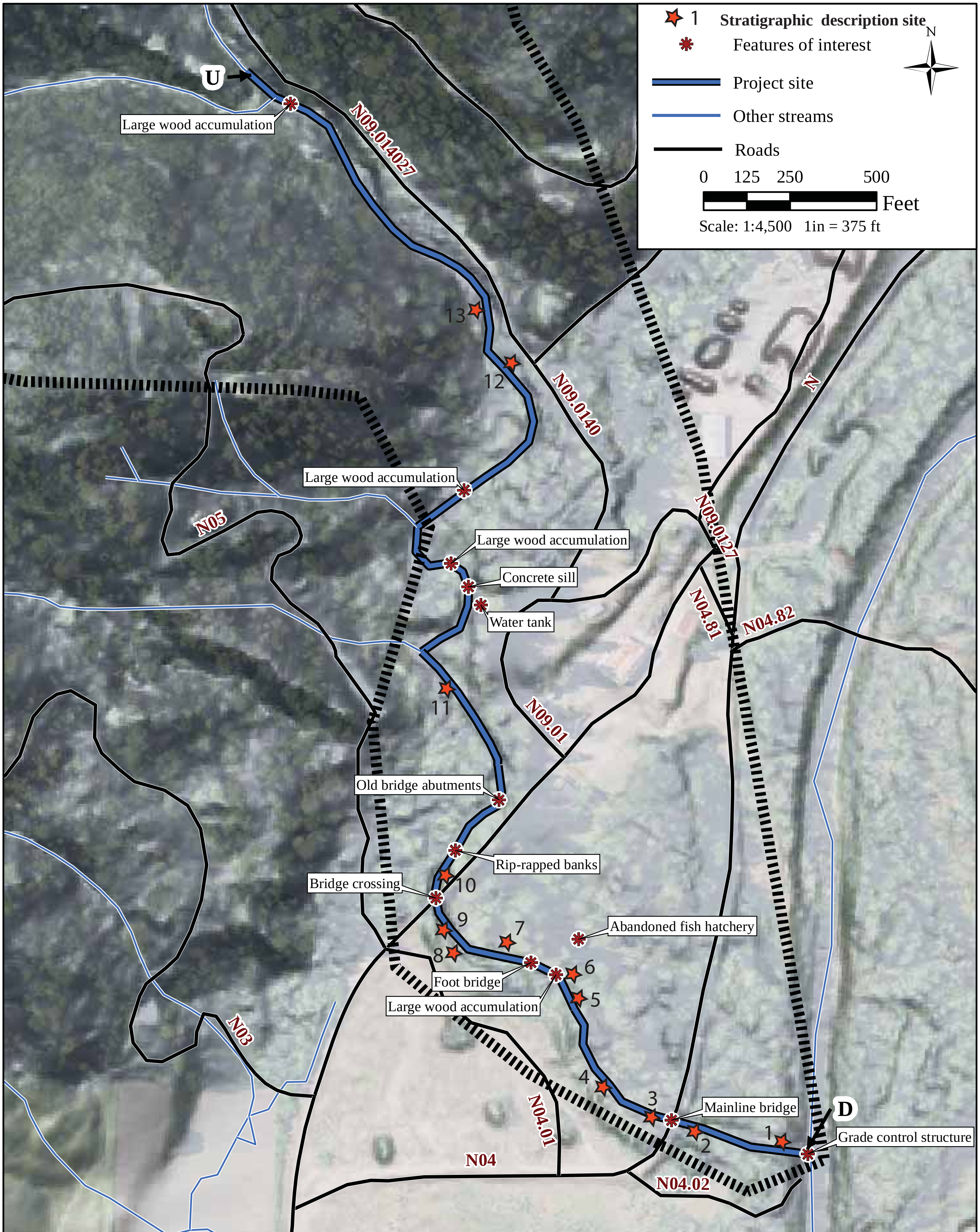
Figure 4. Flow Duration Curve for Yager Creek at USGS gage #11479000

Figure 5. Cross section locations at the Cooper Mill Creek project site. Cross sections for the hydraulic model were located at surveyed cross sections.

Appendix A
Engineered Drawings, Cooper Mill Fish Passage Design Project
C-1 Project Overview
C-2 Cooper Mill Creek Channel Profile
C-3 Cooper Mill Mouth Plan and Profile View
C-4 Cooper Mill Mouth Cross Sections
C-5 Cooper Mill Concrete Sill Area Plan and Profile View
C-6 Cooper Mill Concrete Sill Area Cross Sections
C-7 Cooper Mill Creek Cross Sections



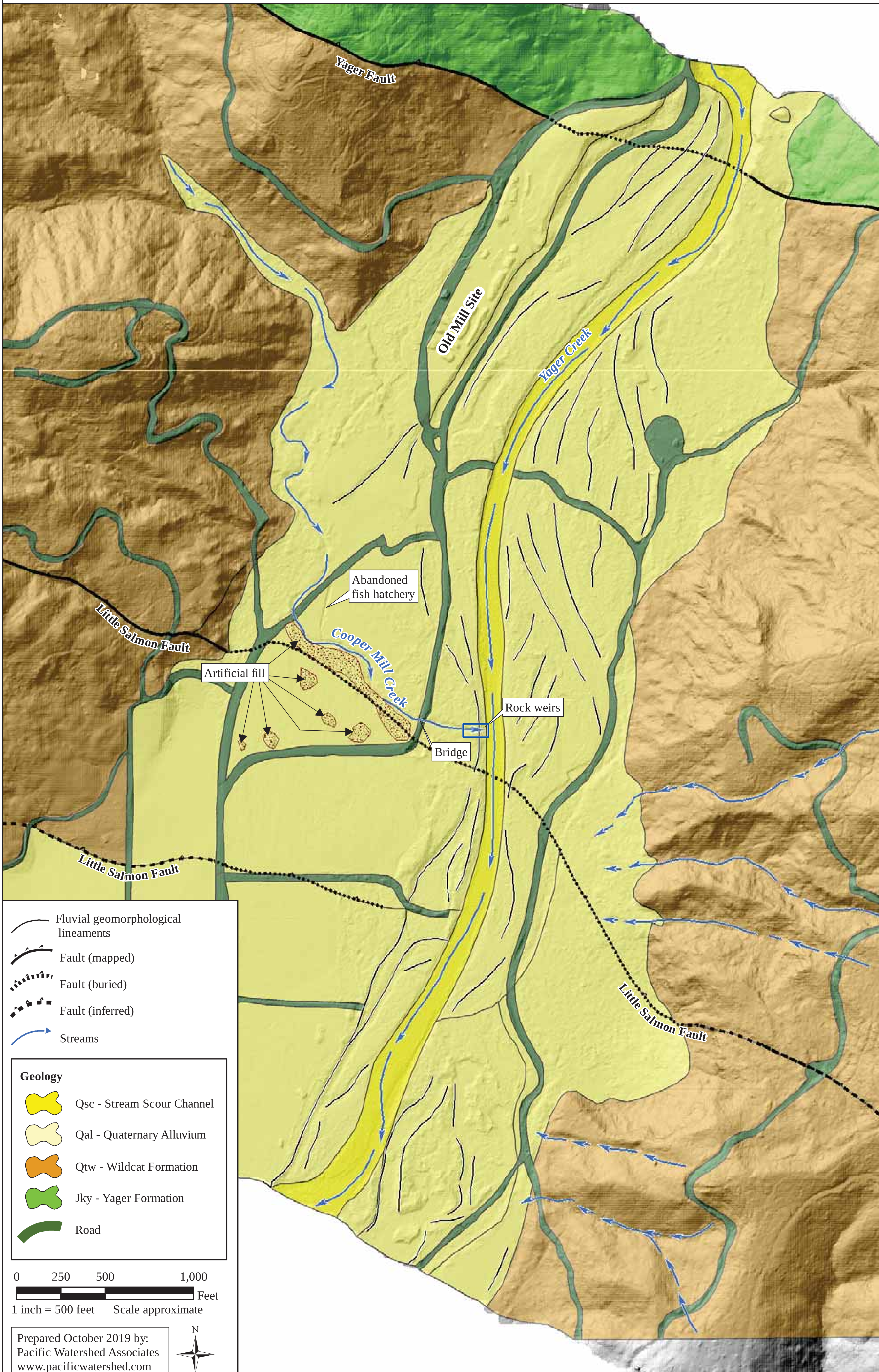
Map 1. Project location topographic map for the Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California. Grantee: Trout Unlimited



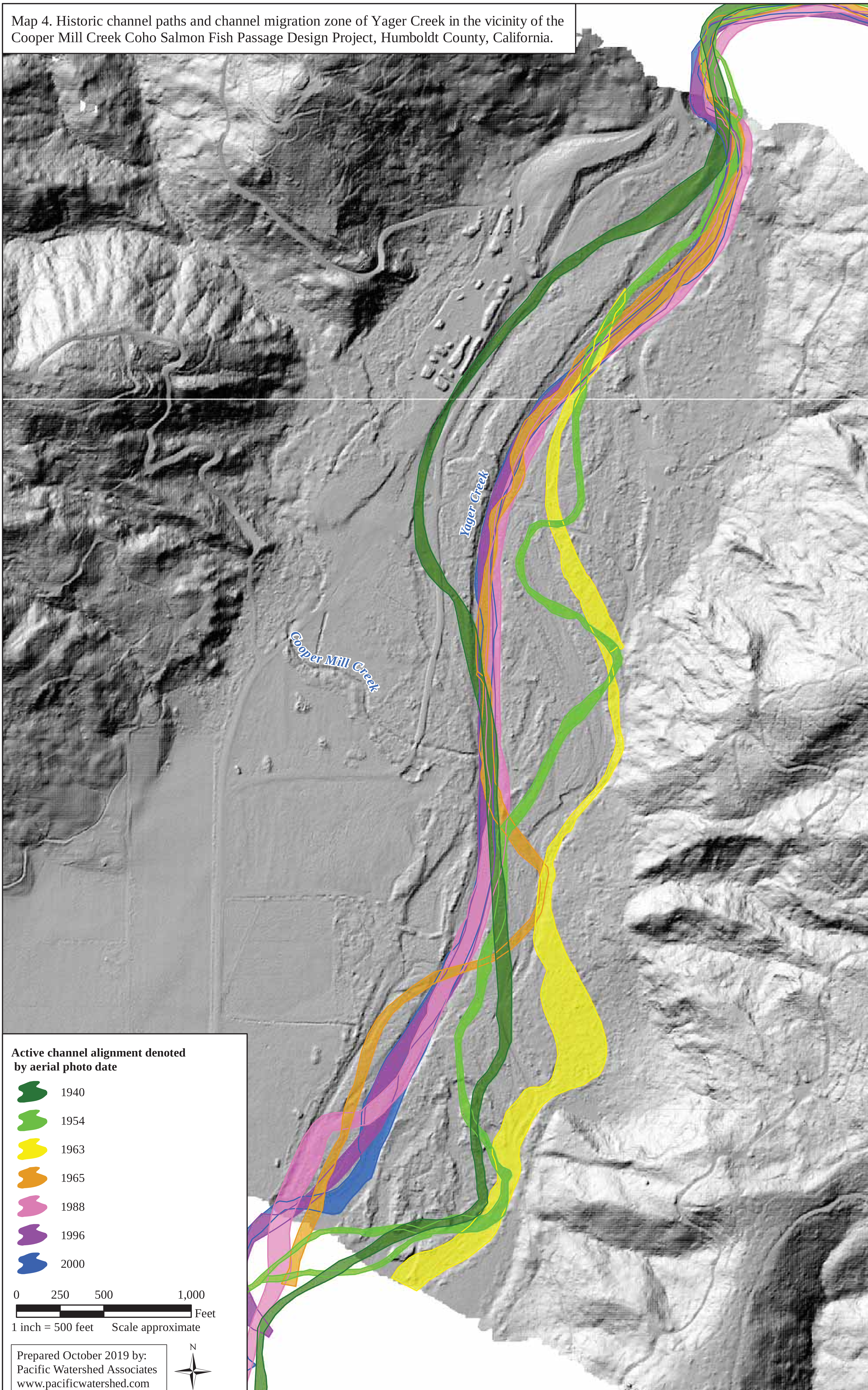
Map 2. Project extent, existing site conditions and site specific pertinent features related to the Cooper Mill Fish Passage site characterization project, Humboldt County, CA

Grantee: Trout Unlimited

Map 3. Geologic and geomorphic map of the Cooper Mill Creek Coho Salmon Fish Passage Design Project area, Humboldt County, California.



Map 4. Historic channel paths and channel migration zone of Yager Creek in the vicinity of the Cooper Mill Creek Coho Salmon Fish Passage Design Project, Humboldt County, California.



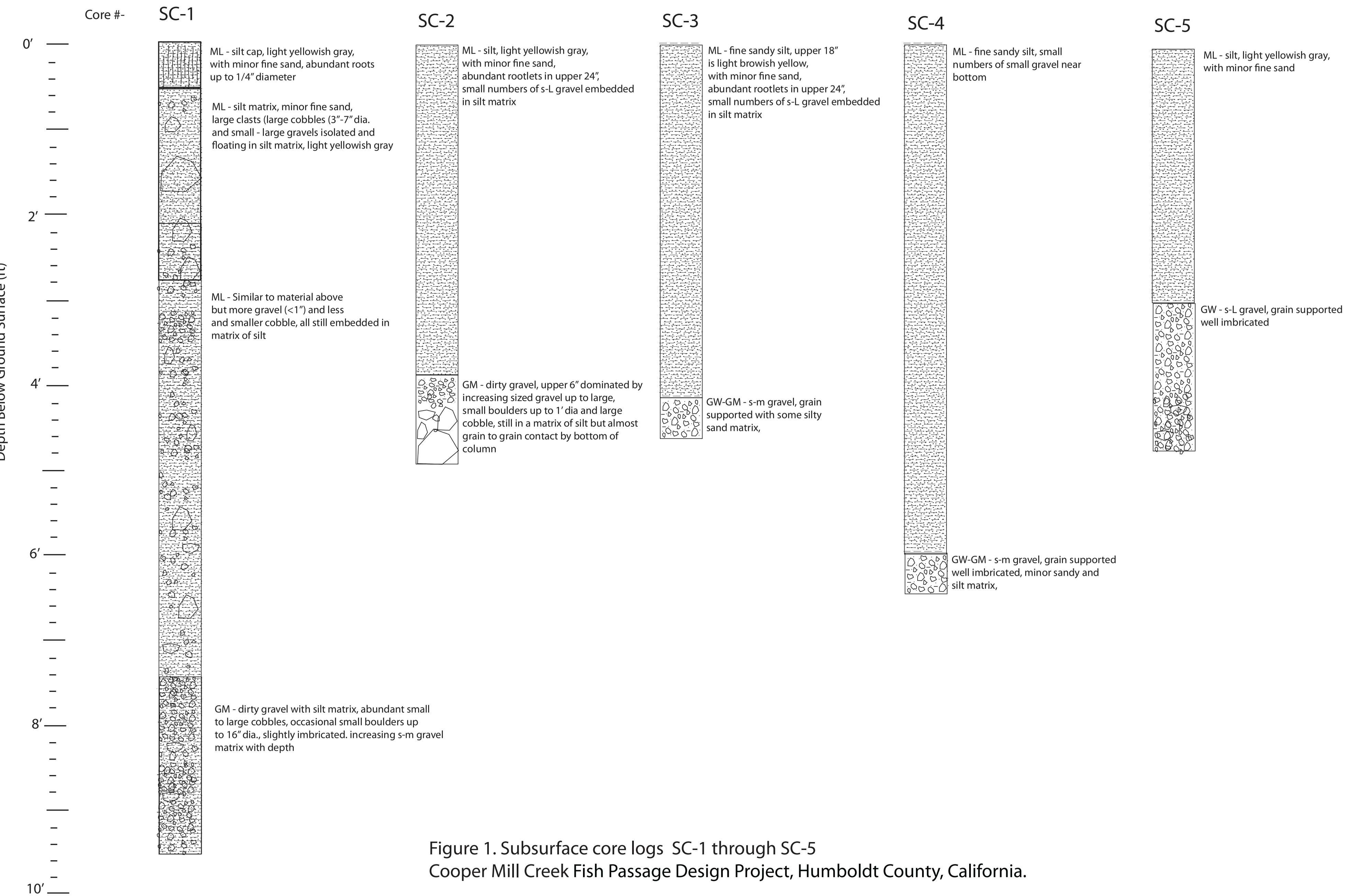


Figure 1. Subsurface core logs SC-1 through SC-5
Cooper Mill Creek Fish Passage Design Project, Humboldt County, California.

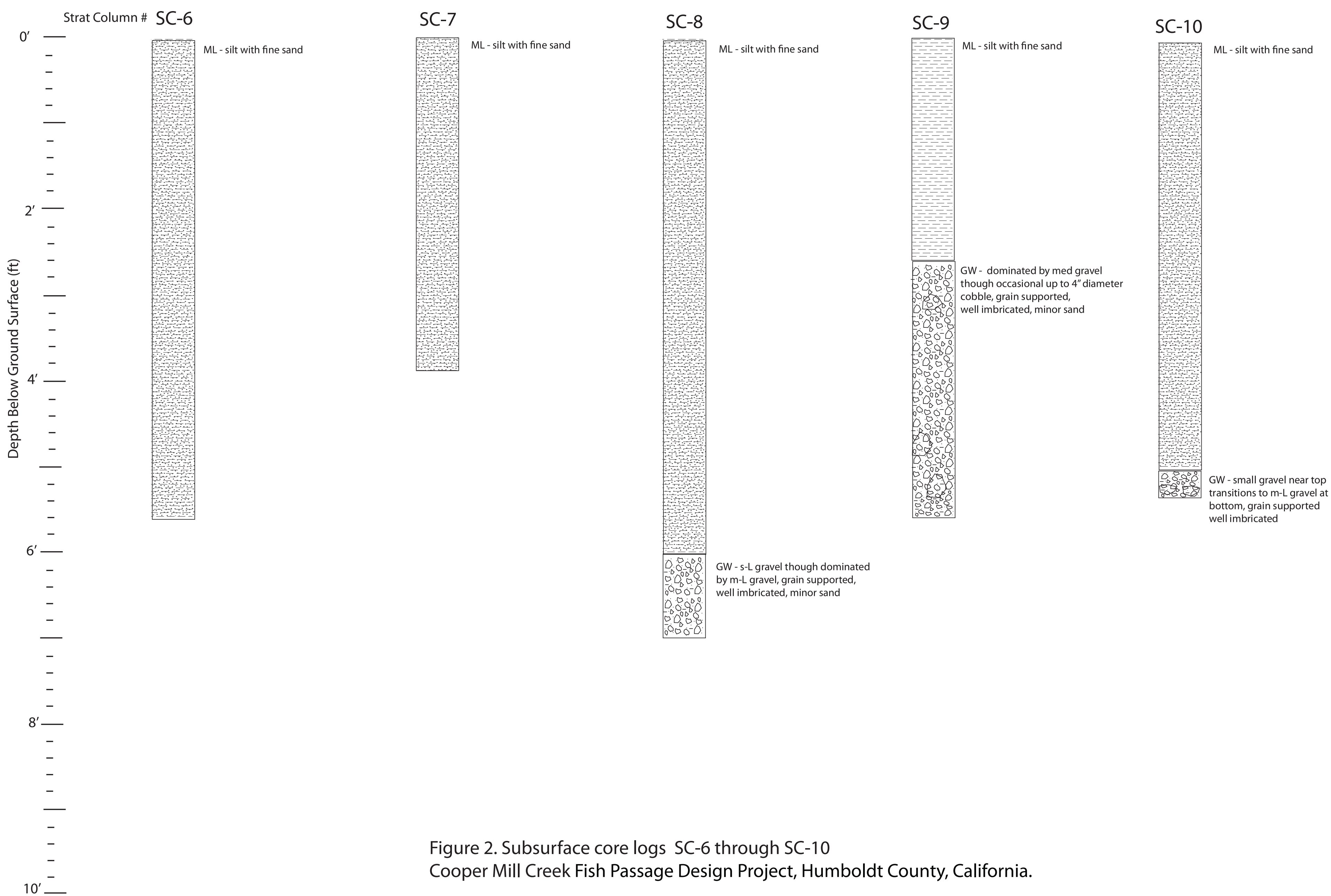


Figure 2. Subsurface core logs SC-6 through SC-10
Cooper Mill Creek Fish Passage Design Project, Humboldt County, California.

Appendix A

Engineered Drawings, Cooper Mill Fish Passage Design Project

C-1 Project Overview

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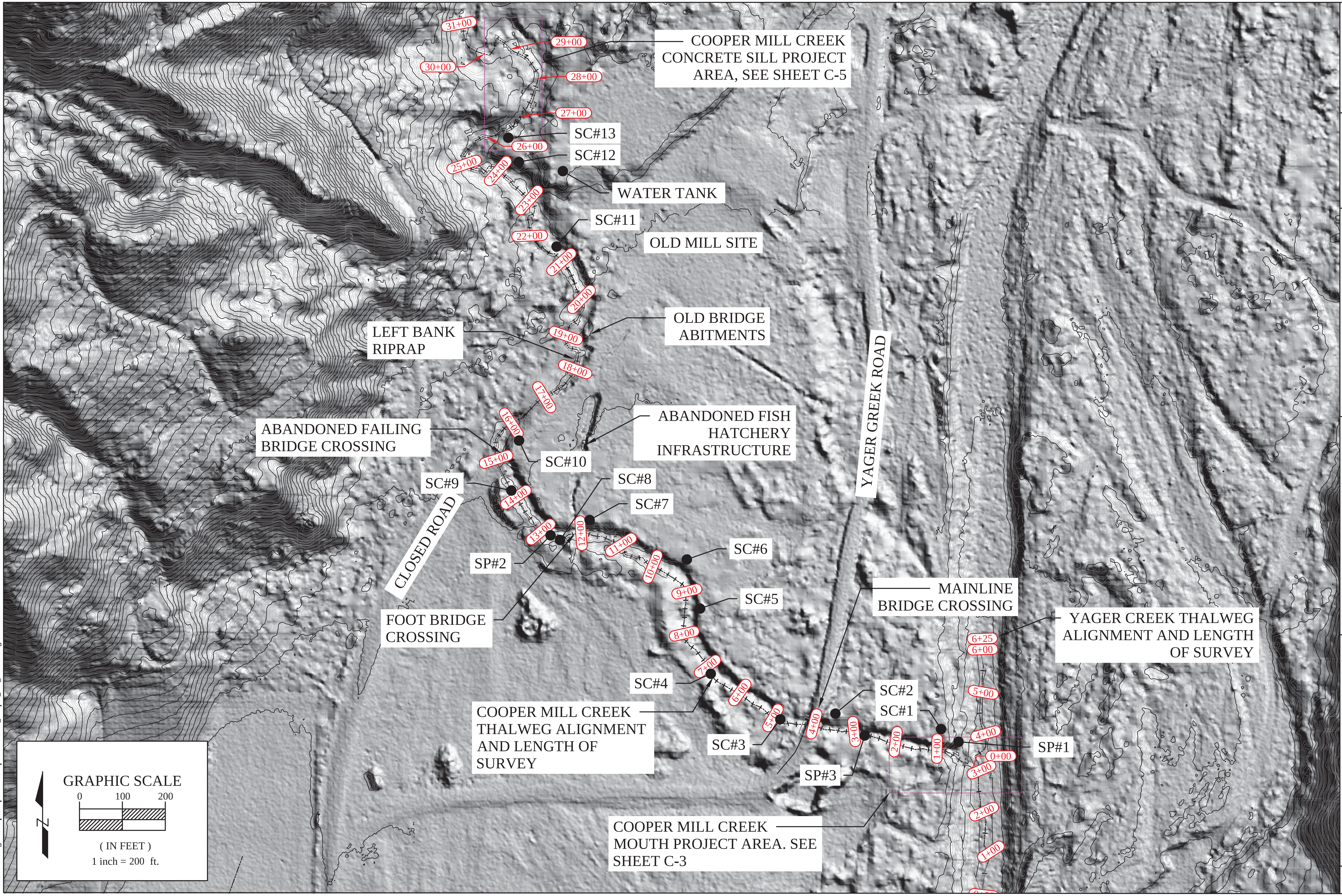
C-5 Cooper Mill Concrete Sill Area Plan and Profile View

C-6 Cooper Mill Concrete Sill Area Cross Sections

C-7 Cooper Mill Creek Cross Sections



DATE 10/4/2019

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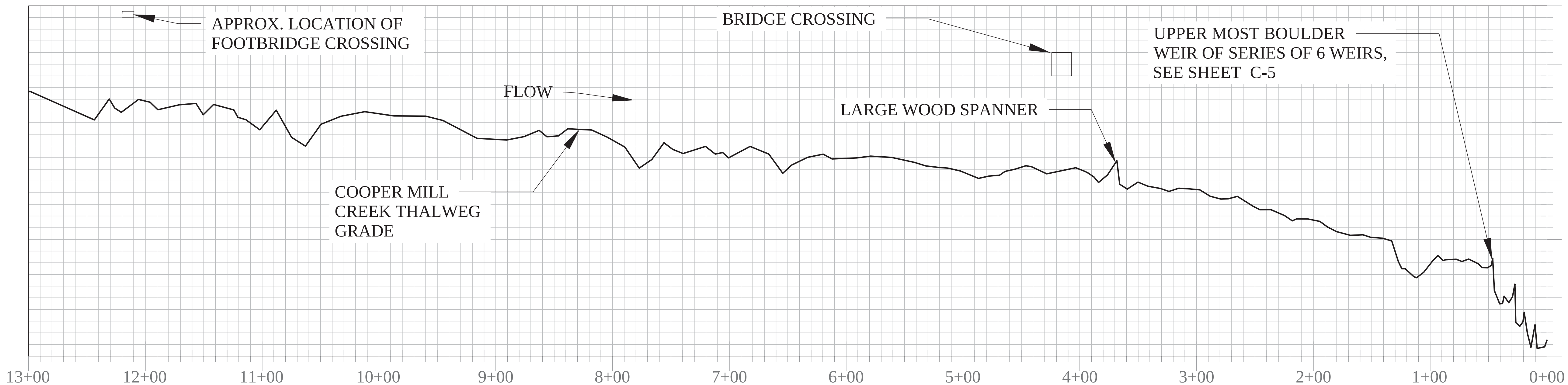
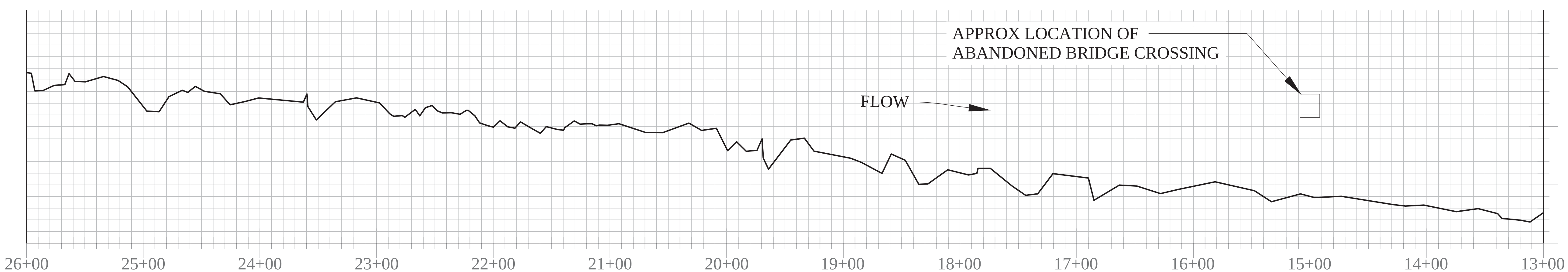
DRAWING DESCRIPTION:
PROJECT OVERVIEW

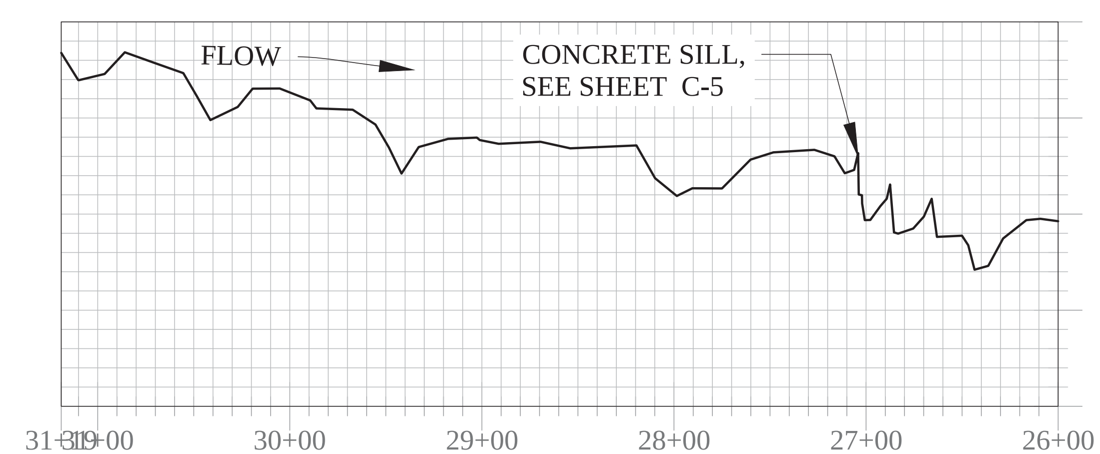
PROJECT LOCATION:
COOPER MILL OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO.: 10409

C-1







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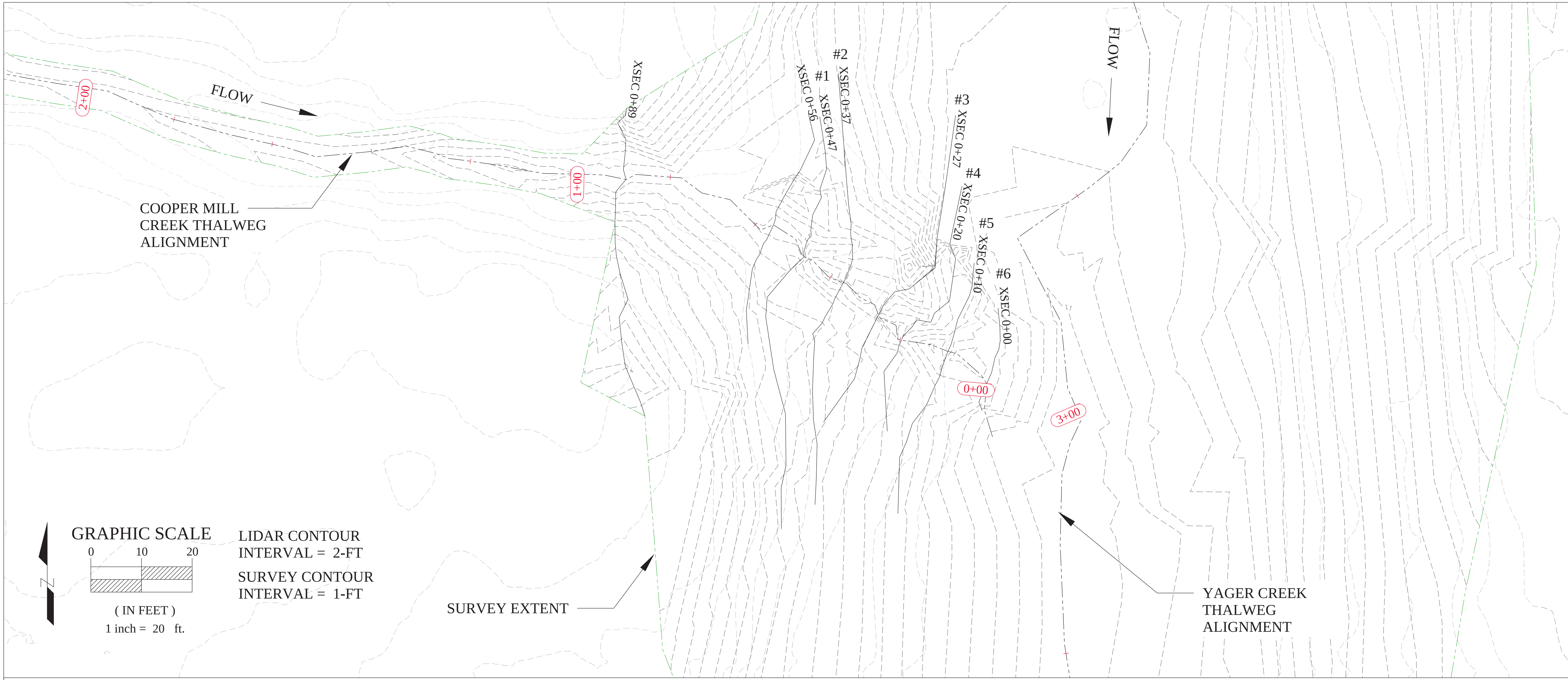
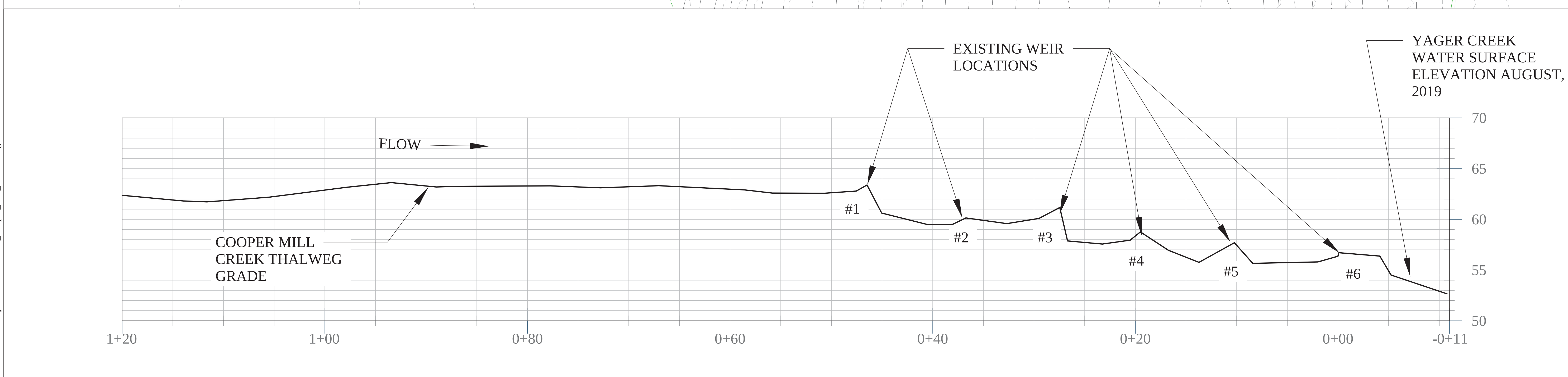
DRAWING DESCRIPTION:
COOPER MILL CREEK PROFILE

PROJECT LOCATION:
COOPER MILL CREEK
OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO.: 10409

C-2





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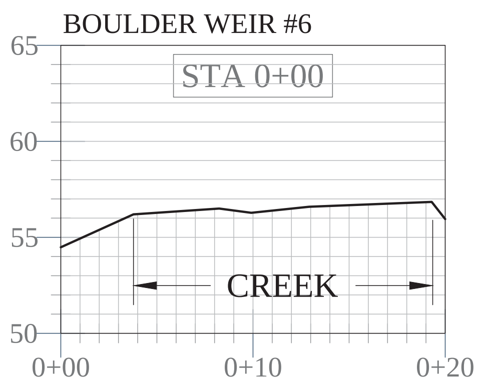
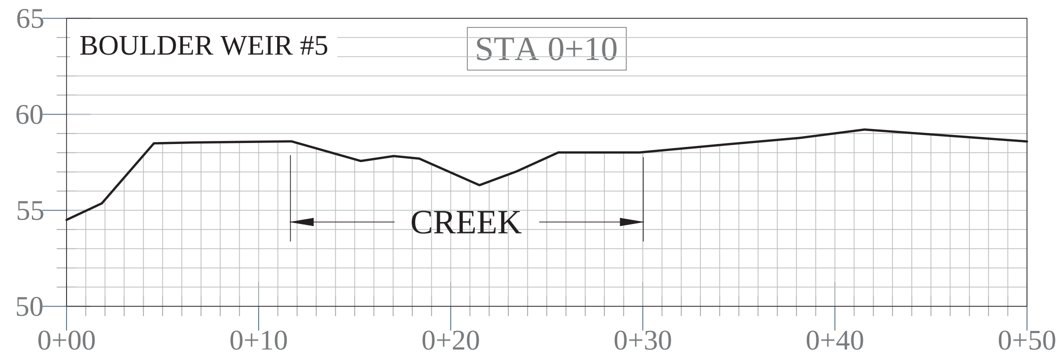
DRAWING DESCRIPTION:
COOPER MILL MOUTH PLAN
AND PROFILE VIEW

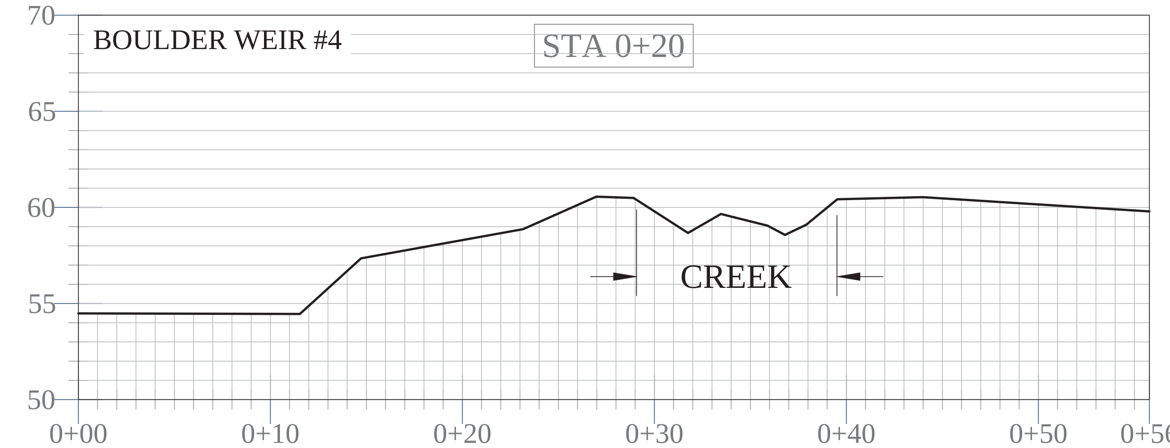
PROJECT LOCATION:
COOPER MILL CREEK
OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

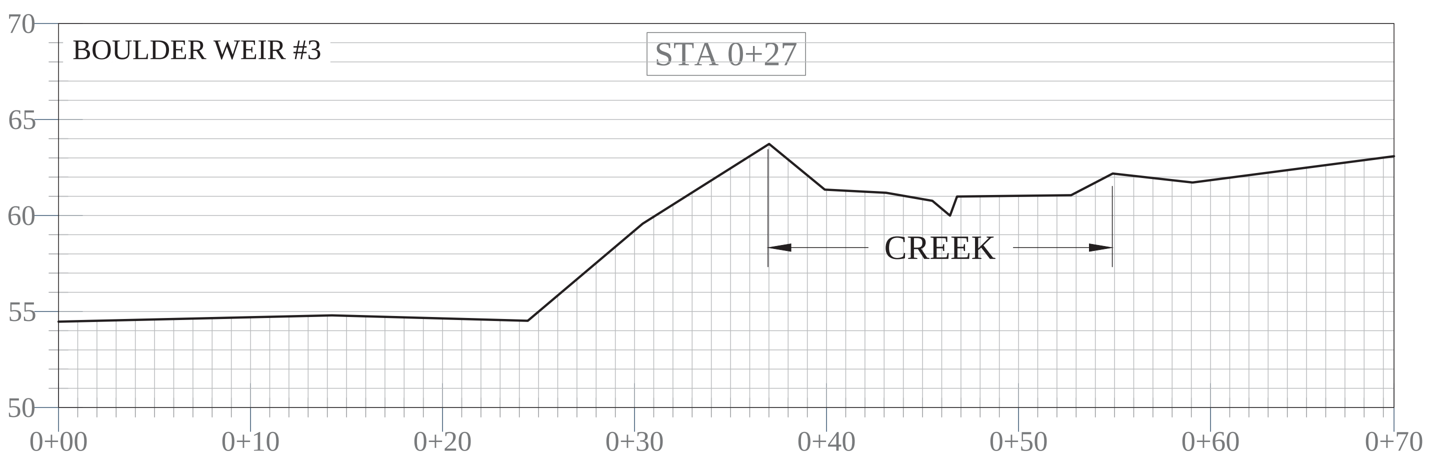
PWA JOB NO.: 10409

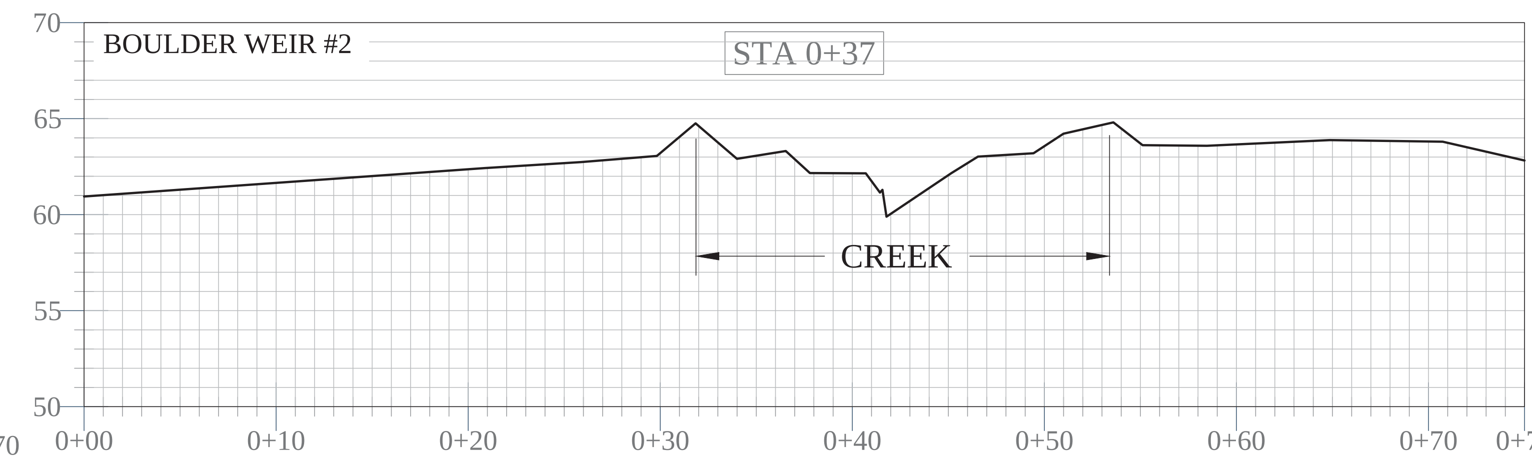
C-3

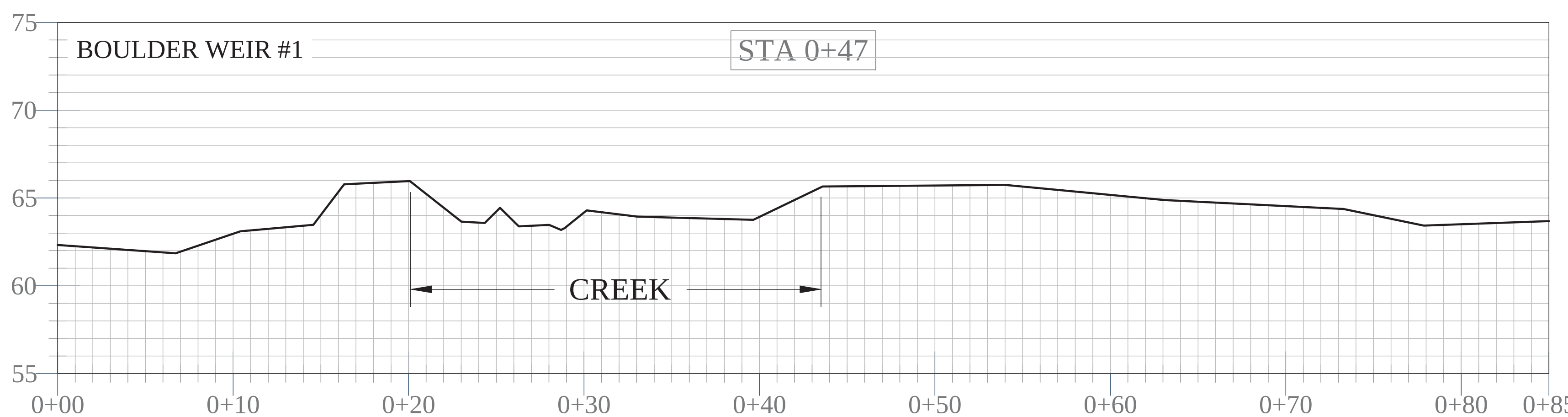


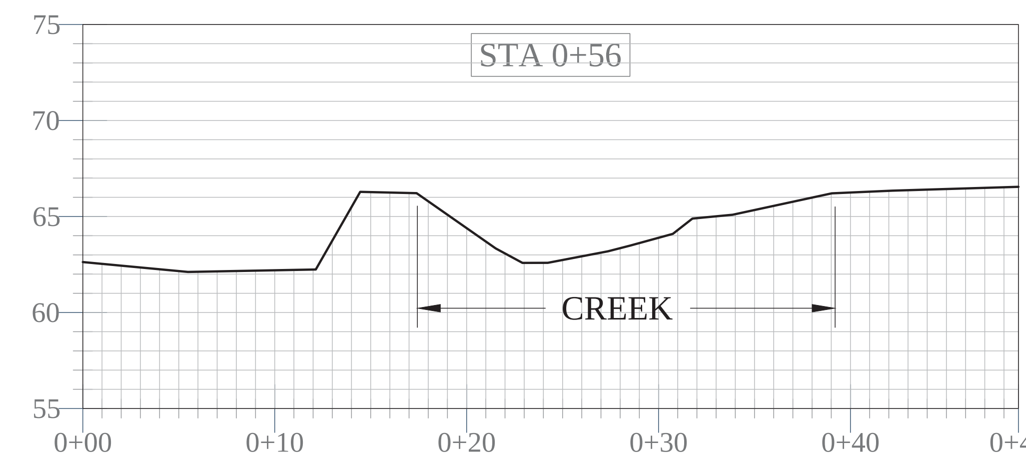


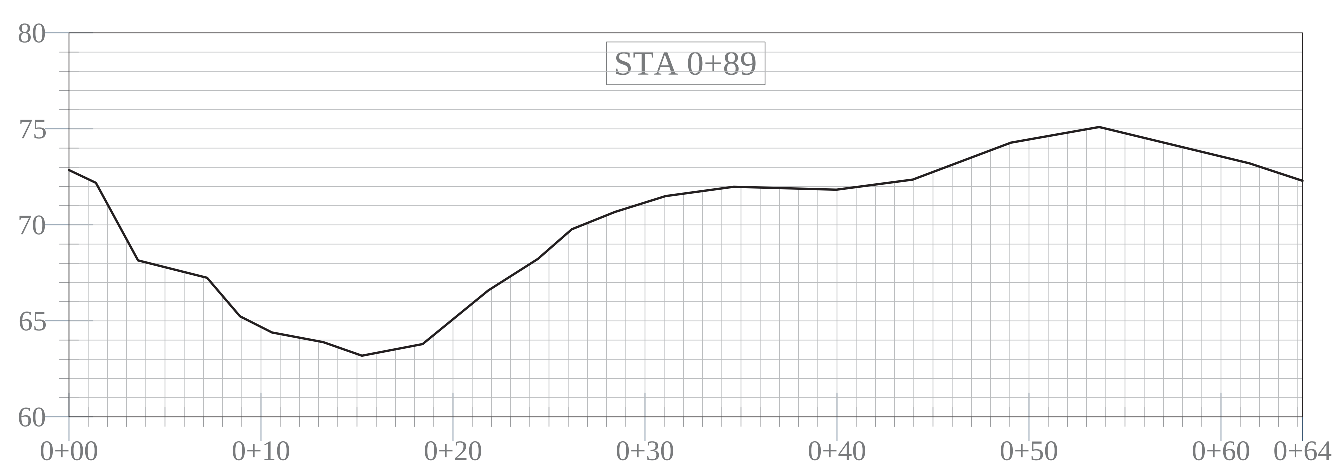












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DRAWING DESCRIPTION:
COOPER MILL MOUTH CROSS
SECTIONS

PROJECT LOCATION:
COOPER MILL CREEK
OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO: 10409

C-4

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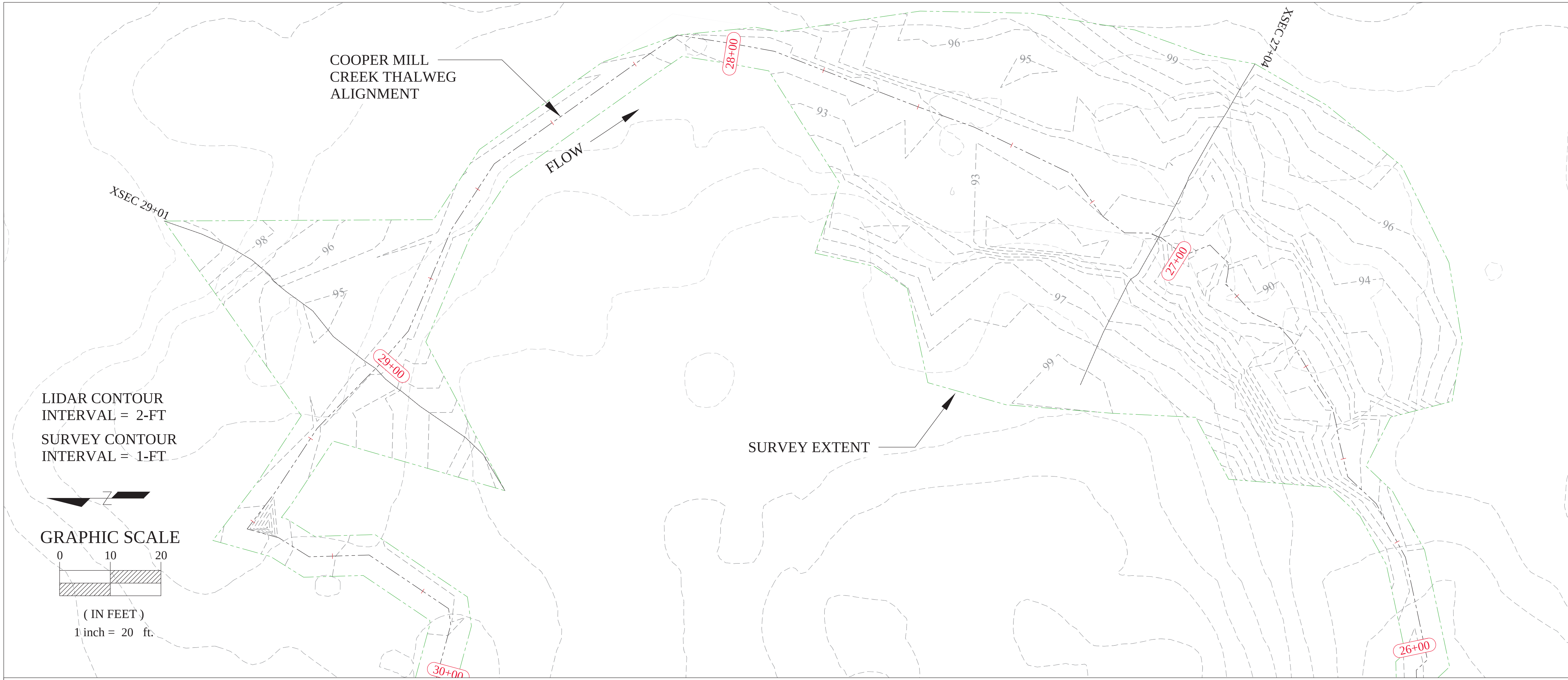

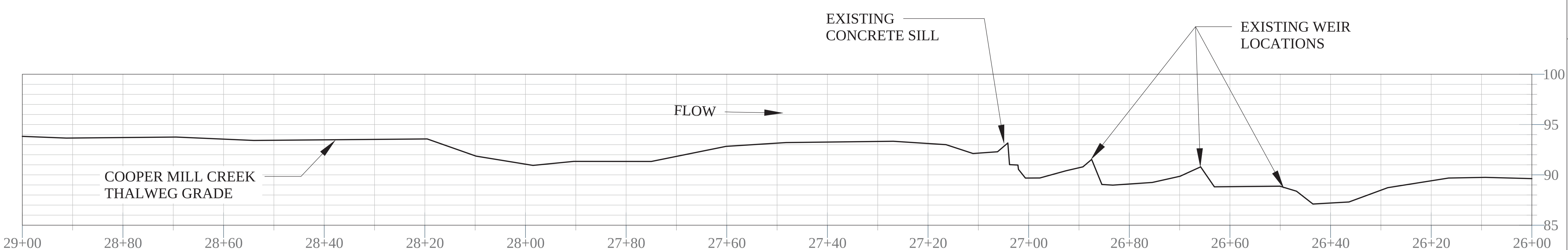

DATE 9/5/2019
NOTES PREPARED BY PWA
FIGURES CREATED BY RS & GO
SHEET ? OF 1

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DRAWING DESCRIPTION:
COOPER MILL CONCRETE SILL
AREA PLAN AND PROFILE VIEW

PROJECT LOCATION:
COOPER MILL CREEK
OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO.: 10409

C-5

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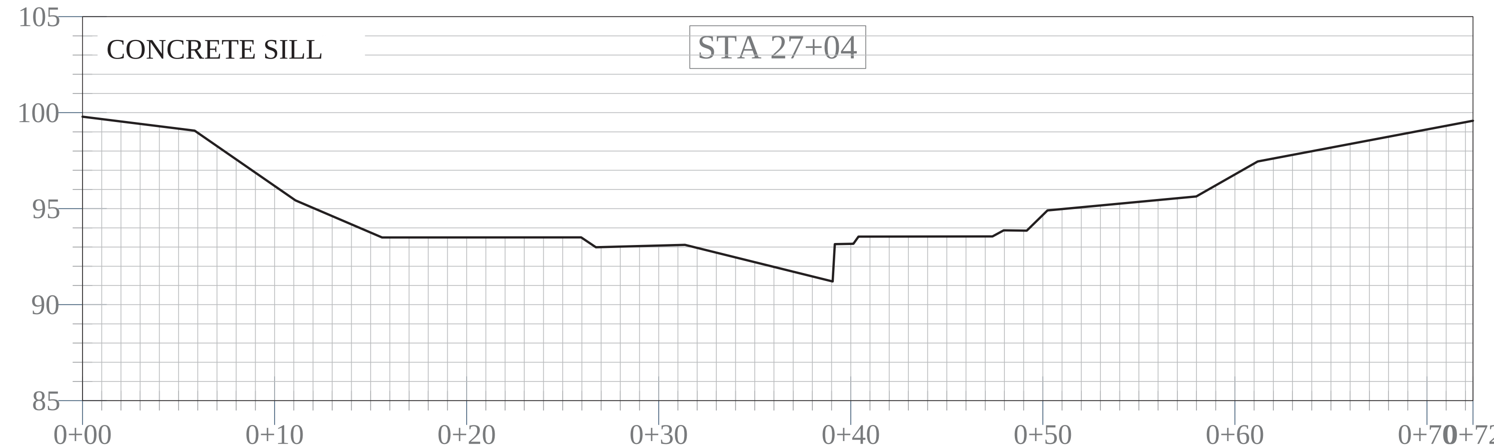

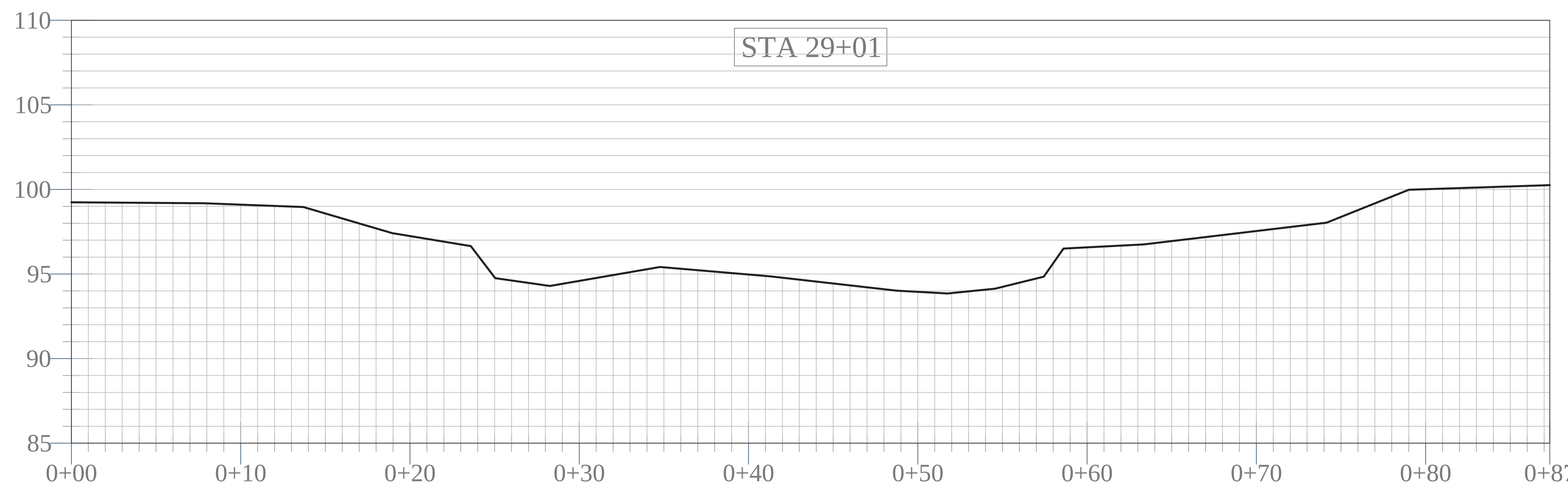

NOTE:

CROSS SECTIONS ARE LOOKING DOWNSTREAM LEFT TO RIGHT

DATE 9/5/2019
NOTES PREPARED BY PWA
FIGURES CREATED BY RS & GO
SHEET ? OF 1

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DRAWING DESCRIPTION:
COOPER MILL CONC SILL AREA
CROSS SECTIONS

PROJECT LOCATION:
COOPER MILL CREEK
OFF CHANNEL COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO.: 10409

C-6

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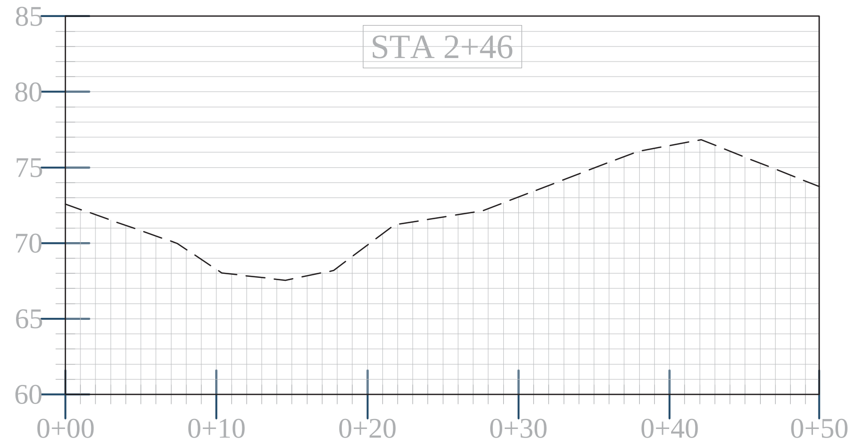

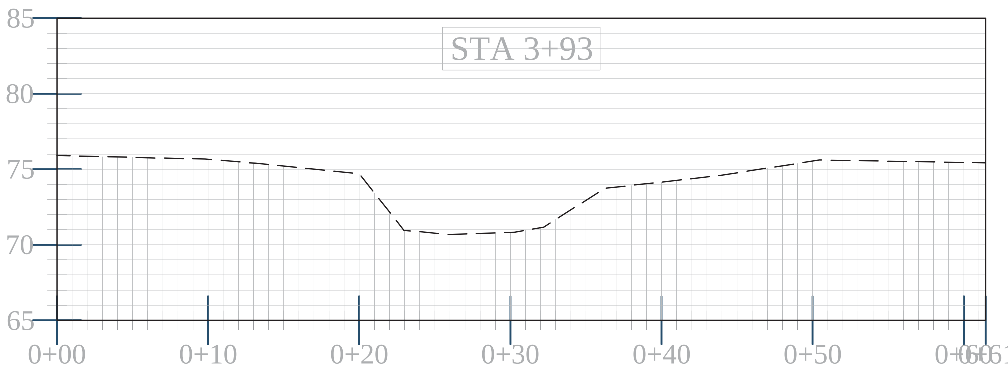

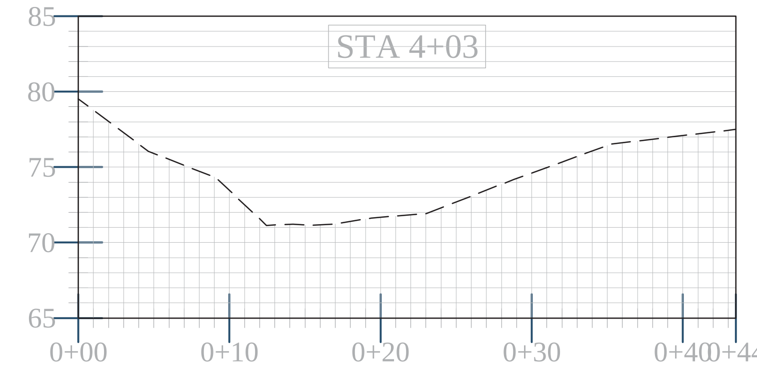

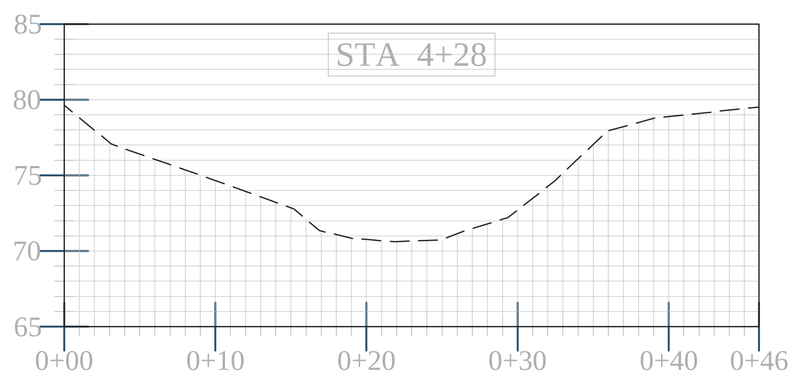

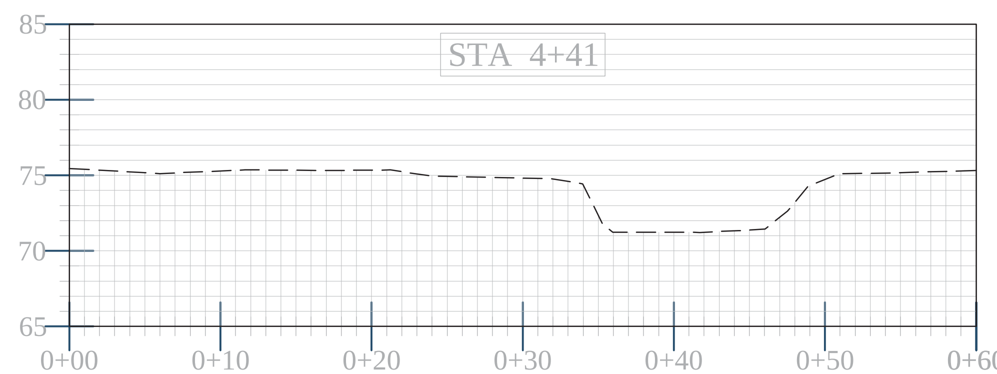

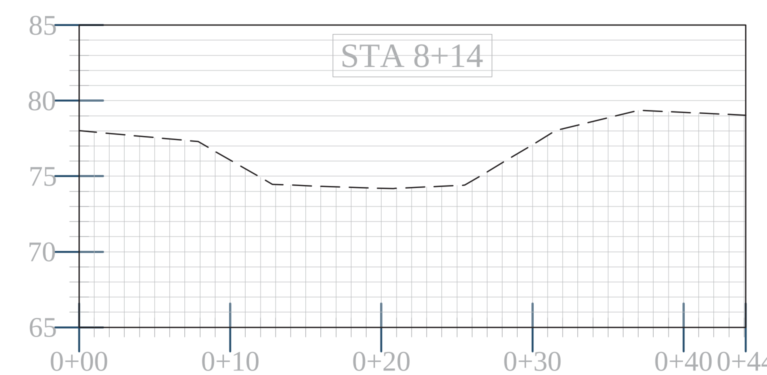

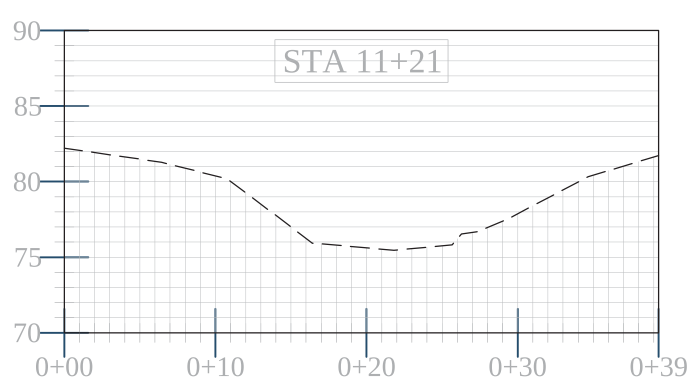

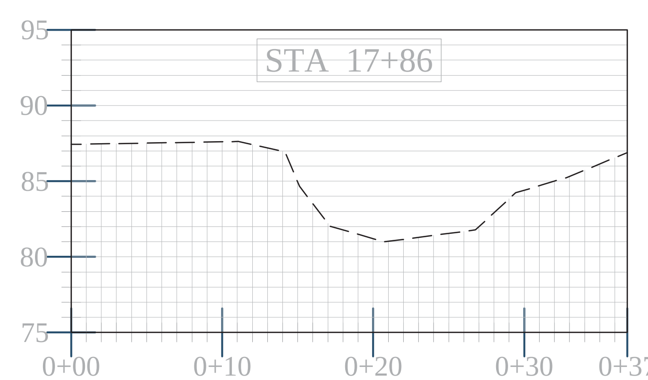

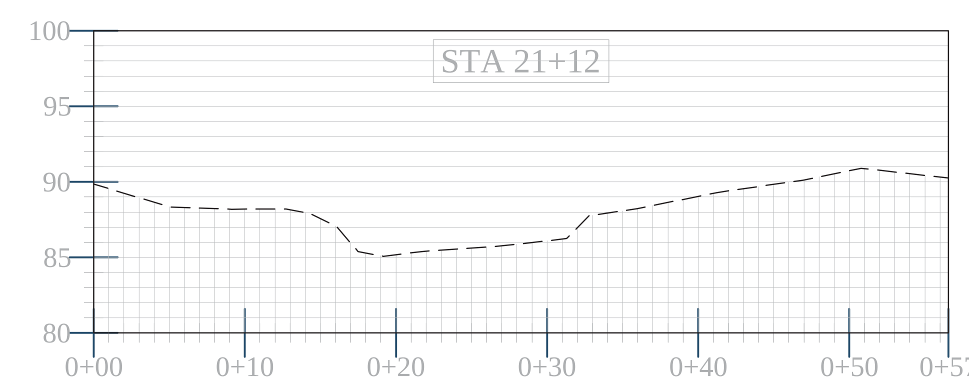

ALL CROSS SECTIONS ARE LOOKING DOWNSTREAM LEFT TO RIGHT

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DATE 10/4/2019
NOTES PREPARED BY PWA
FIGURES CREATED BY DESIGNER
SHEET ? OF 1

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DRAWING DESCRIPTION:
COOPER MILL CREEK SECTIONS

PROJECT LOCATION:
COOPER MILL OFF CHANNEL
COHO HABITAT
HUMBOLDT COUNTY, CA

PWA JOB NO.: 10409

C-7

Meeting Notes -Cooper Mill Creek Fish Passage Improvement Project Designs – Kick Off Meeting

Friday September 6, 2019 at 1:00pm

<u>Location:</u> CDFW Conference Room: 1455 Sandy Prairie Court, Fortuna CA Suite J

<u>Participants:</u>

- Grantee: Anna Halligan (TU
- Grant Manager: Chris Ramsey (CDFW)
- Agency Engineer: Margie Caisley (CDFW)
- Engineering Consultant: Bill Weaver (PWA), Chris Herbst (PWA), Greg Orum (PWA), Tom Leroy (PWA)

*Action – NOAA staff should be included in future design meetings

<u>Funding Review</u>

- Two Funding Sources
  - FRGP - $ 98,711; expires April 30, 2022
  - CA Fish Passage Forum- $ 65, 782; expires September 2019
  - Total: $164, 493

<u>Project Updates</u>

- Using FPF funding the following work has occurred to date:
  - Survey work in channel
  - Detailed surveys of barrier sites
  - Instream gages installed:
    - Near mouth of Cooper Mill in mainstem Yager
    - In Cooper Mill
  - Geomorphic characterization has started, but is still ongoing
  - Fish passage assessment/evaluation will be complete in September
- More surveys remain – Approximately 600' of Yager (thalweg) to look at impacts to confluence; survey may need to be extended downstream
- Surveys will be tied to LiDAR –Using dataset from Little Salmon Fault (which will be re-flown in the next year)
  - HRC has LiDAR data too

Review of FRGP scope of work

- <u>Review deliverables –</u>
  - Access agreement and Subcontracts – Access agreement submitted; PWA subcontract complete (will be submitted with notes).
  - Annual and Final Reports
  - Meetings – Kickoff, 30, 60, 90, 100%

  - Basis of Design Report and Design plans (30, 60, 90, 100%)
- Review timeline –
  - The Schedule and Deliverables table included in the grant agreement includes estimated completion dates. Some of the dates included in the table are subject to change. TU and PWA will maintain good communication with CDFW about changes to the project schedule.
  - PWA would like to add Alternatives Analysis to scope of work and timeline. This will require and additional meeting to review the alternatives.
- This meeting will occur as a call sometime before December 2019.
  - 30% Design Review - June 2020 is still a good completion date.
  - 65% design plan submittal may occur earlier than the completion date stated in the grant agreement.

Preliminary site characterization results

- Reviewed handouts (attached) –
  - PWA List of possible design options and constraints – these are not prioritized or described in detail. The pros and cons of each is similarly not described. They served as talking points for the meeting.
  - Cooper Mill – Existing Conditions
  - Cooper Mill – Working Map

- Existing boulder weirs are 13.5% slope. (PWA)
- 2.5% throughout most of the channel.
- Need to understand geomorphic behaviour of the channel

Identify design objectives and constraints

- Reviewed potential design elements handout:
  - What is the current connectivity of Yager and Cooper Mill ? C. Ramsey
- We don't want to undermine the foundation of the bridge – therefore, steps are one of the only design options (PWA)
    - Roughened channel vs. weirs
  - Long term ideas –
    - Road relocation wouldn't be a huge expense due to current or historic infrastructure. The road is still paved through the site. (PWA)
  - Future uses of the area by Company?
  - Need to collect some more baseline data to present to HRC about road removal and floodplain restoration
    - Margie reviewed old aerials from the 90's (still a loggging deck) and from the 1952 (oldest aerial found).
    - UC Santa Barbara website – aerial imagery dating back to 1941.

        - New bridge out of the floodplain would be better if we are going to design an extensive (and costly) project - set ourselves up for future projects (M.Caisley)
        - Spread energy of Yager out on floodplain.
    - HRC is interested in alcove or pond opportunities.
        - Potential location at the old fish hatchery (gash on the map handout)
        - reach between there and active downstream bridge
        - C. Ramsey – make sure to consider contaminants when digging groundwater monitoring wells. How many groundwater wells should be deployed?
    - Groundwater monitoring:
        - 4-5 wells
        - Reach from hatchery gash downstream bridge
        - Margie thinks a couple on each side of CMC would be good.
        - MC- If we are considering a low flow or channel re-alignment – should we consider installing a well in that area as well.
    - Other Considerations:
        - What is the capacity of the channel with and without the berms?
        - What return interval would flow innundate the floodplain if berms were not there?
        - Anew channel will lose existing riparian

- <u>Constraints to consider</u>
    - What is the current distribution of Pikeminnow? In Yager and in Cooper Mill?
        - Need to understand pikeminnow energetics (HRC) – steps that will hinder adult pikeminnow
        - Keith wants to look at the confluence to see what fish are present at the confluence of Cooper Mill and Yager

*Action - Keith will dive confluence and channel to verify fish use.

        - Keith – would prefer that we not allow pikeminnow upstream
        - We can reach out to other fisheris professionals for additional consultation.
            - Bret Harvey
    - There are also roach, but they are less of a concern.
    - Mainline bridge is failing – what are the plans for replacment?
    - Is the road needed where rip rap armor is along left bank of the channel?
    - Caretaker is gone, but employee lives on property (Mark Colusio)
    - Does HRC have as-builts or information about old utilities surrounding the fish hatchery and potentially around the house and water tank?
    - Is there an intake off Cooper Mill?
    - Is there a water/septic line (or other utilities) in the area?
    - Who will be funding the implementation?
    - What will the permit mechanisms be?

Schedule next design meeting - Alternatives Review – before December 2019.