Euer Valley Restoration Project
30% DRAFT Design Basis Memorandum



Prepared for

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1. Introduction

The purpose of this memorandum is to summarize the data collection and field investigations, design analysis and methods used, and data results and rationale in support of the 30% concept plans for the Euer Valley Restoration Project (Project). The Project is being funded through and managed by the Truckee River Watershed Council (TRWC) with support from the Tahoe Donner Association (TDA). It is also a component of a larger Prosser Creek Watershed Assessment effort being done by others. This should be considered a working document that will continue to be updated through the design development process including continued coordination and information sharing with the parallel watershed assessment efforts.

2. Design Objectives

Our understanding of the primary design objectives and restoration opportunities for the Project are as follows:

- Improve geomorphic function and channel stability;
- Improve floodplain condition and increase hydrologic connectivity;
- Improve water quality by reducing erosion potential and improving channel stability;
- Enhance ecosystem functionality and habitat availability; and
- Improve recreational access and provide a permanent creek crossing.

3. Background

Euer Valley is located within the Prosser Creek basin, the third largest subwatershed of the Middle Truckee River watershed. South Fork Prosser Creek runs through the Project area (Figure 1) at an elevation just over 6500 feet (ft) and drains an approximate 5.5 square mile watershed before joining Prosser Creek and ultimately draining to the Truckee River. The Truckee River is 303(d) listed as impaired due to suspended sediment. South Fork Prosser Creek and Euer Valley have been subject to historic anthropogenic disturbances including grading, timber harvest, irrigation infrastructure and operation, grazing, railroad, land development and associated road development that likely contributed to channel relocation and aggravated incision and degradation. While the channel has degraded somewhat from anthropogenic disturbances the meadow remains relatively healthy due to the persistent spring and groundwater support with the exception of the localized trail disturbances. Recreation is now the dominant land use within the project area including earthen trails and a culverted crossing at one of the tortuous meander bends (Figure 2). The Project was first identified in the Tahoe Donner Association (TDA) Trails Master Plan due to desired improvements to the Coyote Crossing Trail, which transects the site.

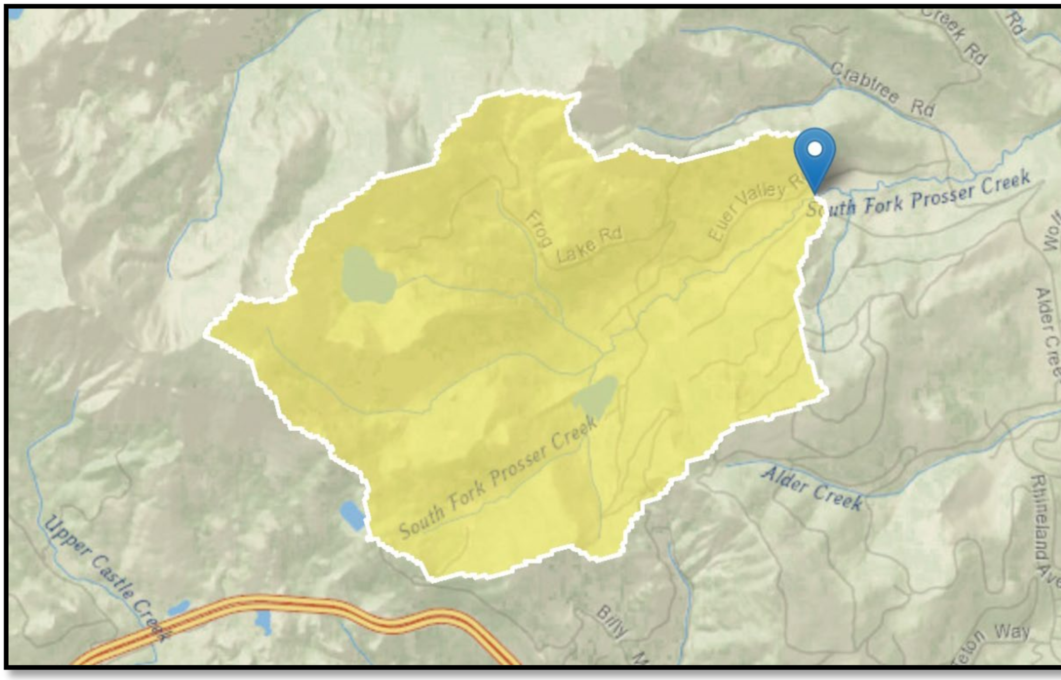


Figure 1. South Fork Prosser Creek Watershed at Project Site *(Source: USGS 2016)*

The Project area includes approximately 2,500 linear ft of South Fork Prosser Creek encompassed by 30 acres of stream, meadow, and upland habitat. Designs are intended to improve trail access through the Project area including replacement of non-optimal volunteer trails and legacy grazing trails through the wet meadow with elevated boardwalks and a permanent bridge feature that will provide year-round access for pedestrians, bicyclists, equestrians, and winter grooming equipment.

Figure 2. View of South Fork Prosser Creek within Euer Valley looking N/E *(Source: TDA Drone Footage)*

4. Data Collection, Analysis and Results

Several desktop and field data collection efforts were conducted during the summer of 2020 by the design and planning teams including: 1) topographic survey, 2) geomorphic survey, 3) cultural survey, 4) biological resources survey, 5) plant resource survey, and 6) subsurface geotechnical investigation. In addition, a wetland delineation is planned for summer 2021 prior to the start of construction. Key takeaways from these efforts are summarized below and several of the full reports are included as Attachments.

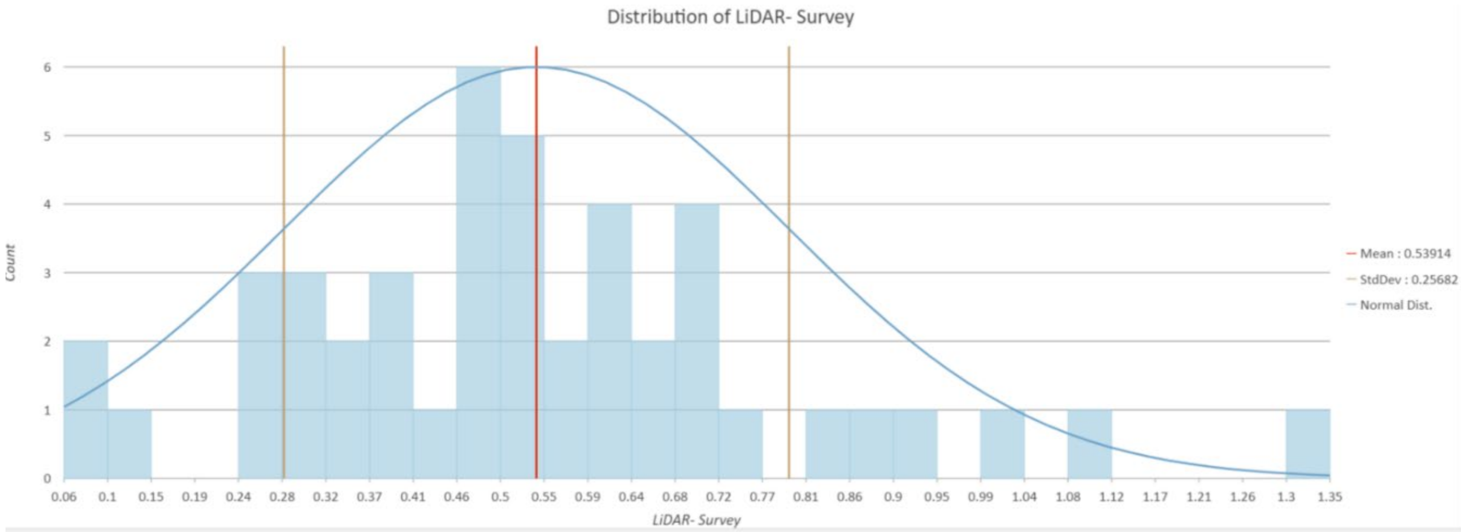
Topographic Survey

A topographic survey was conducted by Wildscape staff in September 2020 using RTK survey equipment. Due to the remoteness of the site and consequent lack of available established benchmarks, the primary project benchmark coordinate was set and determined via static collection and later adjusted using the Online Positioning User Service (OPUS) portal. The purpose of the topographic survey was to supplement the Tahoe National Forest LiDAR data available for the Project Area in the following areas based on input from NHC:

- Along the existing trail corridor;
- Cross sections delineating bank top, toe, and thalweg along the river corridor from the property line to the end of the meanders directly downstream from the existing bridge crossing;
- Old channel scars and swales in the meadow, and;
- A valley cross section

Differences were observed between the field survey data and the LiDAR data where they overlapped. To determine the cause of these discrepancies Wildscape staff confirmed the field data collected and the OPUS solution for final coordinates, and then compared the field survey topography to the LiDAR topography for areas with no vegetative cover. These areas of bare ground allowed Wildscape to compare survey elevations to LiDAR elevations without the interference of vegetation. Vegetation can cause considerable error in LiDAR data collection since the airborne laser will intercept the vegetation never reaching the ground surface. This is especially true in areas of thick cover such as the meadow grasses encountered at the project site. The technical report for the 2014 USDA Tahoe National Forest LiDAR data was also reviewed and it was learned that the 2014 collection was not compared to field collected survey elevations but was compared to the previous LiDAR collection where the two data collections overlapped, with the resulting reported "accuracy" in the range of 0.16 to 1.15 ft. Given this range, a mean difference of approximately 0.5 ft on trail edge and center (Figure 3) is well within the error of the LiDAR. In summary the LiDAR data is not necessarily more accurate than the field survey data and the differences can be easily rectified by either adjusting the survey data to match the LiDAR data or adjusting the LiDAR data to match the survey data. This adjustment step was not yet taken in order to afford the hydraulic model to be set up early with the LiDAR topographic data set only, however the adjustments can still be made at the next design development stage in order to provide additional informative elevation data.

Figure 3. Distribution of the difference between the LiDAR and RTK Field Survey for 45 points collected on the trail.



Cultural Survey

The cultural resources study (Attachment 2) completed by Far Western Anthropological Research Group, Inc. (Far Western) included archival research, literature reviews, assessment of archaeological sensitivity of the Project area and a pedestrian survey of the Option 1 and 2 trail alignments in early October 2020. A few historically significant features were identified along the Project area's southern boundary, however no further consideration was recommended for these given they did not reach the caliber of important resource under CEQA or they lacked integrity to the period of significance. The subsurface geotechnical study showed a low potential for buried archaeological deposits within the Project area thereby eliminating the need for any additional pre-construction subsurface exploration. The pedestrian survey did not reveal any cultural resources along the Option 1 and 2 trail alignments, however given the low surface visibility and chance that resources could be obscured by heavy duff, grasses or other impediments, Far Western recommended that any ground disturbing activities in the slightly elevated areas on the fringes of the meadow be monitored by a qualified professional archaeologist. Far Western also recommended that a representative of the Washoe Tribe of Nevada and California be invited to observe the ground-disturbing activities associated with the trail rehabilitation project, and that the Tribal Historic Preservation Officer, Mr. Darrel Cruz, be kept informed of project planning and activities.

Biological Resources Report

A biological survey was conducted by Sierra Ecosystem Associates (SEA) in late August 2020 that included a desktop database review and field survey of the area. Observations were captured in a Biological Resources Report for the Project. Several biological features within the Project area were mapped and assessed including vegetation, listed species locations, critical habitat as designated by the US Fish and Wildlife Service and wetlands and hydrology. The Biological Resources Report describes the Project area as a seasonally wet meadow with uniform wetland grasses mixed with clumps of small Lemmon's willow (*Salix lemmonii*) and lodgepole pines (*Pinus contorta*) along the edges and upland areas. South Fork Prosser Creek within the project area provides aquatic habitat for trout species including brown (*Salmo trutta*), rainbow (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*). The areas adjacent to the creek provide nesting and foraging habitat for several birds including willow flycatcher (*Empidonax traillii*), yellow warbler (*Setophaga petechia*) and several raptors. There is also evidence of prior American beaver (*Castor canadensis*) activity just downstream of the Project area. The Project area is adjacent to and roughly within 400 ft of designated critical habitat for the Sierra Nevada yellow-legged frog (*Rana sierrae)*.

A wetland Delineation in accordance with US Army Corps of Engineers protocol is planned for the summer of 2021 (prior to construction).

Plant Resource Survey

Julie Etra of Western Botanical Surveys, Inc. (WBS) conducted a plant resource survey to further inform vegetation conditions and provide recommendations on native materials for salvage and reuse as they relate to restoration and erosion control. Due to a late Project start, the plant survey was conducted on August 25, 2020 a suboptimum time for maximum identification of vegetation however adequate for determining dominant plant species and community types. The community types, Wetland, Mesic Meadow/Wetland and Introduced/Transitional were identified and located via GPS (quantification of these community types was not conducted during this survey). Most notable was the almost monoculture of the obligate wetland species, *Carex utriculata* (beaked sedge) between North Euer Valley Road and South Fork Prosser Creek, a species that requires standing water for most of the growing season (Figure 4). Codominant species in the Wetland community at slightly higher elevations included *Juncus articus* (Baltic rush) and *Carex nebrascensis* (Nebraska sedge) (Figure 4).

WBS identified the following reusable resources and recommendations for incorporation into biotechnical treatments:

- *Carex nebrascensis* and *Juncus arcticus* are generally the preferred salvaged sod material due to root structure and cohesiveness. Sandy substrate/subsoil can make any salvageable sod more difficult to handle.
- *Carex utriculata* can be suitable but is not as cohesive or easy to handle as the other species.
- For all salvaged sod, soils should be moist but not saturated when the sod is harvested, and the material should not be stockpiled but replanted as soon as practicable.
- Less cohesive material can be harvested and re-used as topsoil with organic matter.
- The only willow species (*Salix lemmonnii*) were generally small in size and with little available material for use as poles or fascines. These will require importing from another site(s).
- If any plants are in the footprint of construction, they should be salvaged and replanted as clumps.
- Any salvage and replanting along the creek would require the use of heavy equipment which could be difficult given the current limited access.
- Large areas within the project footprint remain saturated until late in the season further complicating constructability.
- All salvaged material will require irrigation following placement and pumping from the creek. Water rights and the feasibility of this type of diversion needs to be addressed early in the design process.

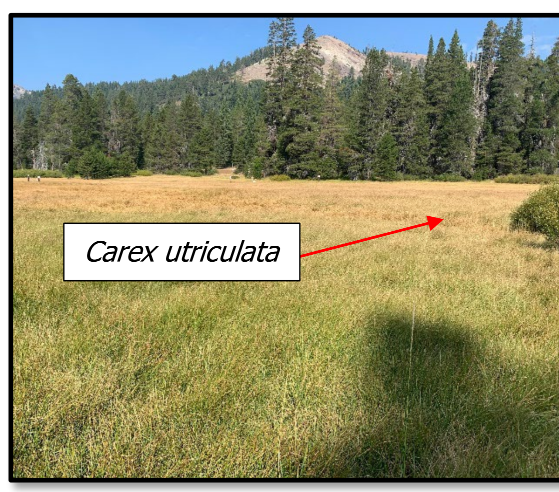


Figure 4. (Left) Monoculture of *Carex utriculata,* (Right). Transition from *Carex utriculata* to *C. nebrascensis* in the foreground.

Subsurface Geotechnical Investigation

A subsurface investigation was conducted by Mark Schroeder, PE of Bear Engineering, to evaluate the soil and geologic characteristics relevant to design and construction of the boardwalk and bridge abutments or piers. As part of the investigation available geologic and seismic reports and maps were researched, borings to depths of 20 to 25 ft were collected and soil classification per ASTM D 2487 and laboratory tests for in-situ moisture and density were conducted on soil samples in order to make geotechnical recommendations for the bridge and boardwalk supports.

The investigation concluded that the site is geotechnically suitable for the proposed improvements provided the recommendations in the report, including a helical anchor/pile foundation system as specified in Table 1 below are incorporated into the designs and adhered to during construction.

Table 1. Foundation Design Criteria

Shaft Size (Pipe) Square Stock NOT recommended Pipe ASTM A500 Grade 80 steel tubing	**Min. 3.5 in. OD**
Min Wall Thickness	**Min. 0.300 in.**
Helical Flight Diameter	**Single 16.0 in.**
Helical Pier Spacing	**Spacing determined by the Structural Engineer. However, no anchor shall be positioned within 6 feet center to center distance**
Depth	**The intent is to rest bearing flight on the gravel bed found between 12 and 16 feet. Load frame test recommended determining depth.**
Working Load	**25 Kips (TO BE VERIFIED IN THE FIELD) or as determined by structural engineer. Min. Torque gage pressure using a Kt value of 7**

- ***All grade beams must be cleaned of loose material and debris prior to placement of concrete.***
- ***The allowable bearing capacity is for dead plus live loads. The bearing capacity may be increased by 1/3 for wind and seismic***
- ***Torque coupling bolts between brackets, extension, and lead section with ASTMA193 Grade B7 or A325 high strength bolt, bolt firmly.***
- **Kt value of 7 shall be used with a safety factor of 2.0 for ultimate strength capacity of the torque loads**
- **All anchor capacity shall be determined in the field by the geotechnical engineer**
- **Each Helical Anchor shall come delivered to the site with a galvanized coating.**
- **The system recommend shall be used for pedestrian path in the areas of Borings 5 and 6.**

5. Geomorphic Setting

The following summary is largely taken from the Geomorphology Technical Memorandum, Attachment 1.

The Project site lies within the upper Euer Valley area which consists of an alluvial valley floor bounded by side valley alluvial fans and hillslopes to the north and south. The Coyote Trail is a legacy trail developed during the Euer family cattle and dairy operations (*TDA personal comm. 2021*), that trends north south extending from the uplands on both sides of the valley and across the meadow that covers the Euer Valley floor. From the south the trail descends a moderately steep and hummocky slope before entering the floodplain at the south edge of the meadow. The trail crosses the east flowing South Fork Prosser Creek channel at the apex of a meander loop then crosses open meadow and an intermittent spring fed channel before leaving the meadow at the upland/forest edge at North Euer Valley Road.

The South Fork Prosser Creek (SFPC) channel forms a steep reach just upstream of the TDA property line and into the meadow about 200 ft downstream. Upon entering the valley floor meadow, the SFPC channel meanders through the Coyote Trail Crossing site and for about 600 ft before straightening and flowing along the upland hillslope south of the meadow and past a distinct oval shaped hillock. Past the hillock, SFPC makes a 400 ft long, broad curve before entering a highly meandering reach that flows along the south side hillslope that bounds the meadow floodplain and valley floor. In the last 3,700 ft, the meandering channel erosively impinges into an irregular 17 to 25 ft high bluff at several locations before entering a 120 ft wide constriction in the valley where the detailed study area ends.

Figure 5. (Left Image) Euer Valley meadow photo taken July 23, 2020.

The valley floor in the study area consists of a meadow floodplain. The meadow receives abundant hydrologic support from groundwater migration from the valley sides, although this appears to be primarily associated with the north side of the valley. This level of inflow is so substantial that there are a number of seeps and small spring-fed ponds that persist well into the growing season (Figure 5). This groundwater inflow provides for a remarkably high level of vigor in the meadow vegetation. Aerial photographs taken during the end of the snowmelt period show the "greening up" of the meadow while the immediate vicinity of the creek has not yet responded. This indicates that the primary hydrologic support of the meadow is lateral subsurface inflows, as opposed to overbank flooding from the creek. However, aerial photographs taken later in the growing season, July, and August, does show uniform green conditions, even along the stream itself indicating that the condition of the stream is not adversely affecting the vigor of the meadow (Figures 6 and 7). In fact, groundwater migration toward the creek may indicate that the stream is a gaining reach within the study area, i.e., the meadow may be supporting the stream as opposed to the stream supporting the meadow.

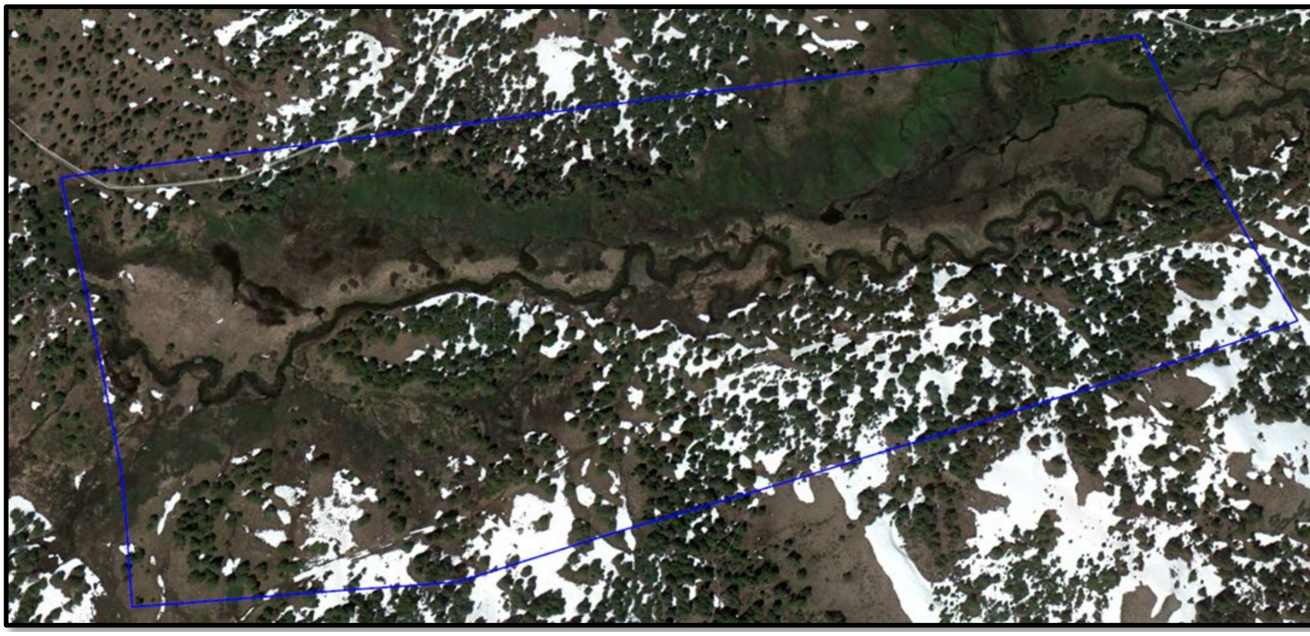


Figure 6: Euer Valley meadow June 2011 aerial image (Source: Google Earth). Note the surface water in the swales likely fed by springs while the immediate area along the creek does not appear to have any sustained saturation by an overbanking event.

Figure 7. Euer Valley meadow August 11, 2017 showing growing green conditions throughout the meadow.

The exposure of lacustrian clay within the channel bottom versus its deeper position in the valley center may indicate that the channel has been moved, perhaps in the 1800s. The lower depth of that material in the valley center would be expected to have been eroded out by the pre-settlement stream alignment. Additionally, there are a number of locations in the valley where the valley bottom is two or more feet lower than the channel edge. Regardless of whether the stream has been moved to the south edge of the valley or not, the wet conditions in the valley bottom indicate that the existing overbank flow regime and stream water surface during the growing season is not a requisite condition in establishing or maintaining meadow vigor. In other words, the meadow is truly a different yet healthy meadow system hydrologically and floristically and preserving and protecting the springs is key.

Using 67 years of instantaneous peak flow data from nearby Sagehen Creek, and adjusting for drainage area, the estimated 2-year peak flow in the project reach is estimated to be 56 cubic ft/second (cfs). Based on the existing LiDAR data, and use of the HEC RAS 2D hydraulic model, the 2-year peak is largely contained within the streambanks. Overbank flooding at that flow does occur behind a relic beaver dam, but meadow flooding elsewhere is sparse. In contrast, a stream in proper functioning condition will result in incipient overbank flooding between the 1.5 to 2-year recurrence intervals which indicates that the stream is incised. Seven cross-valley sections generated from the hydraulic model showed that, on average, the water surface elevation for the 2-year event would have to rise approximately 0.6 ft to result in general incipient overflow. Thus, while the stream is incised, the degree of incision is relatively minor. However, there is a potential risk for further incision upstream of a relic beaver dam introduced later in this document, if no action is taken to stabilize and prevent head-cutting at this location now that it appears the beaver have vacated the area.

Eleven cross-sections were surveyed in the study reach to assess the bankfull width and depth. The mean depth was 1.7 ft. Hydraulic geometry relationships of Central Sierra streams yielded a bankfull depth estimate of 1.4 ft, whereas regional relationships presented by Rosgen (1996) for the Upper Salmon River basin, which is believed to be the most representative of conditions in Euer Valley, give a bankfull depth of 1.0 ft. While these relationships have a considerable degree of uncertainty, they also indicate some degree of incision.

The stability of the channel was assessed by comparing the centerline alignment from a 1953 aerial photograph compared to the 2018 aerial photograph from Google Earth. Such an analysis is approximate because of the differences in the altitude and angle in the two images. The estimated average reliability of actual centerline is +/- 10 ft. The channel has indeed migrated in the 66 years between the two images. Most of the migration might be characterized as minor to modest and most of it has occurred in the more sinuous lower portion of the study reach. At 22 locations where there had been movement, the distance required to shift the centerline of the meander to approximately overlay its original location was 23.8 ft. Where the channel did migrate, it did so through a downstream shift in the alignment, which is consistent with "normal" migration of alluvial channels.

The evidence for incision and migration might suggest a downward trend in channel condition. However, one of the principals of proper functioning alluvial channels is that, although the channel may migrate, it will maintain its bankfull geometry (Leopold 1994). There is no evidence of channel widening based on inspection of the 1953 and 2018 images. Furthermore, the same hydraulic geometry relationships used to evaluate bankfull depth were used to assess the current bankfull width and found that the mean channel width of 13.2 ft is bracketed by the Central Sierra regional relationship, 12 ft, and the Upper Salmon River basin relationship at 14 ft.

A streambank erodibility survey was conducted using the "Bank Erodibility Hazard Index" developed by Rosgen (1996). The study area was broken into five reaches. The computed streambank erodibility hazard was ranked as low to very low in the four upstream reaches, and moderate in the most downstream reach. There are individual locations where there are high eroding banks. These include seven locations where the stream is eroding into the bluff on the lower end of the south valley side. The primary reason for the low erodibility hazard is the common occurrence of what might be described as an "inset" narrow floodplain, typically 1 to 3 ft below the adjacent meadow surface. This surface appears to be largely associated with sod blocks eroded out of the meadow and dropping vertically into the active channel or bending downward from the meadow surface. Once the sod is lowered, the perennial flow in the channel gives rise to dense vigorous sod which cannot be readily eroded, and as the width of the inset floodplain increases, the erosive stress on the inset floodplain/meadow interface progressively decreases.

Overall, there are markers (greater than normal depth, and migration) that the channel may have been relocated which would suggest that it is still actively seeking a new dynamic equilibrium. However, the low bank erodibility and maintenance of bankfull width over the last 66 years, and bankfull dimensions consistent with regional hydraulic geometry relationships points to a stable channel. Given its current stability and low erodibility there is no rationale for extensive stream restoration. This is especially valid in this case since raising the stream profile would not yield any benefits to a meadow that already is very wet.

Instream there appears to be plenty of cover, instream clay blocks, undercut low banks and densely vegetated banks along most areas of the Project reach. However, adding in some beaver dam analogs or similar may be desirable to increase in-stream habitat and resilience in the channel profile. Certainly, the relic beaver dam had a significant influence on the upstream gradient and taking measures to ensure that the loss of that channel dam/grade control feature would not initiate a headcut response is justified. There may also be a rationale to improve aquatic habitat through point application of biotechnical measures, although care should be taken to avoid those in the vicinity of the bridge crossing. Additionally, biotechnical bank stabilization measures composed of willow and meadow sod on eroding banks using small equipment and hand crews may be further considered, with the preference for creating a narrow inset floodplain at the base of existing eroding slopes and taking similar measures where the bank erodibility is low to offset the loss of channel length elsewhere.

It should be noted that the maximum snow depth at the Independence Creek SNOTEL station, which is approximately eight miles away and 100 ft lower than the project site is 9.3 ft. This depth was recorded at the peak of snowpack accumulation, as opposed to much earlier, December-early February, when large rain-on-snow floods occur, and the snowpack depth is typically much less. Several of the recent flood events, including 2017, 2006, 1997 and 1986 likely occurred when there was still two to three ft of snow on the ground in the project area. This would result in channel banks being extended another 2 to 3 vertical ft with the snowpack increasing flow depth and hydraulic forces on the channel bed and banks. In other words, the flow shear stress on the channel would have been increased due to the flow depth and gradient being increased by the artificially steepened and confining snowbanks. The potential for further bed scour may be minimized to some degree by an erosion resistant dense clay layer that runs through the channel at shallow depths and observed in the field in several locations where it is exposed on channel bed and banks. This aspect is critical to bridge and boardwalk designs, given they need to be set high enough above the meadow and creek to facilitate free flow of large floods underneath that include the snowpack assumptions, or they need to be designed and built to withstand the direct forces of the anticipated flood flows. In order to achieve a balance of allowing some proportion of flows to pass under while keeping boardwalks and bridge height to elevations that are aesthetically acceptable and do not require railings (30-inch vertical height or less for boardwalks) or an exorbitant amount of fill to ramp up to the bridge crossing, the designs will likely need to withstand overtopping and direct flow forces and logs and debris will also need to be considered.

In setting up the hydraulic model it was discovered the hydraulic control for the bridge site(s) is well over 1,500 ft downstream. According to the geomorphologist, the maximum flow velocity under a 100-year event is around 4.3 ft per second (fps) in the channel just upstream of the culverts and water surface height is roughly one foot above existing ground immediately north and south of the channel. In addition, the geomorphologist reported that the tortuous meander bend in the vicinity of the existing crossing that appears to be eroding westward towards the trail on the south end has been in the same location as far back as 1993 and has moved roughly 10 ft over the past twenty-five years or more.

In order to increase flow conveyance area if the Option 1 bridge location is carried forward, it is advised that the inside bar/bench be lowered from the south side and coupled with measures to protect the abutments/piers given they will have greater exposure within the water column.

6. Recreational Use and Needs

The Project is located entirely on lands owned by TDA and primarily used for recreation including biking, hiking, and equestrian use in the summer (Figure 10), and cross-country skiing in the winter. With 25,000 TDA members, and trails and open space available to the public, the area experiences frequent use year-round.

Figure 9. Trail approach looking towards SF Prosser Creek from North Euer Valley Road

Figure 8. North side of Coyote Crossing Trail showing clear signs of braiding at locations of spring fed swales, August 2017 (Google Earth)

The existing creek crossing (Coyote Crossing) consists of 3 CMP culverts covered by an anchored wooden walkway and a constructed access ramp which allows summer and winter recreationists and groomers to cross (Figure 11). As a result of the spring fed swales, the north trail approach to the culverted crossing remains saturated with persistent standing water often into July making access difficult and detrimental to the wetland surface.

Due to the persistent standing water well into peak recreation months, multiple volunteer trails are formed (Figure 8). This is especially apparent where it crosses the spring fed swales as recreationists avoid getting their ft wet. This behavior likely exacerbates erosion in the saturated meadow area, compacts soil, and stunts vegetation growth within the vicinity of the existing trail alignment. Once a preferred trail alignment is selected the remaining redundant trails and trail segments under new boardwalks will be decommissioned by de-compacting (ripping/tilling) and revegetating TDA has indicated disturbance by equestrians is especially concerning and would like to discourage equestrians from fording the river at locations other than a developed crossing. Coyote Crossing is a key part of TDA's existing trail system because it is the only crossing on the South Fork Prosser Creek until the access road, Alder Creek Road over 2 miles to the East. There is a warming hut, i.e., Coyote Hut, just northwest of Coyote Crossing that is primarily used by cross-country skiers in the winter season.

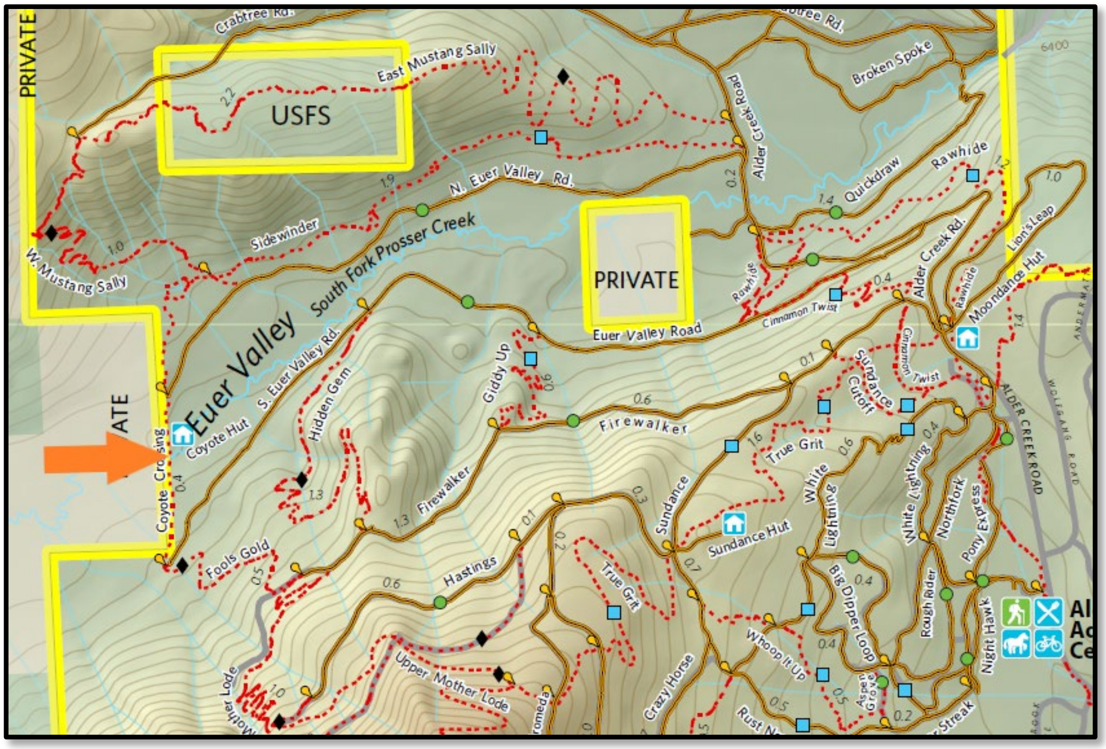


Figure 10.TDA Summer Trail Map 2019. Orange arrow points to Coyote Crossing.

Figure 11. View of existing culverted crossing (Coyote Crossing). (Source: TDA Drone Footage)

Recreation improvement goals for the Project are as follows:

- Provide accessible trail over wetted meadow earlier in the year that will minimize impacts to the meadow and wetland areas.
- Provide year-round access across the creek that will not impact the creek and is usable by recreationists and grooming equipment.
- If possible, provide equestrian access to the creek for watering the horses without damaging creek channel bed or banks.
- Maintain close proximity to the existing trail alignment and grooming pattern for continuity and wider use/enjoyment of the valley.

7. Land Ownership

Between 2002 and 2016 the TDA purchased and significantly expanded recreational land access as illustrated by comparing the 1994 Tahoe Donner trail map with 16 miles of multi-use trails to over 60 miles of single track and fire and access road trails today. TDA has its own Trails Department which manages and maintains the trail system a key component of Tahoe Donner's recreational identity (*TDA personal comm. 2021*). Table 2 highlights the individual and joint land purchases over the past two decades. A significant portion of the Euer Valley that encompasses this Project, 482 acres was purchased from the Euer family in 2012. While TDA currently owns most of the surrounding area there is a patchwork of public and private land in the Project area.

Immediately adjacent and to the West of the project area, is private land (APN 016-060-009-000) that is accessed via North Euer Valley Road. It will be important throughout Project activities and construction to maintain access to this road for the private landowners. Other adjacent landowners include the USDA Forest Service, Tahoe National Forest, Sierra Pacific Industries, the Euer family, the Donner Euer Valley Corporation, and the Truckee Donner Land Trust.

Table 2. Euer Valley Land Acquisition Summary *[Source: TDA 2021]*

Year	**Land Purchase Description**
2002	TDA purchased 240 acres in Euer Valley. The deal included 40 acres in trade, for a net gain of 200 acres.
2004	TDA sold 32 acres.
2010	In partnership with Truckee Donner Land Trust and the Town of Truckee, TDA purchased the 240-acre Bucknam Tract above Donner Lake.
2011	TDA purchased the 160-acre McGlashan Springs parcel above Donner Lake.
2012	TDA purchased the 20-acre S&R Snow Removal property at the end of Teton Way to house the Association's Forestry Department.
2012	TDA purchased 482 acres of the Euer family's remaining 522 acres, leaving the Euers with a 40-acre in holding.
2016	TDA purchased the 640-acre Crabtree Canyon to the north of Euer Valley from the Truckee Donner Land Trust and their partners.

8. Hydrology and Hydraulic Analysis

The following summarizes the hydrology and hydraulic data used to develop 30% bridge, boardwalk, and creek restoration designs.

Design Flows

The design flow results in Table 3 were determined by NHC via StreamStats (USGS 2016)

Table 3. Recurrence Interval Flows for South Fork Prosser Creek (NHC 2020)

RI (years)	Peak flow (cfs)
2	145
5	292
10	435
20	633
50	854
100	1,060

2-D Hydraulic Model Results

Critical to bridge and boardwalk foundation supports and height requirements are the output from the HEC-RAS 2D hydraulic model. NHC provided the model to the design team who were able to use the model to pull the output needed for 30% designs. Table 4 summarizes the approximate average water surface elevations and velocities from the model output used in 30% design development. Of most interest is the 100-year recurrence event, as the design of the bridge and boardwalk is intended to withstand a flood event of similar caliber. The water surface heights assumed for design were rounded up to 6526 ft for Option 1 bridge crossing and 6525 ft for Option 2 bridge crossing.

Per County of Nevada Road Standards (Nevada County, California, Land Use and Development Code) two ft of freeboard under a 100-year flow event is required for bridge crossings. For 30% design we have met this requirement. However, it appears the intent of the County requirement is to minimize interaction with the hydraulic forces rather than design for them. Therefore, there may be an opportunity to reduce this height requirement to some degree for aesthetic or constructability reasons, for example if there is an interest in lowering the height of the bridge to reduce the amount of fill required to ramp up to the bridge deck. Specific site conditions and structural remedies to bring to the County consultation include:

1. Avoiding restricting the flow. In our case the valley is nearly a pond at a 100-year flow event with low velocity and an expansive wetland area for the water flow to spread out.
2. Given the flow is not expected to remain in the active flow channel during such an event, the bridge will be designed to be structurally sound when the abutments will be surrounded by water.
3. The bridge is also being designed to withstand debris flows.

Table 4. HEC RAS 2D Model Output used in Design Development

2 Year Recurrence Event					10 Year Recurrence Event			
	WSE	Velocity	Shear			WSE	Velocity	Shear
	ft.	fps	psf			ft.	fps	psf
Option 1 LB	6524.2	0.9	0.02		Option 1 LB	6525.2	1.5	0.1
Option 1 RB	6524.2	1.4	0.05		Option 1 RB	6525.2	2.5	0.2
Option 1 Center	6524.2	1.2	0.1		Option 1 Center	6525.2	2.3	0.15
Option 2 LB	6523.55	1.8	0.1		Option 2 LB	6524	2	0.4
Option 2 RB	6523.55	1.2	0.1		Option 2 RB	6524	2	0.3
Option 2 Center	6523.55	2	0.15		Option 2 Center	6524	2	0.45
25 Year Recurrence Event					100 Year Recurrence Event			
	WSE	Velocity	Shear			WSE	Velocity	Shear
	ft.	fps	psf			ft.	fps	psf
Option 1 LB	6525.44	2.1	0.1		Option 1 LB	6525.75	2.4	0.2
Option 1 RB	6525.44	2.9	0.3		Option 1 RB	6525.75	3.5	0.35
Option 1 Center	6525.44	2.6	0.25		Option 1 Center	6525.75	3.1	0.4
Option 2 LB	6524.3	2.1	0.45		Option 2 LB	6524.73	2.25	0.4
Option 2 RB	6524.3	2.2	0.3		Option 2 RB	6524.68	2.3	0.35
Option 2 Center	6524.3	2.1	0.45		Option 2 Center	6524.71	2.35	0.4

9. 30% Design Development

This section describes the process by which decisions were made for each of the three design components: 1) location of the trail alignment and creek crossing, and considerations related to identifying potential locations; 2) structural design components for the boardwalk and bridge for each of the alignment options; and 3) creek restoration elements. This section also reviews general construction details including likely access and staging locations, and factors to consider for construction timing, dewatering and dust abatement.

Trail Alignments Considered

Three trail alignment options were presented to the client and stakeholders for review, consideration, and discussion in early September 2020 (Attachment 4). The Option 1 trail and bridge alignment closely followed the existing trail alignment through the valley. Option 2 avoided as much of the wetted spring fed swale as possible and crossed a straighter reach of the creek while still staying at the western end of the valley. Option 3 was the shortest path along the wet meadow before crossing the creek but located much further east within the Project area. As a result of stakeholder input, trail alignment Option 3 was discarded in large part due to it eliminating a substantial portion of the meadow for access and enjoyment and Options 1 and 2 were carried forward to 30% designs with some minor adjustments as shown in the accompanying 30% plans.

Structural Designs

The following summarizes the structural design considerations and options for the boardwalk trail and bridge installations largely provided by Linchpin Structural Engineering, Inc. for 30% designs.

Boardwalk

The boardwalk designs remain generally the same for either trail alignment options.

- Foundation: Foundations will consist of helical piers to support boardwalk framing, similar to bridge foundation however with smaller 12-inch diameter helical bearing plates for cost savings. The smaller size should also minimize any potential encounters with subsurface boulders.

- Framing: Wood-framed vs. steel-framed or combination of both sees little cost difference based on previous boardwalk designs. Alaskan Yellow Cedar is recommended for wood stringers, as it is naturally resistant to decay. Weathering steel is the recommended material for steel framing as its surface will patina to provide a protective coating, resulting in minimal maintenance. The increased strength of steel allows for shallower beams resulting in a lower boardwalk elevation profile. We assume pressure treated Douglas fir is not permitted in this sensitive environment due to its chemical make-up, but we note that it would provide a significantly less-expensive wood option.

- Decking: Wood can be Douglas fir, as used elsewhere at Tahoe Donner, or cedar or redwood, which is naturally decay resistant. Pressure treated wood is assumed to not be permittable due to the environmental sensitivity in the wetland. Modest improvements in the durability of Douglas fir could include pre-staining the wood. Untreated Douglas fir is expected to require (relatively easy) replacement more often than naturally durable wood.

- Approach: The boardwalk approaches to the bridge crossings were separated from the winter groomed trail in order to keep grooming equipment off the boardwalk. A very robust boardwalk section that could withstand the weight of the groomer could be designed, however concerns remain that the lateral force caused by the groomer driving on and off could be quite large. In order to allow room for the grooming equipment to access the bridge crossing the boardwalk trail swings out for Option 1 and comes in from the side for Option 2 to tie in with the 20-foot wide rock armored access ramp to meet the bridge decking. Another option that could be considered would be to intersect the boardwalk directly with and at the side of the bridge rather than with the constructed ramp.

- Elevation: The boardwalk elevation should be kept to 30 inches or less above grade in order to eliminate the need for guardrails which would increase the cost of construction and be less visually appealing.

Bridge

Independent of the trail alignment option, design of the bridge will be relatively similar, with the spans varying in lengths to keep the foundations out of the active channel. Two options are available for the design and construction of the bridge, including locally designed and fabricated or pre-manufactured.

Manufacturers of bridges offer design, fabrication, and installation services. In either case, portions of the bridge would be fabricated off-site and then assembled on-site. Either method of delivery provides similar structure types as discussed below. It may be beneficial to secure a contractor in this early phase to help determine the most cost-effective design.

- Bridge Superstructure: The structural sheets provide three options for the bridge superstructure, discussed below. Steel is the only logical option for the bridge structure. Weathering steel is recommended for the bridge framing as it is preferred by the forest service for lack of maintenance. Although it is a bit more costly upfront, it is cheaper in the long run.

    - The two-girder assembly provides a lower overall deck height by placing the deck on secondary members that span between the two main girders. A concern with this option is the groomer navigating between the two girders, which may be quite tall. The potential arises for the groomer blade to accidentally come in contact with the girder, possibly causing damage to the structure.

- The five-girder option places the bridge deck on top of the main girders. This option is ideal, as it provides an un-obstructed platform (with the guardrails removed seasonally) for the groomer to maintain the winter cross-country ski trail. The five-girder design is beneficial as the bridge loads are distributed along the width of the bridge at the supports, more evenly distributing the loads to the soil.

- The truss option has similar design aspects as the two-girder option, including placement of the deck between the main structural members. Typically, the design of a truss bridge is more efficient in terms of weight as the taller truss assemblies provide more strength with less material. Although the truss bridge may be more aesthetically appealing, there is concern of the groomer navigating between the truss members as discussed in the two-girder option.

- Span length: A 150-ft single clear span bridge was considered but ruled out due to the resulting forces at the bridge supports that would have to transfer to the soil. The helical piles (discussed below) would not have the capacity for these loads. A clear span would require very large concrete footings which are not desirable in the wetland. Adding a single interior support does not resolve this, as the interior support would see the same high load as the ends of a single span. Therefore, we recommend a minimum of 3, 50-ft spans (4 supports) to transmit bridge loads into the soil. In addition to the span length reductions to minimize loads at the supports, the shorter spans reduce the bending stresses in the bridge superstructure members. The 3 span option reduces the required girder or truss depth, which is aimed to be kept minimal to reduce excessive trail approach grading and consideration of freeboard requirements.

- Foundations: Helical piles will support the bridge girders at abutments and intermediate bents as described in the geotechnical study. The geotechnical study recommends load frame testing of the helical pile at the site which may show additional capacity of the helical piles, reducing the number of helical piles required. The load frame testing is recommended to be done in summer 2021 in order to allow for sufficient time to purchase and acquire the targeted number and size of helical piles based on the test results.

- Decking: Options include wood, steel, or aluminum. Wood can be Douglas fir, cedar, or redwood as discussed in the boardwalk section. Steel or aluminum decking may be ideal for winter operations; however, these materials are not recommended for summertime use. For example, steel can be quite slick and unsafe for bicyclist or pedestrians during wet conditions. Another option may be a hybrid deck with a wood path down the centerline and steel decking at the track path of the groomers, although this may add complexity and construction cost. The hybrid option may be ideal if equestrian users are expected to use the bridge where an overlay of longitudinal wood is preferred by horses. Guard post may slot in either side of this reduced width walkway.

- Railing: The bridge will require railing during summertime use and may be removable for winter operations. We understand the county has approved previous projects with removable railing for maintenance due to snow. Removable railings are ideal as lateral forces may be imparted to the railings from the groomer pushing snow across the bridge, which may be greater than forces typically used to design a pedestrian bridge railing. The concept drawings show Douglas fir railings consisting of 6x6 posts, 3x8 top rail, and 2x6 horizontal rails. Other options include steel posts, and top rails. Options for the horizontal rails include stainless steel cables or steel mesh. Railing for the truss design can be wood or steel integrated into the truss members, likely options would be steel slats or stainless steel cables.

- Approach: The snow groomer will require access to the bridge from grade in the winter months. Three viable ramp construction options were proposed by the structural engineers and included large cobble-fill, earth-fill, or rib-reinforced steel plate. Both large cobble and earth-fill ramps are ideal for providing double curvature to the ramp to ease the transition to the bridge. A ramp built of large cobble-fill may be preferred as it may help deter and prevent summertime motor vehicles from crossing the bridge, while still providing a surface for wintertime snow accumulation. The rib-reinforced steel plate includes a hinged connection at the abutment and sloping to grade. This option may be least desirable as the steel plate would need to be quite thick and require additional fabrication to weld the rib-reinforcement. Building a ramp to the bridge completely of snow was discussed, however, this would likely not be achievable in early or late winter and/or low snow years. The 30% plans show a compacted earthen ramp with cobble/rock armoring at a maximum 20% slope. In order to reduce fill requirements this slope could potentially be steepened and the ramp shortened in consultation with the TDA groomer operators.

Creek Design Elements

Figure 12. Prosser Creek downstream of Coyote Crossing.

During field reconnaissance efforts, the restoration team consisting of the geomorphologist, restoration ecologist and restoration engineer all agreed that the meadow area was already of high quality due to the spring fed water source and did not necessarily justify significant alterations to the creek channel in order to increase overbanking frequency and duration or raise groundwater surface levels to further "wet" the meadow. This is also emphasized in the Geomorphology section above.

Based on the geomorphic data however, the relic beaver dam appears to have significantly held the channel grade and contributed to aggradation upstream (Figure 13). In order to mitigate any potential future incision from migrating upstream of this location given the beaver dam is no longer active, we recommend a series of boulder cascade weirs to hold channel grade while stepping down from the higher elevation reach above the location of the former beaver dam to the reach below. In addition, engineered log and root wad structures can be incorporated at strategic locations to increase and improve in-channel aquatic habitat complexity.

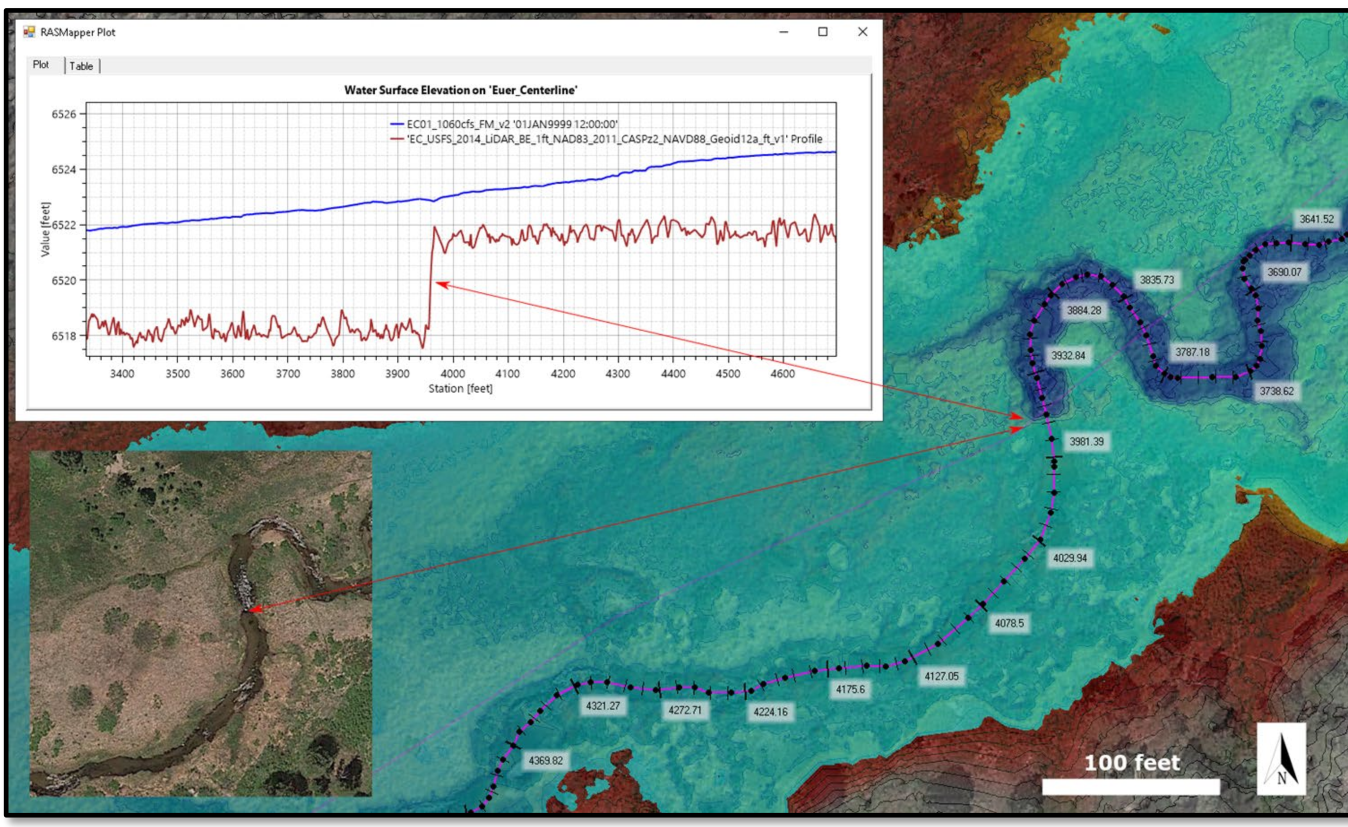


Figure 13. Location where relic beaver dam held grade and resulted in 4 feet of drop (Source NHC 2020)

Intermittent bank treatment measures and in-channel structures to increase in-channel habitat complexity and/or prevent further channel bed incision or aggravated bank erosion are restoration elements that will be incorporated into 65% designs. Instream there appears to be plenty of cover, instream clay blocks, undercut low banks and densely vegetated banks along most areas of the Project reach, however adding in some beaver dam analogs or similar may be desirable to increase in-stream habitat and decrease bed grade through aggradation. Following discussion and review of the geomorphology results, biotechnical bank treatments composed of meadow sod and staked with wood or willows are proposed in the 30% plans where the hydraulic model velocities are higher and erosion more likely. These areas will require additional field fitting to target the right locations appropriately. Bank protection measures, such as willow plantings, boulders, rootwad bank revetment, and willow/blanket bank treatment will also be incorporated in the vicinity of the bridge abutments to protect against scour. In the immediate vicinity of the bridge crossing, where an adequate conveyance area needs to be maintained, keyed boulders or rock armoring without any planted willow poles may be required.

With the exception of the bridge work and grade control element at the relic beaver dam location, work in the river should be done by small equipment and hand labor. When larger equipment such as an excavator is necessary, a controlled spur road access point and meadow protection measures such as encapsulated roads, timber mats or Duradeck mats will need to be incorporated into the 65% designs in order to allow heavy equipment to cross the meadow without causing any damage.

One unique challenge to this site is finding a way to allow equestrians to access the creek water for their horses without causing damage to the creek bed and banks. Options for this could include 1) a controlled access point to the river that is clearly designated and stabilized with pavers or similar or 2) a "dipping" bucket system at the river bank and trough located away from the river bank to allow horse watering outside of the creek. More discussion with the equestrian users is recommended before deciding on elements to incorporate into 65% designs.

Given the meadow is well supported by the spring fed swales, there isn't a critical need to promote channel aggradation to increase overbanking frequency, therefore 65% channel restoration design will focus on erosion prevention and aquatic habitat improvements .

Access and Staging

Three optional temporary staging locations in upland areas along the temporary South Euer Valley Road access are shown on 30% Plans Sheet C-3. These areas could be combined or eliminated, and additional areas could be added based on stakeholder, particularly TDA as the landowner input. There are a few areas of South Euer Valley Road that will need to be retrofitted, particularly at drainage crossings, in order to allow large equipment or trucks and trailers to reach the Project site.

Creek Diversion/Dewatering/Construction Water

A majority of the bridge and creek work will be initiated later in the season to take advantage of a drier meadow and low base flows making access and diversion easier. , Given Prosser Creek is a perennial stream, a diversion plan will be needed and included in the 65% design documents. Dewatering will also be needed for pier/abutment installations and incorporated into the 65% plans and specifications.

Due to the remoteness of the site, source water for dust control and construction applications is currently assumed to be SF Prosser Creek, however this may be an issue in regard to water rights or sensitive resource protections. Further discussion with TRWC and TDA regarding possible water sources for construction is needed during 30% design review.

10. Option 1 and Option 2 Comparison

The following highlights design opportunities and constraints associated with the Option 1 and Option 2 trail and bridge alignments to support further discussion during 30% design review and ultimately selection of a single trail and bridge alignment to move forward into 65% designs. A matrix that includes additional considerations is provided as Attachment 6.

Opportunities

- Option 1 trail and bridge alignment more closely follow the existing trail alignment through the valley meadow so remain a likely preferential trail alignment for users.
- Option 2 bridge crossing is located at a straighter, more stable channel reach and requires a shorter bridge span.

Constraints

- Option 1 bridge location requires a longer span and center bents (i.e., is not free spanning).
- Option 1 bridge is located on the edge of a landslide/alluvial fan surface and crosses at a tortuous meander bend. This brings increased risk of bridge undermining under a significant flood event such as 1997 where the river could potentially cut off the meander and cut a more direct channel in the vicinity of the south bridge abutment.
- Option 2 bridge and trail alignment requires a second boardwalk crossing at an existing drainage swale on the south side, as well as a potentially substantial amount of boardwalk, depending on the outcome of the final wetland delineation study
- Option 2 impacts the current wintertime alignment and grooming operation, as well as the location of the existing Coyote hut.

11. 30% Design Sheet Summary

The following describes the sheets included in the 30% Plan set and includes notes on those sheets that will be added for 65% plans. In addition, the required Nevada County design plan standards will be reviewed and incorporated into the 65% plans and the required technical specifications will be included.

Title Sheet

(A-1) Project Title, Key Signatories and Project Vicinity and Site Location Information

Notes Sheet

(A-2) General Notes/Specifications, Sheet Index, Legend and Abbreviations

Sheet Index

(X) [Not yet in 30% Plans- Placeholder for 65% Plans] Will be added to show layout of plan view sheets for trail, bridge and creek improvements once single alignment is chosen and extent of creek improvements is determined.

Existing Site Layout

(C-1 and C-2) Plan view of creek improvements.

Access and Staging

(C-3) Optional Staging Areas and Access via South Euer Valley Road

Bridge Option 1

(C-4) Plan view of Option 1 Bridge Crossing and Approaches

Bridge Option 2

(C-5) Plan view of Option 2 Bridge Crossing and Approaches

Trail Plan and Profile

(C-6-C-10) Option 1 and 2 Trail Alignment Plan and Profile Views. Note profiles have 10x vertical scale exaggeration. Once single alignment and bridge option is chosen, the trail designs will be further developed and detailed including alignment adjustments to reduce gradients for trail sections steeper than 10% gradient.

Boulder Weir Profile

(C-11) Creek Profile showing potential locations for boulder weir placement

Bridge Elevation

(S-1) Structural Sheet showing Option 1 Bridge Crossing Elevation View and Partial Plan View of Boardwalk Trail tied directly to Bridge Deck (rather than constructed ramp).

Optional Bridge

Sections (S-2) Section Details of Bridge Structure (Optional) Types and Supports

Optional Boardwalk

Sections (S-3) Section Details of Boardwalk Structure (Optional) Types and Supports

Abutment Details

(D-1) Placeholder for Abutment Details to be further developed at 65% design, once Bridge Structure Type is selected

Bridge Approach

Details (D-2) Details for bridge approach options.

Creek Details

Details (D-3) Biotechnical bank treatment typical details.

Diversion/Dewatering A Diversion and Dewatering plan and specifications will be integrated at 65%.

Revegetation Revegetation sheets will be developed at 65% design to include treatment areas and seed tables.

Misc. Details Sheets

Additional Detail sheets will be added at 65% design to include creek improvement details (e.g., BDAs, biotechnical bank stabilization details, etc.), temporary erosion control details (i.e., exclusion fencing, silt fencing, fiber rolls), and possibly required signage, creek diversion, meadow protection measures, etc.

12. REFERENCES CITED

Nevada County, California, Land Use and Development Code (Title 3), Chapter XVII: Road Standards, Article 5, Storm Drainage. Available at: http://qcode.us/codes/nevadacounty/view.php?topic=3-xvii-5-l__1&frames=off

USGS U.S. Geological Survey, 2016, The StreamStats program, online at http://streamstats.usgs.gov, accessed on November 11, 2020.