Twisp River

Scaffold Camp Project

Concepts

Basis of Design Report

Yakama Nation Fisheries

December 2020

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1. Preface

The Scaffold Camp Reach is between River Mile (RM) 15.1 and 16.4 of the Twisp River. Several concepts for enhancements in this reach were provided in the Scaffold Camp Concept Report (Inter-Fluve 2015). The concepts described in this 2020 conceptual design report focus more narrowly on opportunities for on Yakama Nation property and adjoining private parcels on the river-right floodplain between RM 15.4 to RM 15.8 (Figures 1 & 2).

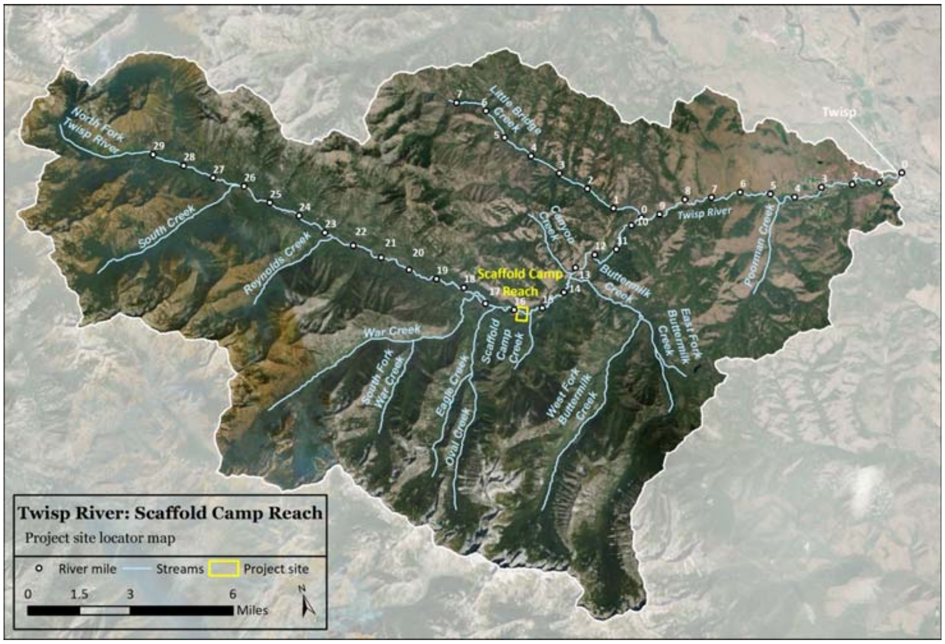

Figure 1. Project reach location map.

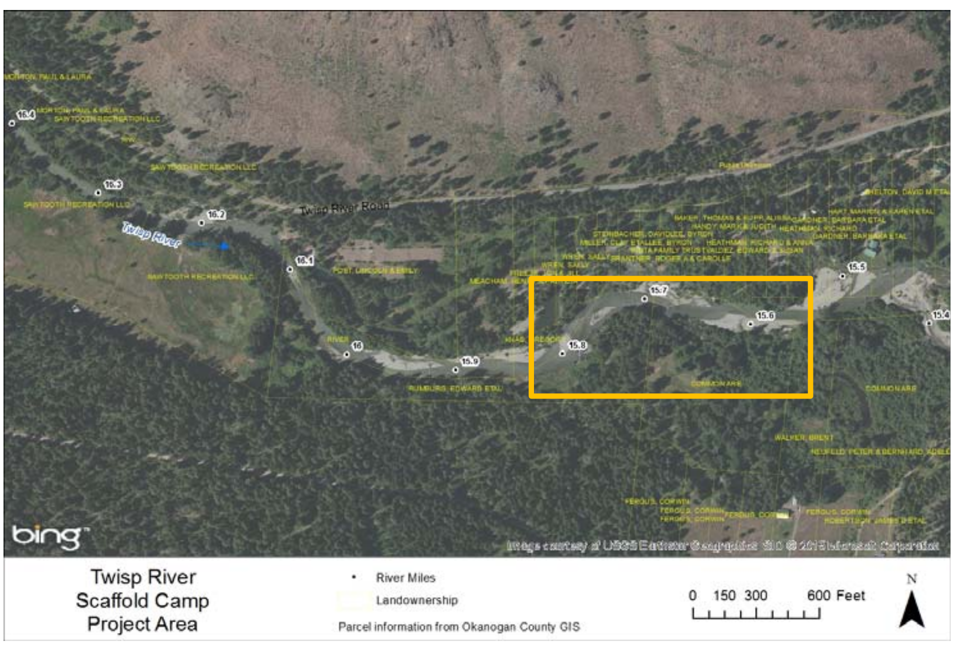

Figure 2. Scaffold Camp project area

The goal of the proposed project is to enhance adult spawning and juvenile rearing habitat for ESA-listed endangered Upper Columbia spring Chinook Salmon (*Oncorhynchus tshawytscha*) and threatened summer steelhead (*Oncorhynchus mykiss*) in accordance with the 2017 Biological Strategy (UCRTT 2017). Bull trout (*Salvelinus confluentus*) and west slope cutthroat trout will also benefit from the project.

1.1 NAME AND TITLES OF SPONSOR, FIRMS AND INDIVIDUALS RESPONSIBLE FOR DESIGN

The project is sponsored by Yakama Nation Fisheries (YN). Inter-Fluve is the engineering design firm. Mike McAllister (PE) is the licensed engineer of record for this project and Mike Brunfelt (LG) is on the design team.

1.2 LIST OF PROJECT ELEMENTS THAT HAVE BEEN DESIGNED BY A LICENSED PROFESSIONAL ENGINEER

Mike McAllister (PE) is the licensed engineer of record for this project. Project elements include the following, with BPA HIP activity and risk category included:

Table 1. Activity categories and risk included in the project.

Description of Proposed Enhancement	Work Element	HIP Category	HIP Risk Level
Log structure construction to improve main channel habitat suitability and stability	Install habitat-forming natural material instream structures	2d	Medium
Low floodplain enhancement to improve off-channel habitat	Improve secondary channel and wetland habitats	2a	Medium
Revegetation of all disturbed surfaces	Riparian vegetation planting	2e	Low

1.3 EXPLANATION AND BACKGROUND ON FISHERIES USE (BY LIFE STAGE – PERIOD) AND LIMITING FACTORS ADDRESSED BY THE PROJECT

Fish species known to utilize the project areas include ESA-listed (endangered) spring Chinook Salmon, ESA-listed (threatened) summer steelhead and Bull Trout, and unlisted Westslope Cutthroat Trout, Pacific Lamprey, Mountain Whitefish, and non-native Brook Trout (Figure 3). Chinook Salmon, steelhead, and Bull Trout are focal species for this habitat enhancement project, while the work is also expected to benefit all species present.

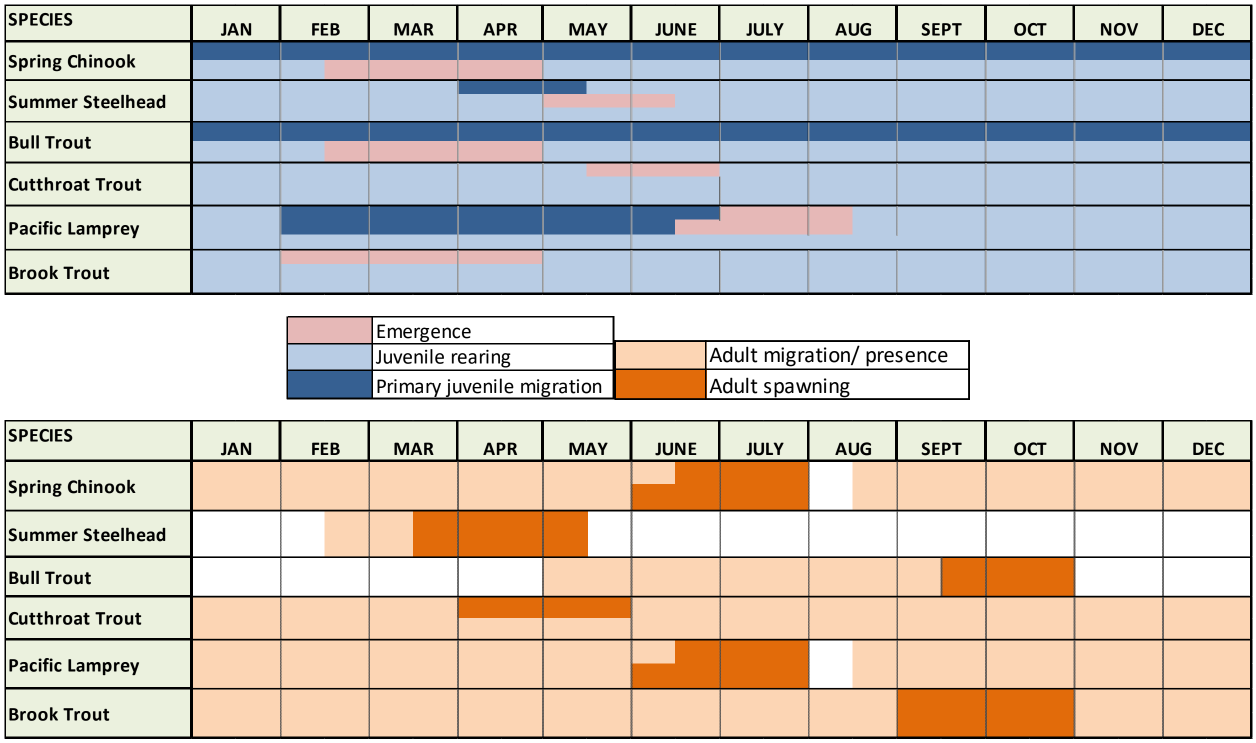

Figure 3. Life history timing of fish species within the Upper Twisp River and Little Bridge Creek.

1.3.1 Summer steelhead

Adult summer steelhead destined for the Twisp River pass Wells Dam from July through May, with peak migration in September. Most adults overwinter in the Wells pool, while some hold in large pools in the mainstem Methow River. Adult summer steelhead enter the Twisp River from February through May, holding in deep pools with overhead cover (NWPCC 2004). Spawning begins in late March, peaks in late-April, and lasts through May. Egg survival is highly sensitive to intra-gravel flow, temperature and is particularly sensitive to siltation earlier in the incubation period (Healy 1991). Fry emerge from the redds 6-10 weeks after spawning (Peven 2003).

Age-0 juveniles spend their first year primarily in shallow riffle habitats, feeding on invertebrates and utilizing overhanging riparian vegetation and undercut banks for cover (Moyle et al. 2002, US Fish and Wildlife Service 1995). Age-0 steelhead use slower, shallower water small boulder and large cobble substrate (Hillman et al. 1989). Older juveniles prefer faster moving water including deep pools and runs over cobble and boulder substrate (US Fish and Wildlife Service 1995). Juveniles out-migrate between ages one and four, though some hold over and display a resident life

Figure 4. Sub yearling steelhead resting behind a constructed log structure (Entiat basin, WA).

history form. Smolts begin migrating downstream from natal areas from April through mid-May (NWPCC 2004).

1.3.2 Spring Chinook

Spring Chinook enter the Twisp River from late May through early September, with peak spawning occurring in late August and early September (Inter-Fluve 2016). Spawning in the Twisp River is concentrated between RM 10 and 27 (Inter-Fluve 2016). Fry emerge in the spring and seek out backwater or margin areas with lower velocities, dense cover, and abundant food (Quinn 2005). Near-shore areas with eddies, large woody debris, undercut tree roots, and other cover are very important for post-emergent fry (Hillman et al. 1989, Healy 1991). Age-1 parr move into deeper pools with resting cover in natal streams and migrate to smaller tributaries for extended periods of rearing. On the Twisp River, juvenile rearing occurs downstream of RM 27 (Inter-Fluve 2016). Spring Chinook express a stream-type life history where they rear for 1 year in freshwater before out-migrating as yearlings from late February through early May.

Figure 5. Yearling spring Chinook feeding in the Entiat River

1.3.3 Bull Trout

The Twisp River supports a population of resident, fluvial, and adfluvial bull trout (NWPCC 2004). Bull Trout from the Columbia River migrate into the Methow subbasin from May through June (BioAnalysts 2002, 2003). Spawning occurs in the Twisp River from RM 22 to 29, and other tributaries from mid- September through October. Bull trout juveniles rear in headwater streams for at least two years before migrating downstream as adults or sub-adults to express fluvial, adfluvial, or resident life histories in downstream reaches (McPhail and Baxter 1996).

1.3.4 Limiting factors for resident and anadromous fish

Ecological concerns for the Twisp River have been summarized in the document *A Biological Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region* (UCRTT 2017). The Regional Technical Team (RTT) identified several ecological concerns or limiting factors affecting habitat conditions in the Upper Twisp River. They are:

1. Peripheral and transitional habitats – Reconnect disconnected side channels or where low wood loading has changed the inundation frequency, improve hydraulic connection of side channels and wood complexity within the side channels;

2. Channel structure and form (instream structural complexity) – Install large wood and engineered log jams in strategic locations to provide short-term habitat benefits and intermediate-term channel form and function benefits;

3. Channel structure and form (bed and channel form) – Remove levees, undersized bridges, bank armoring and other human features;
4. Riparian Condition – Restore conditions in degraded areas, improve large woody debris (LWD) recruitment, fence riparian areas and wetlands;
5. Food – Estimate amount of nutrients needed in the assessment unit, and increase nutrients to the watershed using hatchery carcasses and/or carcass analogs;
6. Sediment – Road management, reduction, and maintenance to restore sediment and large wood recruitment rates within riparian and upland areas; and
7. Species interactions – Reduce or eliminate brook trout in high-density areas.

1.4 LIST OF PRIMARY PROJECT FEATURES CONSTRUCTED OR NATURAL ELEMENTS

The proposed project actions address Ecological Concerns 1, 2, & 4 identified in the Biological Strategy. Key components of the proposal are to (1) create a new perennial side channel, and (2) construct mainstem large wood structures, and (3) develop spring creek flow to an existing oxbow.

1.4.1 Side Channel

There is a series of channel scars to the south of the main channel between RM 15.8 and RM 15.7, through which a side channel could be excavated and connected to the main channel to provide a perennial juvenile rearing habitat.

The concepts drawings in Appendix A depict the activation of the proposed side channels through river-right floodplain on land owned by the Yakama Nation. The side channel network is shown as having two inlets: a primary inlet just downstream of an existing logjam, and a secondary alcove with an inlet to receive flow that seeps through/under the existing porous logjam. The site characteristics and existing river planform are well suited for a side channel project. The multithread inlets would provide diverse flow conditions with the primary inlet receiving relatively unimpeded flood inflow to a 550 foot long channel, while the secondary inlet would be fed more metered flow to a 380 foot long alcove.

The side channel and alcove converge to a single thread side channel with outlet that would occur at the downstream end of an existing pool in the river. The river bank near the outlet has remnants of a push up gravel berm that would be removed. Site disturbance will be kept to a minimum by keeping construction access largely within the footprint of the new side channel and berm removal.

The conceptual design took into account existing trees. The disturbance limits avoid them to the extent practicable; however, several trees are unavoidable and would be removed. All removed trees and shrubs would be salvaged and used to enhance side channel or mainstem large wood habitat. Additional imported logs with roots will be needed to provide habitat by providing structure that creates diversity in velocity, inducing scour and deposition patterns, and dissipating flood energy through physical roughness.

Site access routes are relatively open. The main access and staging would occur in an open field where the existing driveway accessing the property ends. All of the side channel work would be on Yakama Nation property.

1.4.2 Spring Creek

Providing spring creek flow to off channel areas using a groundwater gallery has shown promise in some segments of the mainstem Methow River valley where local groundwater conditions and slope can support it. A groundwater gallery is a system of slotted pipe, or well-screen, lain horizontally underground to collect groundwater. The well-screen is connected to conveyance pipe to deliver the collected water to an outfall to produce a concentrated outfall of groundwater flow, or spring. The groundwater gallery system relies on gravity to move the water so there are no pumps and no maintenance.

Groundwater side channels can provide beneficial cold water habitat in the summer months as well as more productive warm-water habitat in the winter months. The warm water habitat during winter is particularly important because an ice free habitat can be very valuable for salmonid rearing.

The relationship between groundwater and surface water at the Scaffold Camp site is currently unknown, but site conditions appear conducive to the collection of hyporheic flow where it is abundant and accessible and delivering it downvalley to a large abandoned river channel, which is now an oxbow and wetland complex that is currently disconnected from surface flows.

See drawing in Appendix A. The buried well screen would be on private land at roughly RM 15.8, and flow would be conveyed by pipe across Yakama Nation property, and discharged to the oxbow at about RM15.6. The upper 200 feet of the oxbow is on Yakama Nation property and continues another 1,000 feet across private land.

The feasibility of a groundwater gallery system will be contingent on groundwater monitoring and pump testing results. Groundwater monitoring will by a piezometer and data logger that will track seasonal groundwater levels. The pump test will verify key variables including: 1) the quantity of water that can be harvested reliably in a given length of well-screen, and 3) the drawdown elevation of the water table where the groundwater is withdrawn. The drawdown elevation will be important to determine whether adequate slope exists to support gravity fed flow. For planning purposes, 3 cfs would be a typical spring creek flow provided by a groundwater gallery.

1.5 DESCRIPTION OF PERFORMANCE/ SUSTAINABILITY CRITERIA FOR PROJECT ELEMENT S AND ASSESSMENT OF RISK OF FAILURE TO PERFORM, RISK TO INFRASTRUCTURE, POTENTIAL CONSEQUENCES, AND COMPENSATING ANALYSIS TO REDUCE UNCERTAINTY

1.5.1 Infrastructure and flood risk

There is no infrastructure flood risk related to the project. The work area is on Yakama Nation land, the project sponsor. The project will not increase existing risk to adjacent landowners.

1.5.2 Design criteria

Ground based heavy equipment will be used to construct the project. Large wood structures will be stabilized to maintain position and function during high flow by using partial burial of logs and bracing to timber piles. The side channel creation requires excavation. Removed materials would be hauled to an upland fill location.

1.5.3 Risk of failure to perform

The site is well suited for a side channel enhancement project. There is very low risk that importing large wood will fail to improve channel and floodplain habitat. Side channel slope is sufficient to maintain sediment transport and likely to be maintained by natural runoff. Natural woody debris entering the side channel could change hydraulic and depositional characteristics.

Changes in the natural logjam may impact flows to the secondary (alcove) leg of the side channel network. If the logjam where to break up and introduce more flow to the alcove, it could become a side channel but it will be designed with this is mind so there will be no risk of failure to perform.

At this early stage in the design, it is unknown whether there is viable groundwater or landowner support to enhance spring creek flow to the oxbow wetland. The viability of such a project will be determined at a later date if landowner support is gained.

1.6 DESCRIPTION OF DISTURBANCE INCLUDING TIMING AND AREAL EXTENT AND POTENTIAL IMPACTS ASSOCIATED WITH IMPLEMENTATION OF EACH ELEMENT

Disturbance areas and access are depicted in the drawing set. Disturbance will be limited to access routes, the side channel footprint, and extents of log burial. Excavation and hauling will largely remain within the side channel limits, working back to the main access point. Trees will be avoided to the extent possible. All removed trees will be utilized in the project to provide habitat or floodplain roughness. The timing of construction will be connected with the July/August Twisp River in water work period.

2. Resource inventory and evaluation

2.1 DESCRIPTION OF PAST AND PRESENT IMPACTS ON CHANNEL, RIPARIAN AND FLOODPLAIN CONDITIONS

Valley bottom roads, timber harvest, mining and fires, have altered the watershed and indirectly the project reach. Disturbances that have depleted the valley bottom of large wood (trees) that may eventually find their way into the river channel and create natural salmonid habitat (cover and pools) have been most impactful. Although the valley bottom has patches of large trees, a significant percentage are in a young seral stage that will take decades to mature enough to create habitat if they enter the active stream channel.

Downstream of the USFS boundary land has been cleared for pasture and/or developed for part time or full-time residential use. Levees and/or riprap have been installed to protect these structures from flood damage and channel migration. The project reach is very responsive to large wood accumulation and can quickly migrate and alter its planform if large trees accumulate along river bends and on gravel bars. While positive for creating and maintaining quality fish habitat, these natural processes conflict with nearby residential development and have been stopped or altered in several locations to protect existing infrastructure.

2.1.1 Instream flow management and constraints in the project reach

There are no known instream flow management constraints, although it remains unknown if landowner permission will be granted for spring creek flow to the oxbow.

2.2 DESCRIPTION OF EXISTING GEOMORPHIC CONDITIONS AND CONSTRAINTS ON PHYSICAL PROCESSES

Bedrock geology in the upper Twisp headwaters is composed of intrusive ingenious rocks. Immediately upstream of the Scaffold Camp reach the northeast (left) side of the valley is composed of sedimentary and volcanic rocks and the southwest (right) side of the valley composed of metamorphic rocks. The Scaffold Camp reach is downstream of this structural fault that divides the two rock types and lies entirely within the zone underlain by sedimentary and volcanic rocks Existing geomorphic conditions in the Upper Twisp are those left behind following alpine glacial advance and retreat. Alpine glacial advances ran down the Twisp River valley following the NW to SE trending structural fault zone that divides the rock types described above.

During glacial melt and retreat the valley was filled with alluvium. During this time, tributaries formed perpendicular confluences to the valley depositing alluvium eroded from their watersheds onto the valley forming alluvial fans. Debris torrent processes then and now occur in steep tributary drainages especially following stand replacing fires and over time have episodically transported sediment to the valley floor and Twisp River channel. As glacial retreat proceeded, melt water and sediment supply that filled the valley lessened. The reduction in sediment supply enabled the Twisp to slowly cut down through deposited glacial alluvium and today is primarily controlled vertically by bedrock contacts and alluvial fan deposits. Bed, bank, landslides and tributaries continue to feed the project reach with new and reworked alluvium.

Historically the river has been free to migrate across alluvial segments of valley bottom. Residential structures are often protected by riprap and levees in portions of the valley bottom which prevent migration processes and natural habitat development in those areas. The Scaffold Camp project reach provides a good example of this activity.

2.3 DESCRIPTION OF EXISTING RIPARIAN CONDITION AND HISTORICAL RIPARIAN IMPACTS

Riparian vegetation is in good condition adjacent to the channel within the project reach. Large cottonwood trees are intermixed with younger age classes of riparian cottonwood, alder, willow and dogwood.

2.4 DESCRIPTION OF LATERAL CONNECTIVITY TO FLOODPLAIN AND HISTORICAL FLOODPLAIN IMPACTS

Channel modifications are prevalent in the Scaffold Camp Reach. A series of pushup berms limits the river's access to the floodplain surface to the north, and an associated series of excavated ponds occupy portions of the former main channel alignments. Limitations on in-stream fish habitat in this overall reach include channel planform simplification, floodplain disconnection, and a reduced quantity of in-stream wood.

The floodplain where the current Scaffold Camp Project is intended has good potential for restoring lateral connectivity. The site has discontinuous push up berms and what seems to be excavation to create ponds and/or fill to form pads for homes or outbuildings. All permanent structures have been removed from the site but the fill associated with them remains.

2.5 TIDAL INFLUENCE IN PROJECT REACH AND INFLUENCE OF STRUCTURAL CONTROLS (DIKES OR GATES)

Not applicable to this project.

3. Technical data

3.1 INCORPORATION OF HIP SPECIFIC ACTIVITY CONSERVATION MEASURES FOR ALL INCLUDED PROJECT ELEMENTS

HIP (currently HIP IV) conservation measures will be met through the project design and requests for variances will be submitted for any conservation measures that cannot be met.

3.2 SUMMARY OF REACH INFORMATION AND MEASUREMENTS (SURVEY, BED MATERIAL, ETC) USED TO SUPPORT ASSESSMENT AND DESIGN

3.2.1 Elevation data

Project survey was completed in 2014, 2015, and 2020. The 2014 survey was river cross sections for the Middle Twisp Assessment. The 2020 survey was for detailed topography of floodplain in the project area, and updating river bank where erosion has occurred since 2014. The 2020 survey data also included large trees on the site and a natural accumulation of large wood. The 2020 survey was associated to the 2014 survey by utilizing recovered control points. New temporary control points were installed outside of the floodplain for reference during future survey and layout.

3.2.2 Fish use

Fish presence and life-stage timing data were taken from the 2017 Biological Strategy (UCRTT 2017), Methow Subbasin Plan (NWPCC 2004), Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007), Middle Twisp Reach Assessment, and empirical PIT tag and screw trap data from Columbia River Data Access in Real Time (DART 2018). Habitat preference information was taken from the primary literature.

3.2.3 Aerial images

Historical air photo images back to 1998 were found and examined, but are not included in this report.

3.3 SUMMARY OF HYDROLOGIC ANALYSES CONDUCTED, INCLUDING DATA SOURCES AND PERIOD OF RECORD INCLUDING A LIST OF DESIGN DISCHARGE (Q) AND RETURN INTERVAL (RI) FOR EACH DESIGN ELEMENT

In 2008 the United States Bureau of Reclamation (USBR) completed an incremental peak flow hydrologic analysis below the confluence of several named tributaries of the Twisp Watershed. Scaffold Camp Creek (RM 15.9) was one tributary very near the proposed project work. USBR hydrologic analysis was found to be consistent on a watershed area basis with a more recent analysis completed by Rio ASE below Eagle Creek (Rio ASE, 2016) 1.5 miles upstream. The 2008 USBR flows were used in the hydraulic analysis and are summarized in Table 2.

Table 2. Peak Discharge at RM 15.9 from USBR (2008).

Recurrence flow	Downstream of Eagle Creek	2-YR	5 -YR	10-YR	25-YR	50-YR	100-YR
Discharge (cfs)		1,152	1,714	2,111	2,639	3,050	3,473

3.4 SUMMARY OF SEDIMENT SUPPLY AND TRANSPORT ANALYSES CONDUCTED, INCLUDING DATA SOURCES INCLUDING SEDIMENT SIZE GRADATION USED IN STREAMBED DESIGN

The Middle Twisp River Reach Assessment and Restoration Strategy collected several representative pebble counts (Interfluve, 2015) that included the Scaffold Camp project reach. The Scaffold reach is composed of small cobble and gravel, and pebble counts on riffles of the reach are summarized in Figure 6. D84 is roughly 180mm (6”) and D50 of 90mm (3.5”).

Observations of riverbank, riverbed, and scouring of floodplain indicate that the project area has been worked by river processes. The underlying materials are likely to be alluvium at the elevations and alignments of the side channels. Therefore, it appears that side channels could be formed within the floodplain surfaces without importing streambed materials for channel construction.

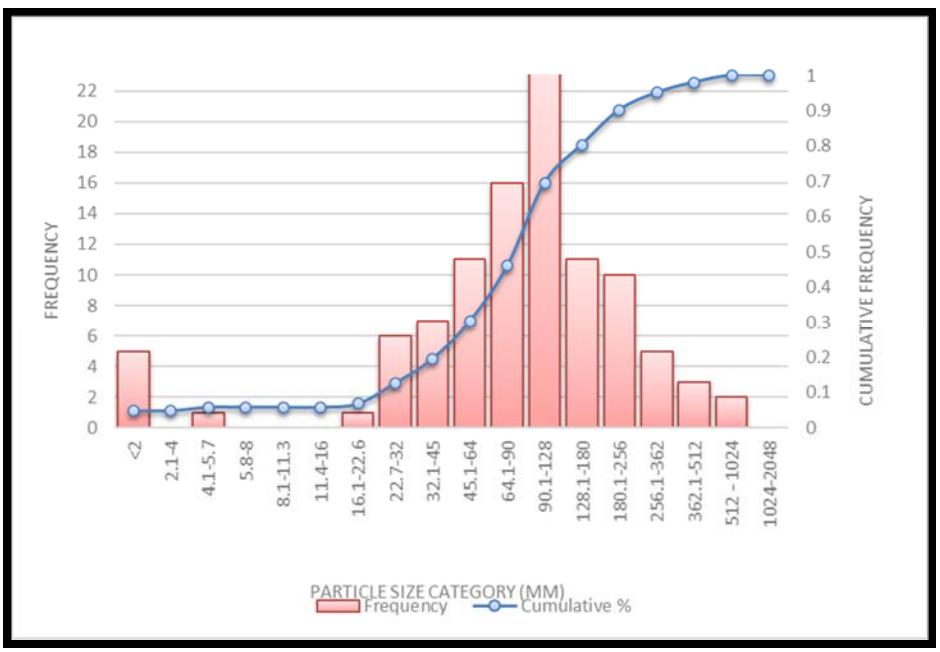

Figure 6. Pebble count results representing Scaffold Reach substrate.

3.5 HYDRAULIC MODELING OR ANALYSES CONDUCTED AND OUTCOMES – IMPLICATIONS RELATIVE TO PROPOSED DESIGN

3.5.1 Hydraulic Model

Existing channel and floodplain hydraulics were simulated using the U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS 5.0.7; USACE 2019), a computer software package that calculates the hydraulics of water flowing on terrain using one-dimensional (1D) or two-dimensional (2D) equation sets. At the current project phase (concepts), the main objectives of the modeling efforts were to assess the hydraulics of the project site and surrounding areas for existing conditions, and to provide the basis for modeling proposed actions in future project phases.

The existing conditions HEC-RAS model was developed using a combination of several sources, including 2018 LiDAR, and survey data collection of river and floodplain in 2013 and 2020. The modeled reach extends well upstream and downstream of the project area so that hydraulic computations are stable in the project vicinity.

The 1D model geometry consists of cross-sections spanning the river corridor, perpendicular to flow, with an spacing ranging 50-150 feet. Station-Elevation data from the combined terrain model were applied using the RAS Mapper tools in HEC-RAS.

The roughness values for the 1D model are 0.04 in channel and 0.12 on floodplain. These values are consistent with field observations as well as published guidelines for channel types and vegetation conditions (Arcement & Schneider 1989).

The 1D model was run as subcritical flow with downstream boundary condition as normal depth associated with slope of 0.006 ft/ft.

The 2D model geometry consists of a computational grid with a nominal cell size of 25 feet. Breaklines were added as needed to align cell faces along high ground features. Elevation data from the composite terrain model was applied to the computational domain and hydraulic roughness were applied by delineating a spatially varying landcover layer in GIS Software.

A spatially varying roughness (Manning's n) layer was created by hand-digitizing regions with similar land cover. In general, roughness coefficients were applied to these regions based on field observations, aerial photos, and professional judgement. Manning's 'n' or roughness values corresponding with various types of land cover and channel characteristics were input to the 2D model as follows:

Main channel - 0.038
Pond (open water in oxbow, relict channel) - 0.02
Side channel – 0.065
Gravel bar, scattered shrubs and occasional woody debris - 0.07
Floodplain with thin riparian forest – 0.085
Dense riparian forest – 0.1

Roughness values for the 2D model are lower than for the 1D model because irregularities in terrain are represented in the model geometry and do not need to be incorporated into the roughness coefficient (Robinson et al., 2019).

The peak flows for floods listed in Table 2 were run in the 1D model as steady state flows, and for the 2D model they were incorporated into a synthetic hydrograph with periods of steady flow (at the discharges of interest and other intermediate discharges) connected by smooth transition periods to create a stair-step like pattern. The periods of steady flow allow the model to come to a quasi-steady state condition, which facilitates the interpretation of hydraulics at specific discharges.

3.5.2 Model Results

1D and 2D model results are shown in Appendix B.

The 1D model predicts channel shear during the 2-yr flood varies 0.4 to 2.1 psf and an average of about 1.0 psf (Figure 7). The Shields Equation $\tau^*=0.047/(\gamma_s-62.4)D_s$ calculates an incipient motion size of 5.1 inch cobble for a shear of 2.1 psf, and 2.7 inch cobble for shear of 1.0 psf. This is fairly consistent with D50 and D84 (3-6″) of the pebble count (Figure 6), which suggests ~6″ and smaller alluvium is transported by the 2-yr flood.

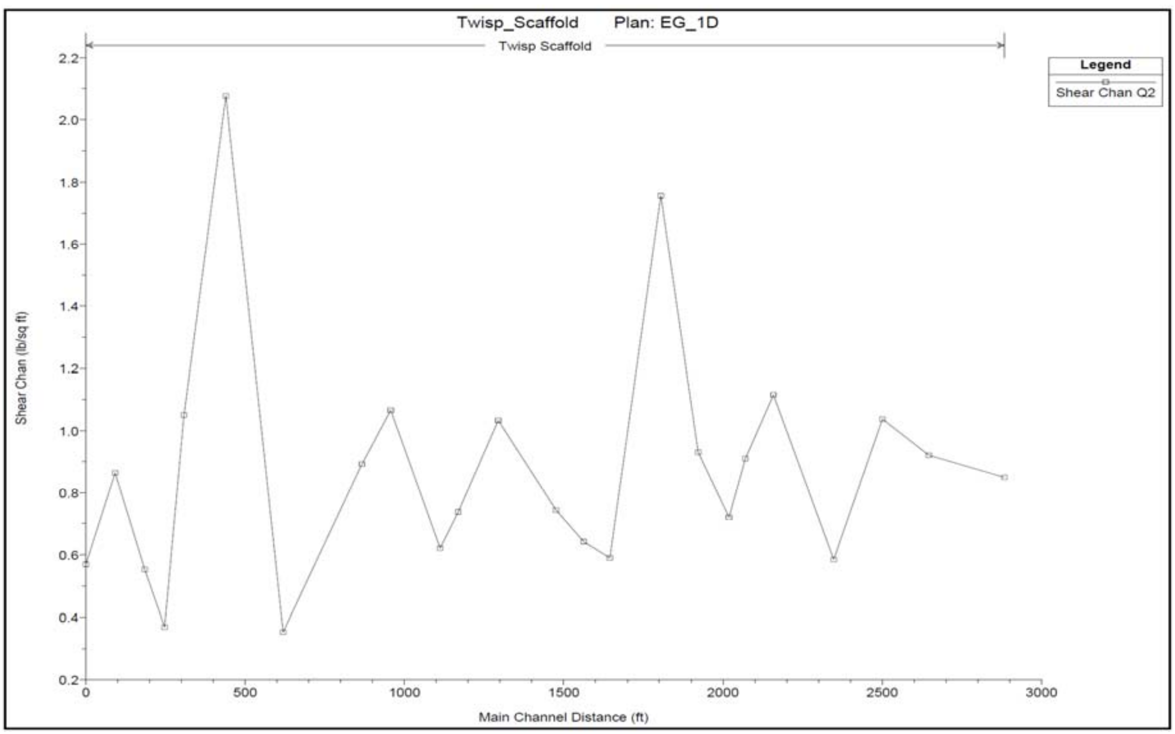

Figure 7. 2 Shear plot – 2 yr flood of Twisp River at Scaffold Camp project.

A new side channel on the inside of the river meander would have equal or greater slope than the mainstem, and with appropriate design of channel dimensions and roughness, could maintain sediment transport continuity.

Proposed conceptual enhancement actions were not modeled.

3.6 STABILITY ANALYSES AND COMPUTATIONS FOR PROJECT ELEMENTS, AND COMPREHENSIVE PROJECT PLAN

Wood ballast computations are not included in the concepts phase. For future design phases, it is anticipated that ballast using both burial and vertical piles will be used for the project work in the Scaffold Camp reach. Stability analysis will follow professional practice guidelines for large wood design (Knutson and Fealko 2014 and USBR and ERDC 2016), stream habitat restoration (Cramer 2012), Stability of Ballasted Woody Debris Habitat Structures (D'Aoust and Millar 2000) and institutional knowledge combined with professional judgment.

3.7 DESCRIPTION OF HOW PRECEDING TECHNICAL ANALYSIS HAS BEEN INCORPORATED INTO AND INTEGRATED WITH THE CONSTRUCTION – CONTRACT DOCUMENTATION

The preceding analysis is the basis for conceptual design plans only.

3.8 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A LONGITUDINAL PROFILE OF THE STREAM CHANNEL THALWEG FOR 20 CHANNEL WIDTH UPSTREAM AND DOWNSTREAM OF THE STRUCTURE SHALL BE USED TO DETERMINE THE POTENTIAL FOR CHANNEL DEGRADATION

Not applicable to this project.

3.9 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A MINIMUM OF THREE CROSS-SECTIONS – ONE DOWNSTREAM OF THE STRUCTURE, ONE THROUGH THE RESERVOIR AREA UPSTREAM OF THE STRUCTURE, AND ONE UPSTREAM OF THE RESERVOIR AREA OUTSIDE OF THE INFLUENCE OF THE STRUCTURE) TO CHARACTERIZE THE CHANNEL MORPHOLOGY AND QUANTIFY THE STORED SEDIMENT

Not applicable to this project.

4. Construction – contract documentation

4.1 INCORPORATION OF HIP GENERAL AND CONSTRUCTION CONSERVATION MEASURES

At later design stages, standard conservation measures will be included in the drawings.

4.2 DESIGN – CONSTRUCTION PLAN SET INCLUDING BUT NOT LIMITED TO PLAN, PROFILE, SECTION AND DETAIL SHEETS THAT IDENTIFY ALL PROJECT ELEMENTS AND CONSTRUCTION ACTIVITIES OF SUFFICIENT DETAIL TO GOVERN COMPETENT EXECUTION OF PROJECT BIDDING AND IMPLEMENTATION

Concept drawings can be viewed in the drawing set. Design drawings will provide greater detail.

4.3 LIST OF ALL PROPOSED PROJECT MATERIALS AND QUANTITIES

Imported and placed large wood/trees are the only proposed material for the project.

4.4 DESCRIPTION OF BEST MANAGEMENT PRACTICES THAT WILL BE IMPLEMENTED AND IMPLEMENTATION RESOURCE PLANS INCLUDING:

Later stages of design will include:

- Reach access staging and sequencing plan
- Work area isolation and dewatering plan
- Erosion and pollution control plan
- Reach reclamation and restoration plan
- List of proposed equipment and fuels management plan

4.5 CALENDAR SCHEDULE FOR CONSTRUCTION/IMPLEMENTATION PROCEDURES

A construction timeframe has not been finalized.

4.6 REACH OR PROJECT SPECIFIC MONITORING TO SUPPORT POLLUTION PREVENTION AND/OR ABATEMENT

To be completed during later design phases.

5. Monitoring and adaptive management plan

Monitoring and adaptive management plans will be determined at the discretion of the Yakama Nation. It is anticipated that following project construction a monitoring plan will be completed at a scale and level of effort similar to previous Yakama Nation projects constructed within the Methow Basin.

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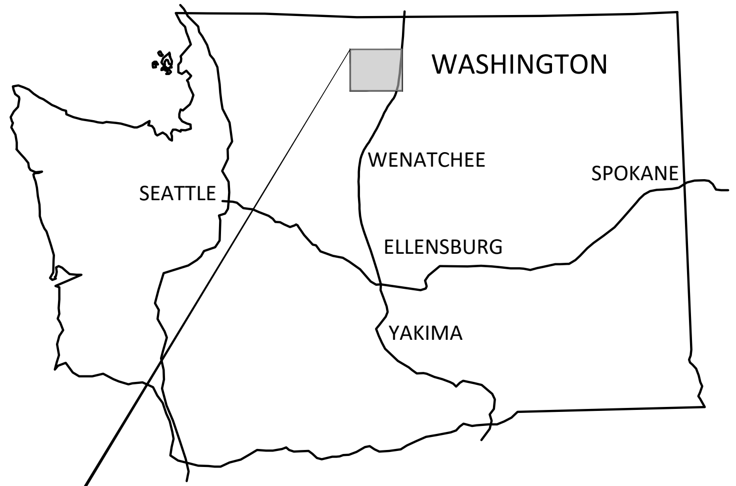
7. Appendices

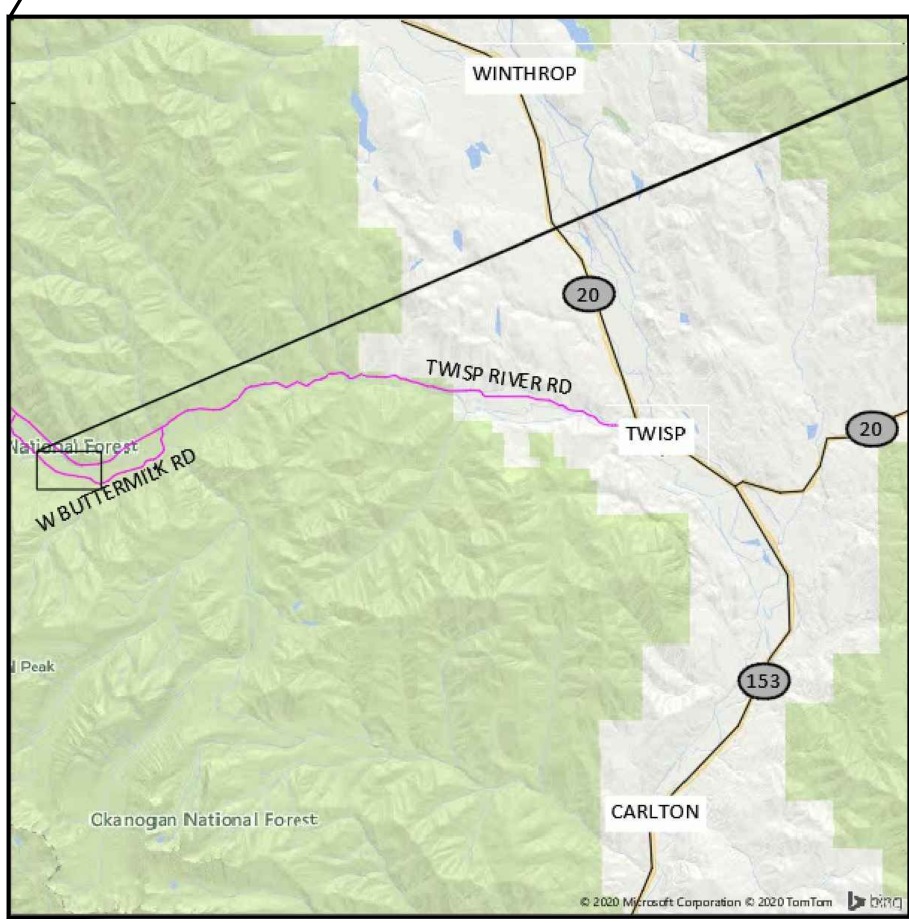
A – Concept Drawings

B – Hydraulic Model Results

Appendix A
Concept Drawings

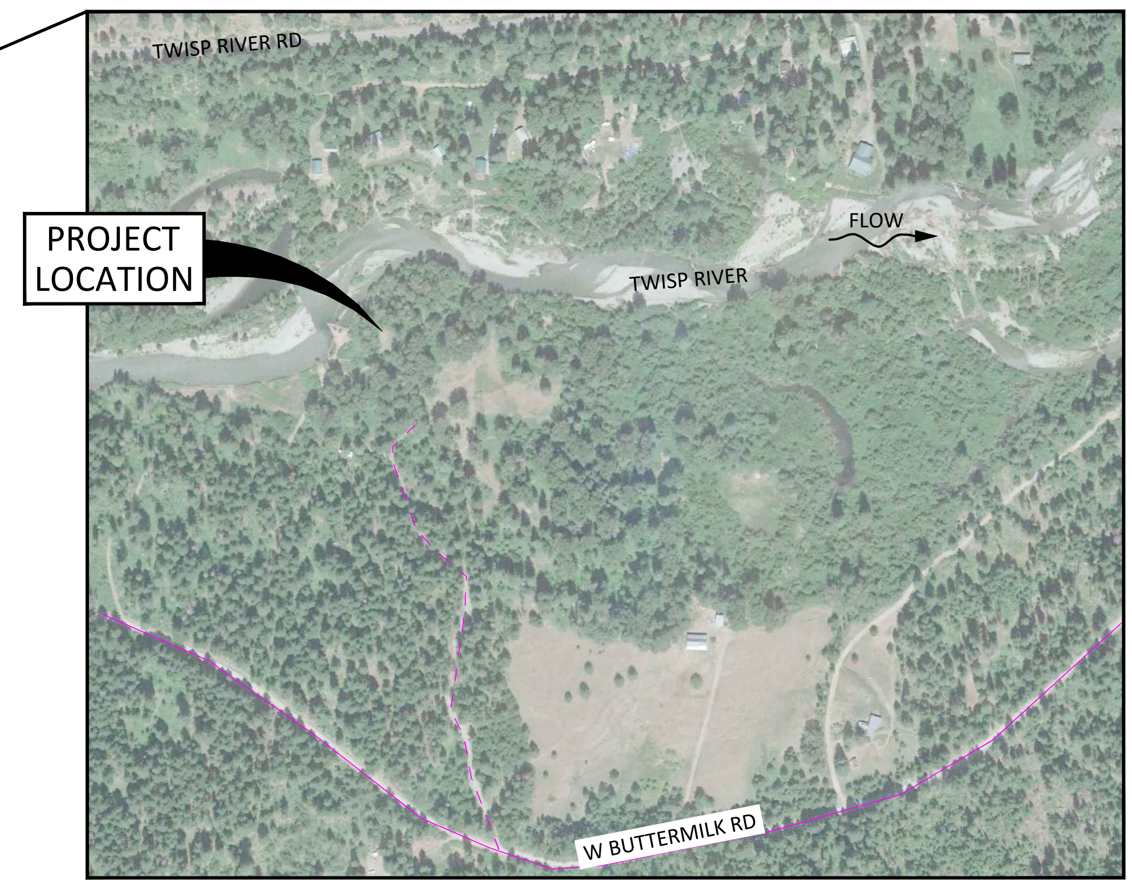
TWISP RIVER - SCAFFOLD CAMP
FLOODPLAIN ENHANCEMENT PROJECT
Conceptual Design





VICINITY MAP

4 MILES



LOCATION MAP

1000 FEET

YAKAMA NATION FISHERIES
2 JOHNSON LANE
WINTHROP WA, 98862

SHEET LIST

1 COVER
2 EXISTING CONDITIONS
3 CONCEPTS OVERVIEW
4 SIDE CHANNEL PLAN & PROFILE
5 SIDE CHANNEL DETAILS
6 SPRING CREEK

SITE LOCATION:

LATITUDE: 48°18'30"
LONGITUDE: -120°4'3"
OKANOGAN COUNTY, WASHINGTON

WATERBODY: TWISP RIVER
TRIBUTARY OF: METHOW RIVER

NO.	BY	DATE	REVISION DESCRIPTION

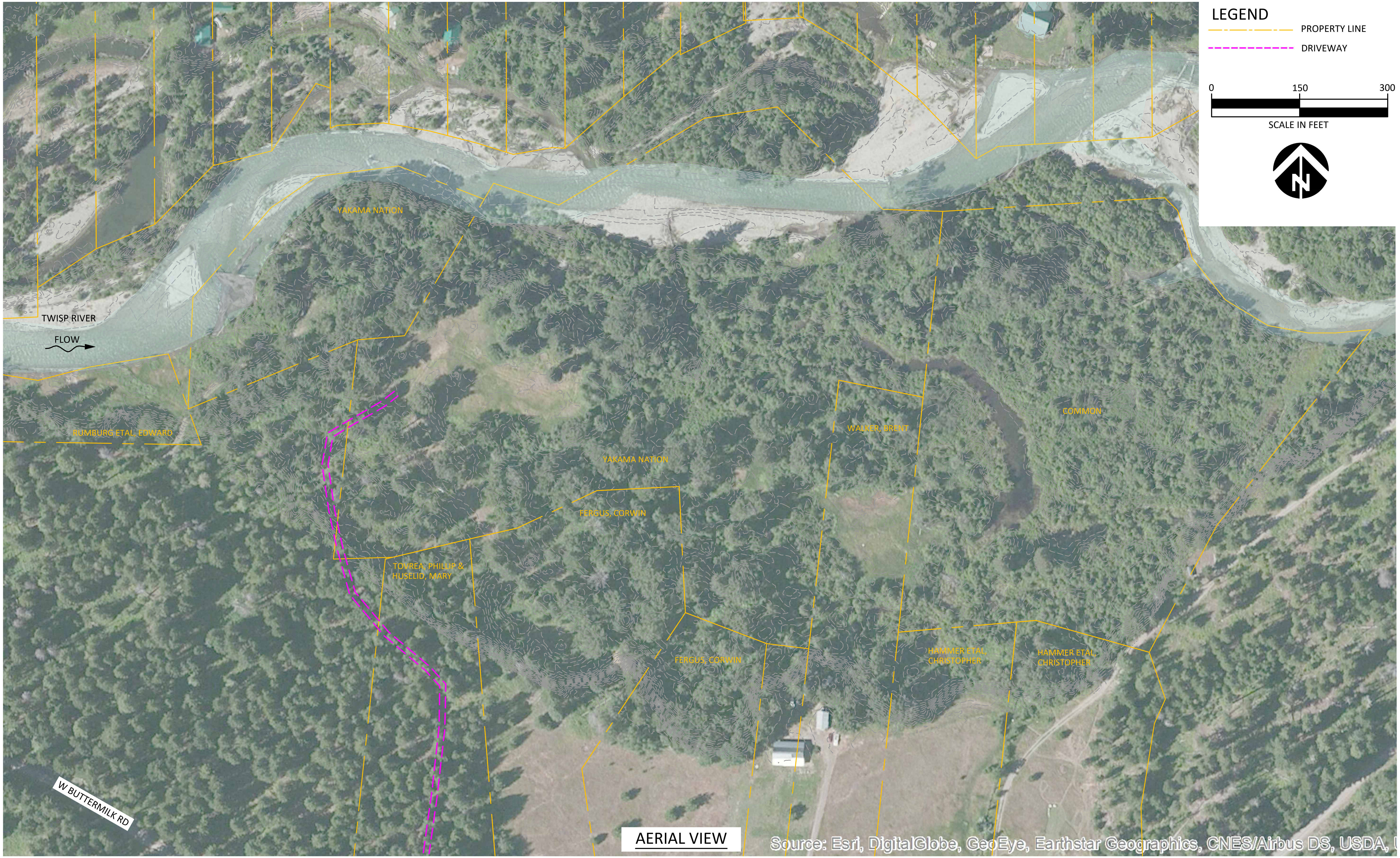
MM	MM	MB
DRAWN	DESIGNED	CHECKED
MM	DEC-30-2020	
APPROVED	DATE	PROJECT

YAKAMA NATION FISHERIES
TWISP RIVER - SCAFFOLD CAMP
CONCEPTS

inter·fluve
501 Portway Avenue, Suite 101
Hood River, OR 97031
541.386.9003
www.interfluve.com

COVER

SHEET
1 OF 6



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YAKAMA NATION FISHERIES
TWISP RIVER - SCAFFOLD CAMP
CONCEPTS

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Hood River, OR 97031
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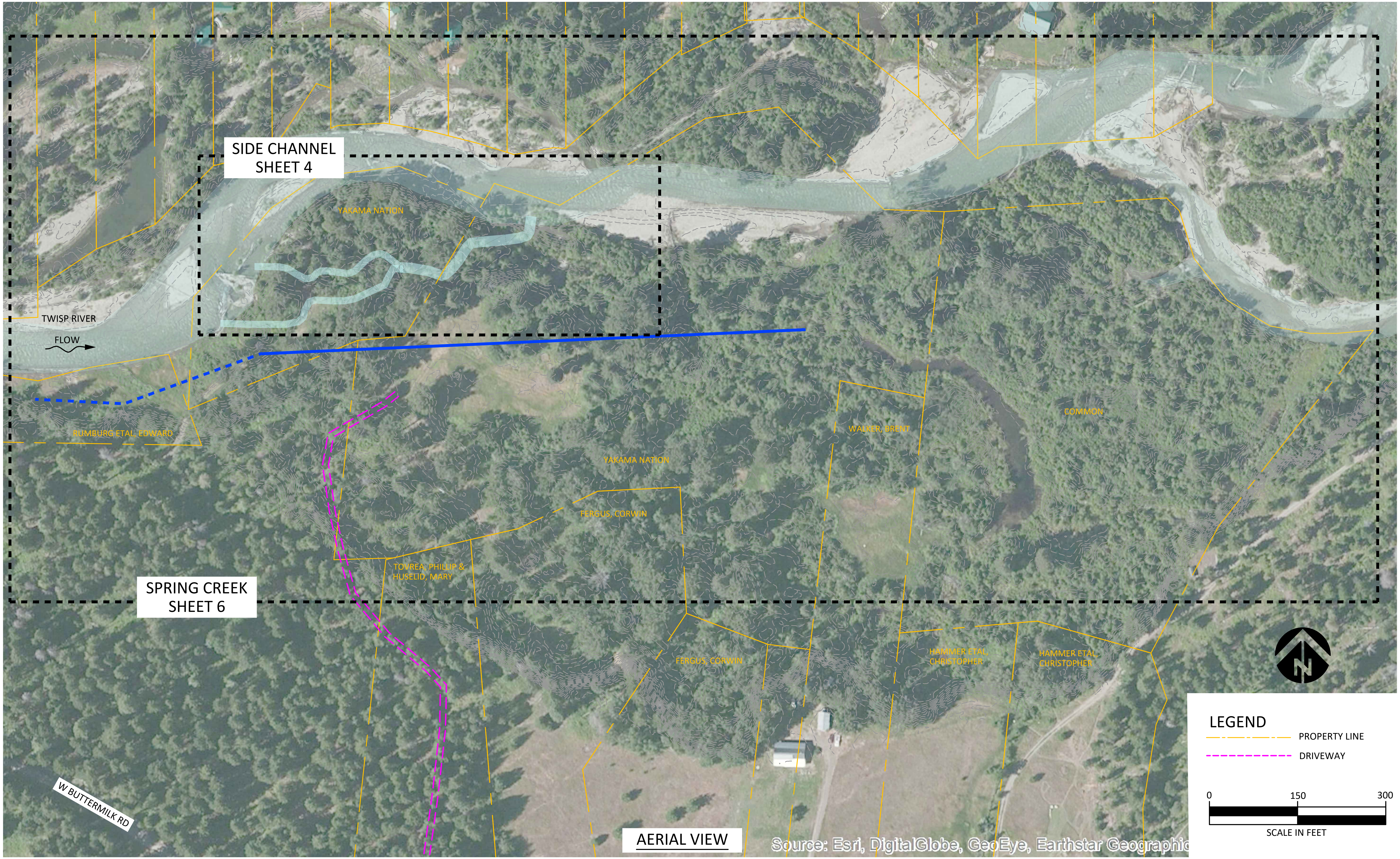
EXISTING CONDITIONS

SHEET
2 OF 6



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MM	MM	MB

APPROVED	DATE	PROJECT
MM	DEC-30-2020	

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TWISP RIVER - SCAFFOLD CAMP
CONCEPTS

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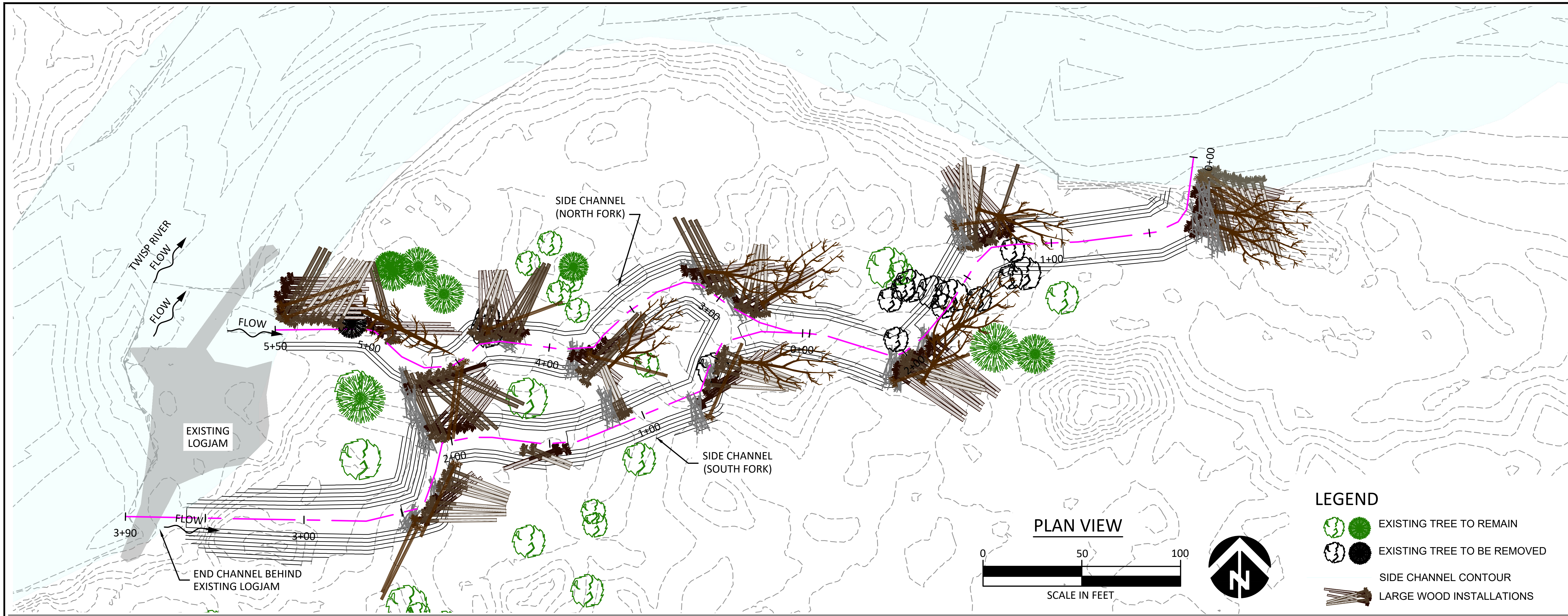
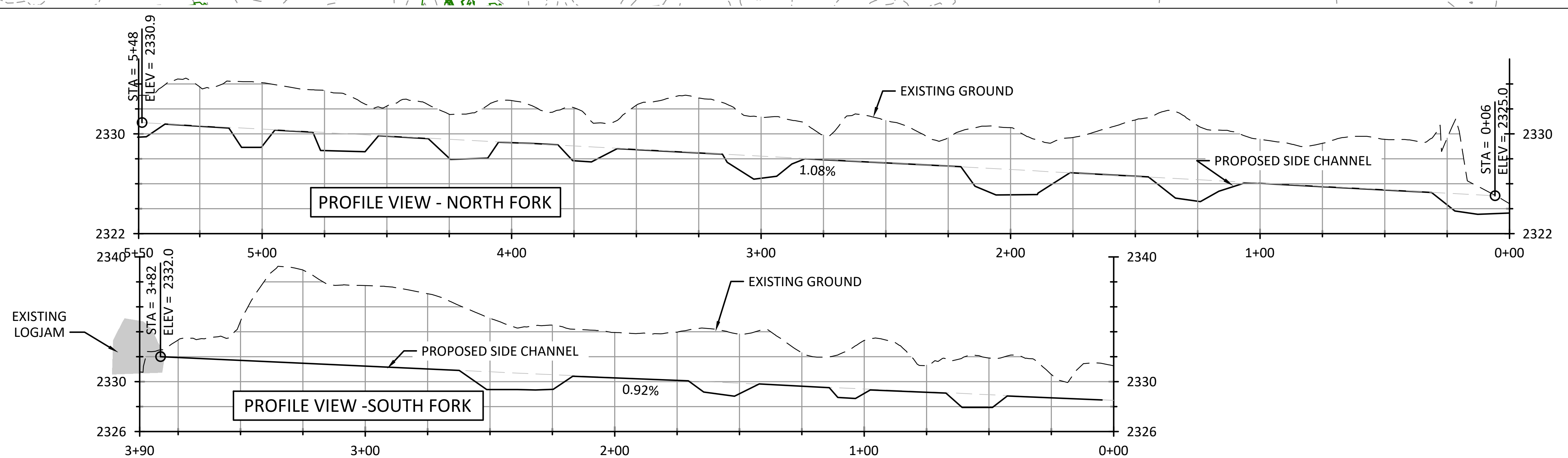
CONCEPTS OVERVIEW





NO.	BY	DATE	REVISION DESCRIPTION

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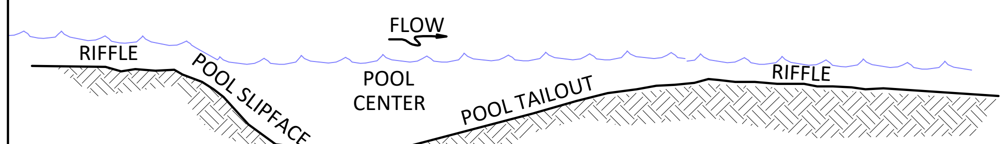
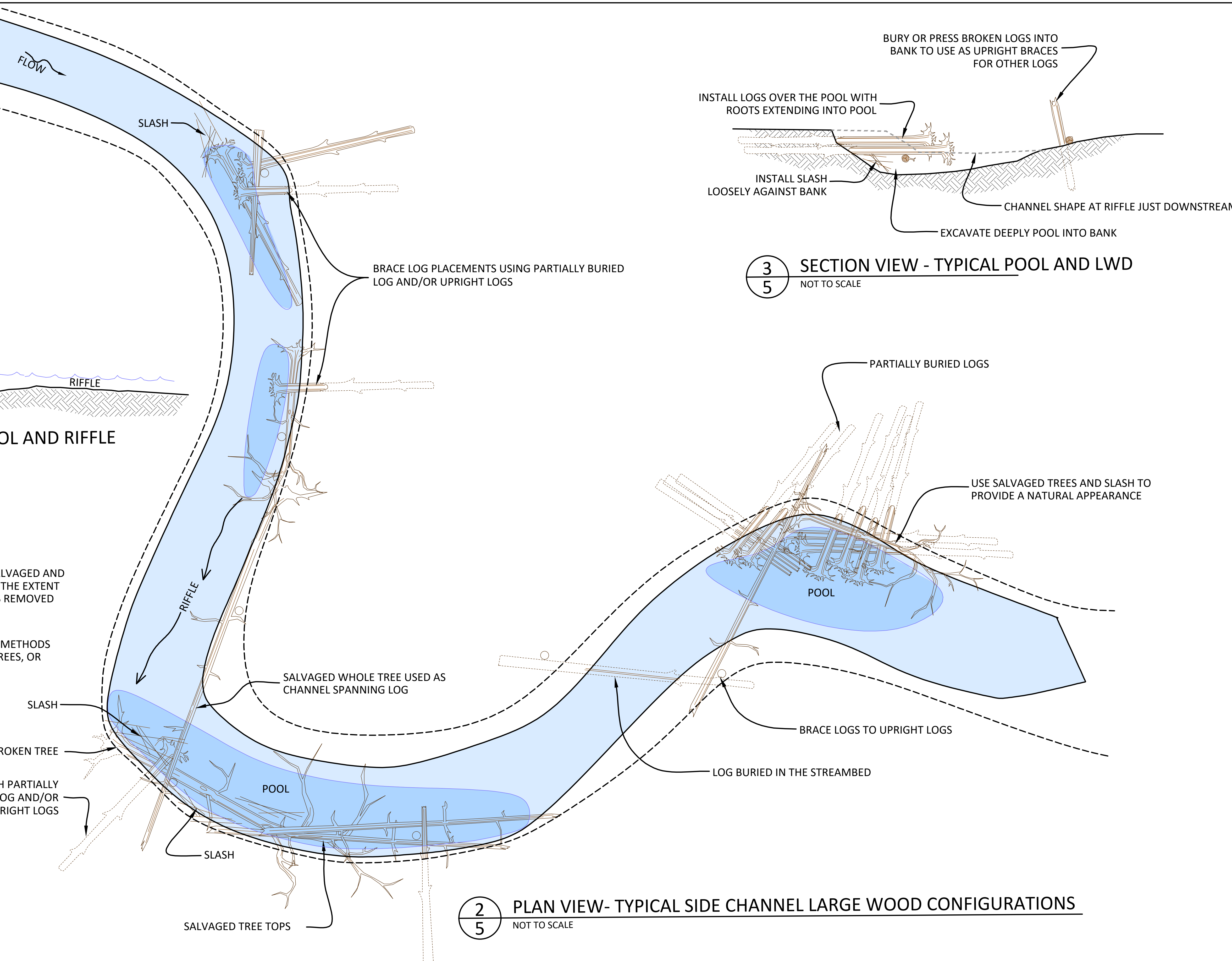
SIDE CHANNEL PLAN & PROFILE



1/5 PROFILE VIEW - TYPICAL POOL AND RIFFLE
NOT TO SCALE



3/5 SECTION VIEW - TYPICAL POOL AND LWD
NOT TO SCALE

2/5 PLAN VIEW- TYPICAL SIDE CHANNEL LARGE WOOD CONFIGURATIONS
NOT TO SCALE

NOTES:

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

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

NO.	BY	DATE	REVISION DESCRIPTION			
				MM DRAWN	MM DESIGNED	MB CHECKED
				MM APPROVED	DEC-30-2020 DATE	PROJECT

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TWISP RIVER - SCAFFOLD CAMP
CONCEPTS

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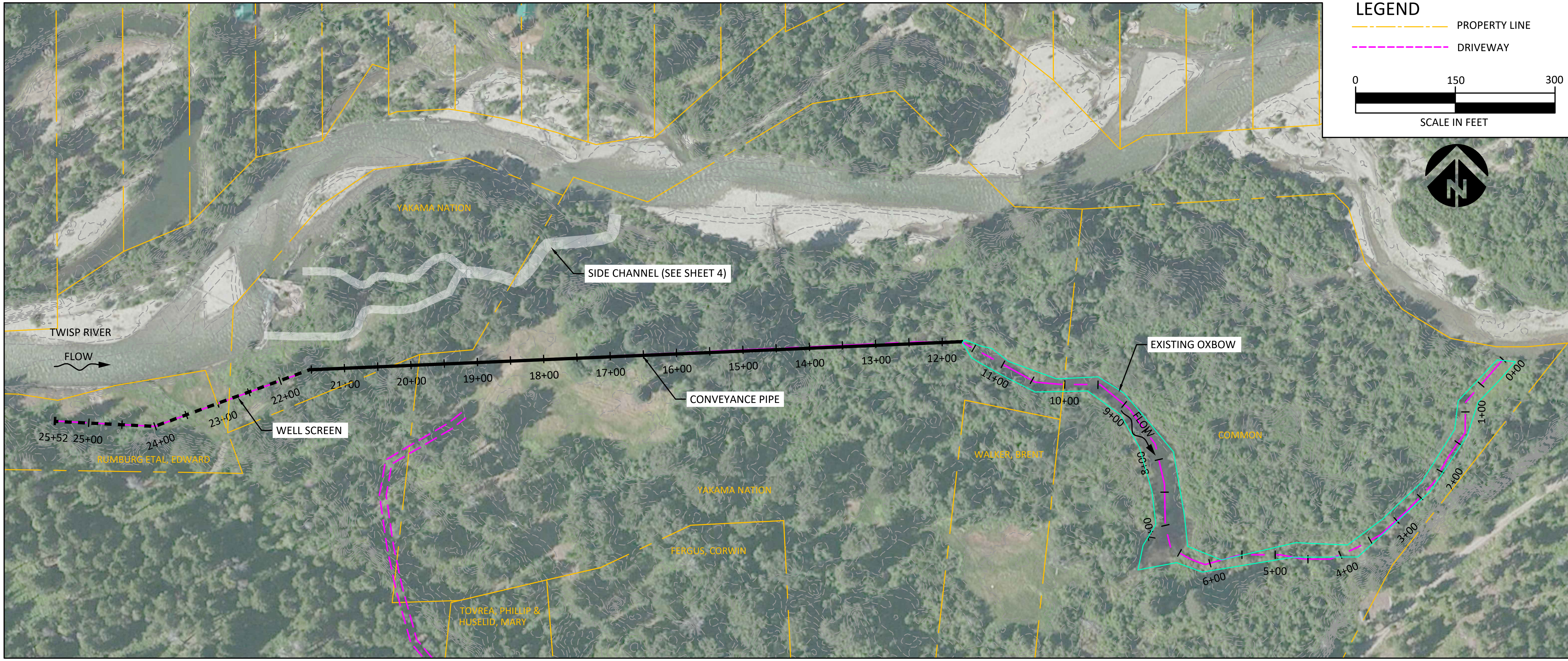
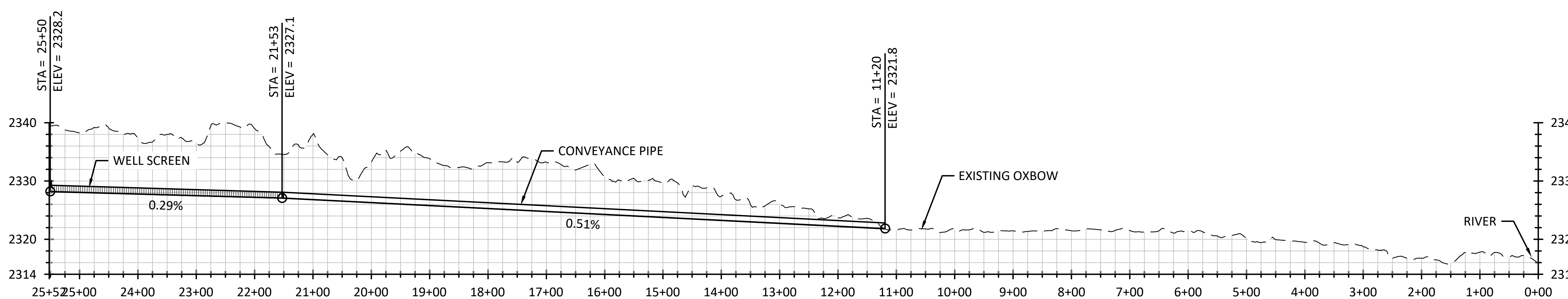
SIDE CHANNEL DETAILS





NO.	BY	DATE	REVISION DESCRIPTION

MM DRAWN | MM DESIGNED | MB CHECKED
MM APPROVED | DEC-30-2020 DATE | PROJECT

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TWISP RIVER - SCAFFOLD CAMP
CONCEPTS

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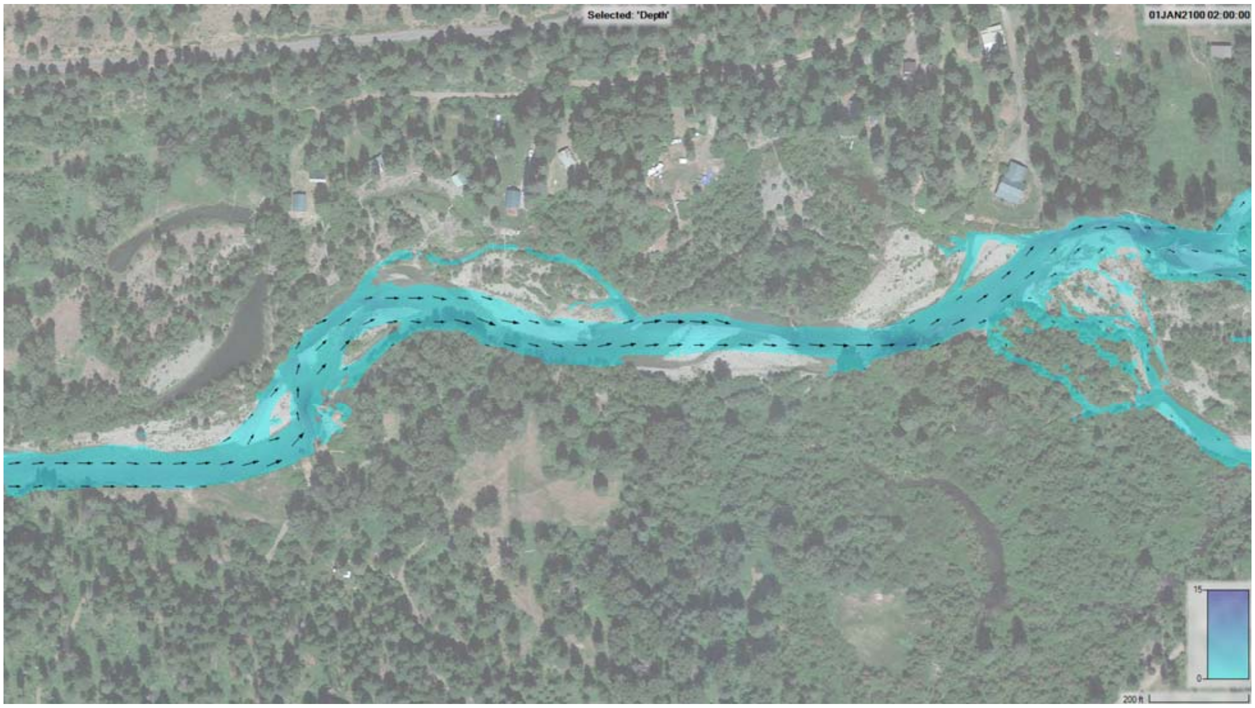
SPRING CREEK

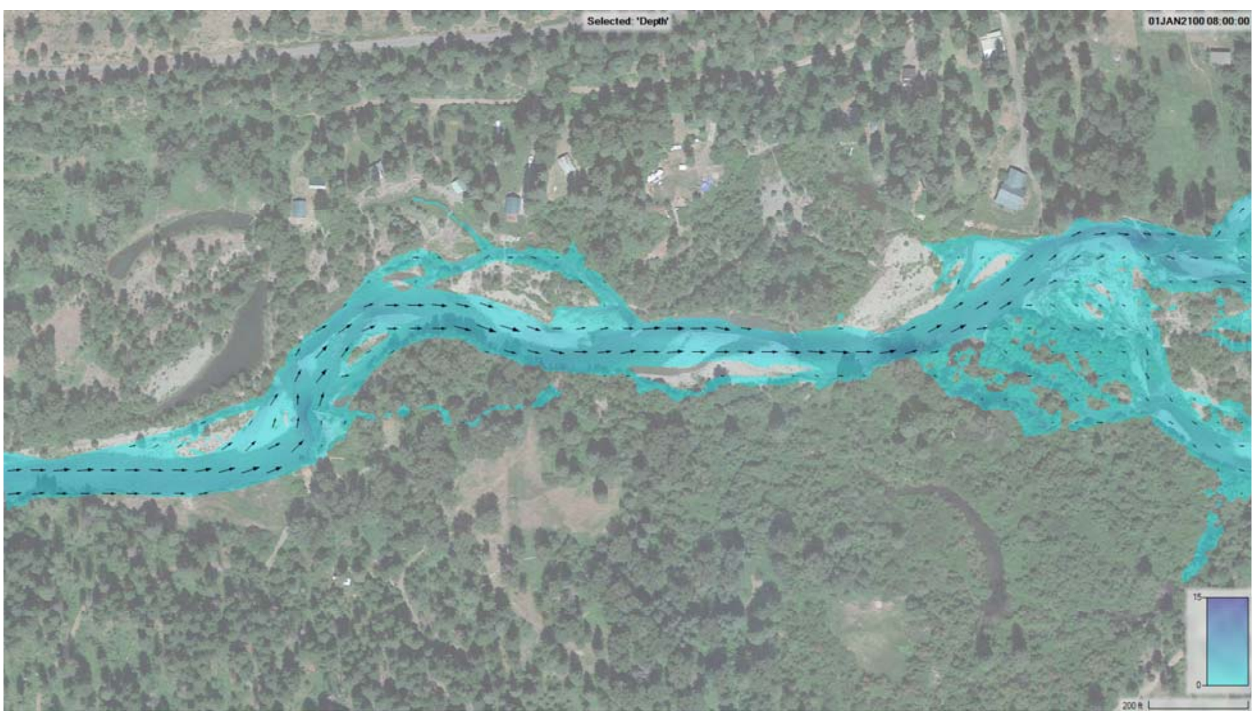
Appendix B
2D & 1D Hydraulic Model Results

Twisp River – Scaffold Camp

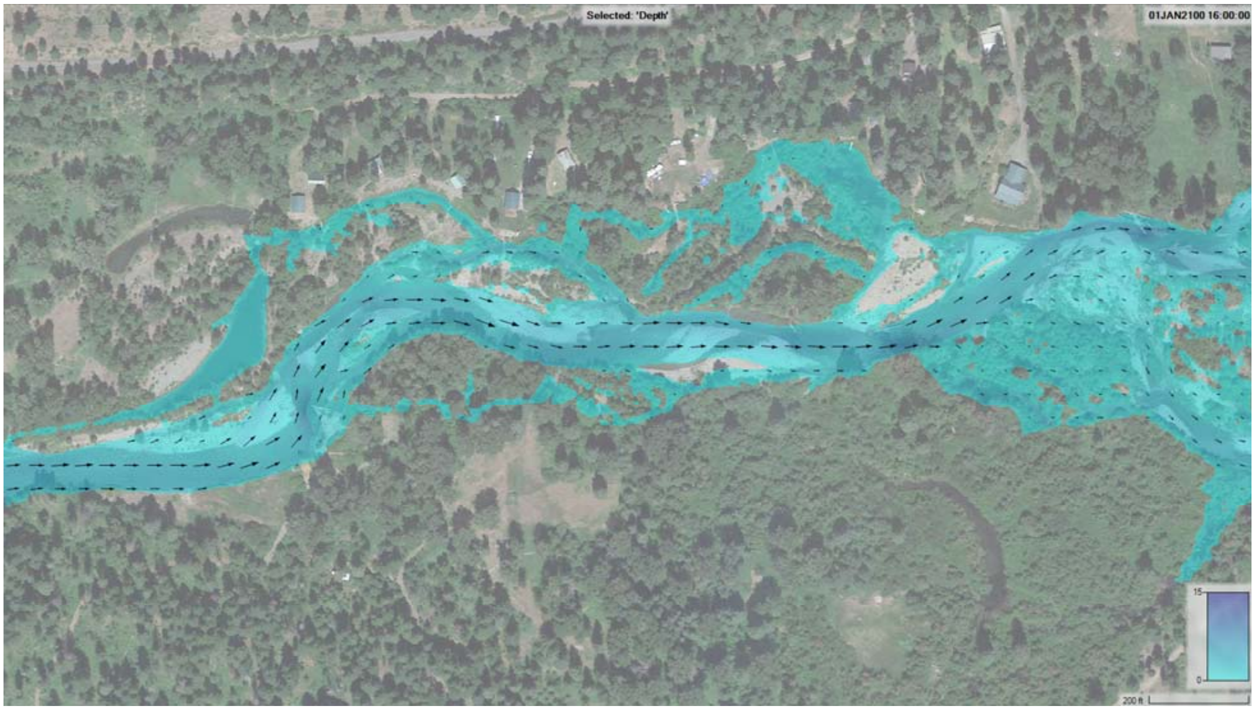
2D Model Results - Depth Plotted on Aerial



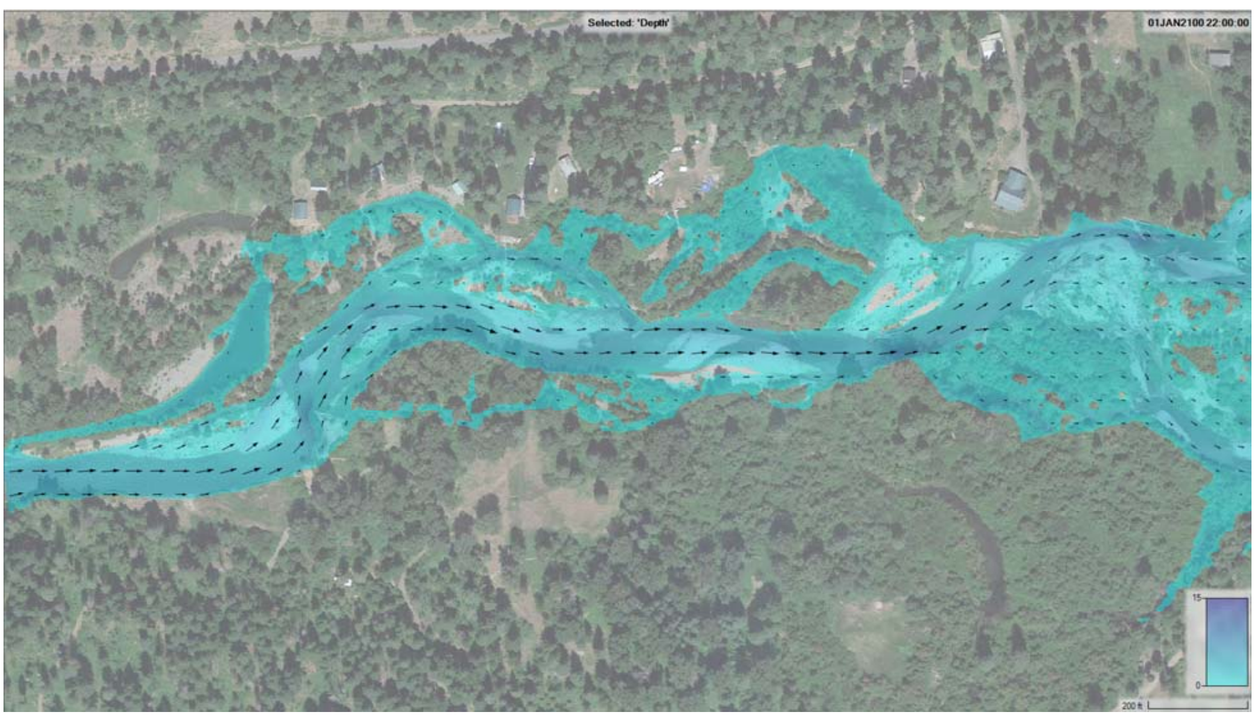
500 cfs (typical springtime high water)



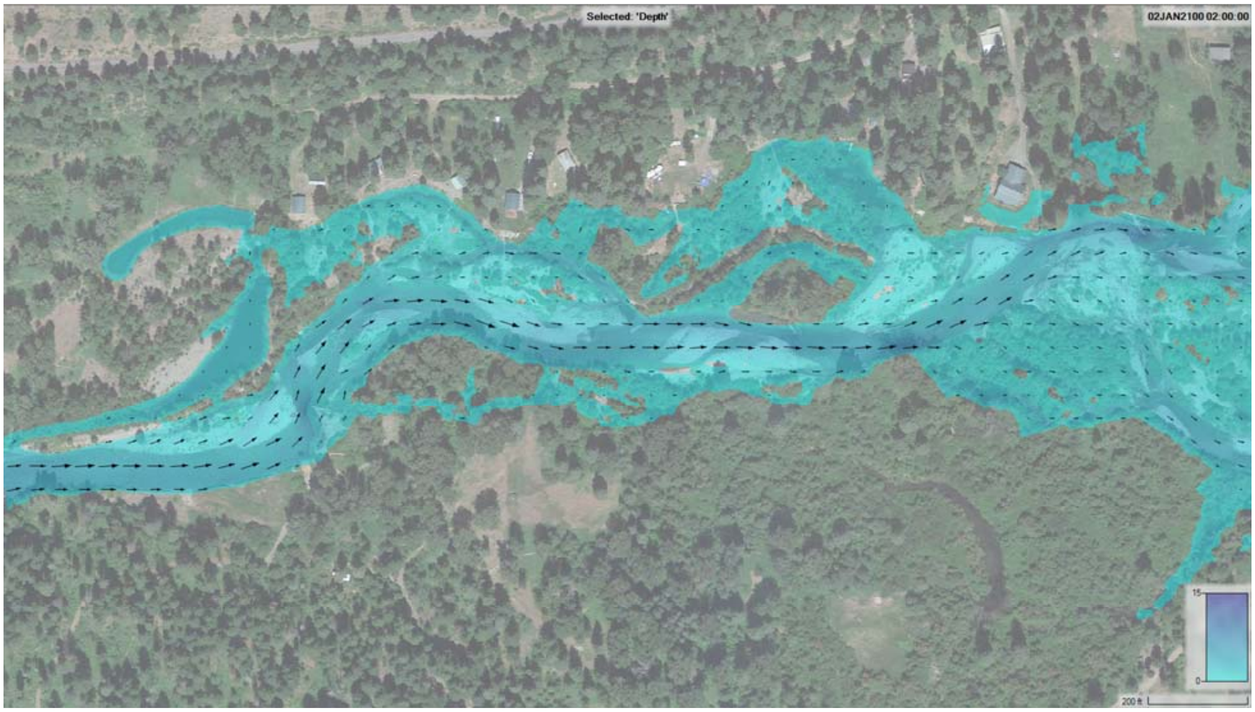
2-yr flood, 1,152 cfs



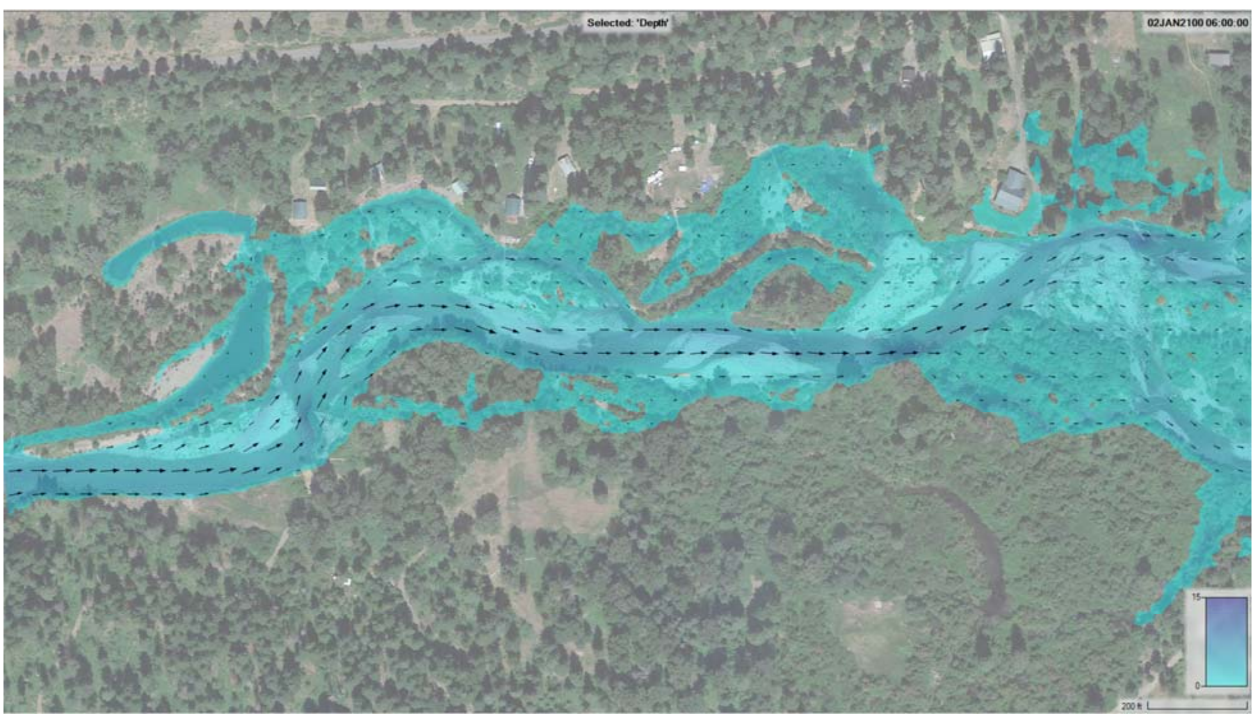
5-yr flood, 1,714 cfs



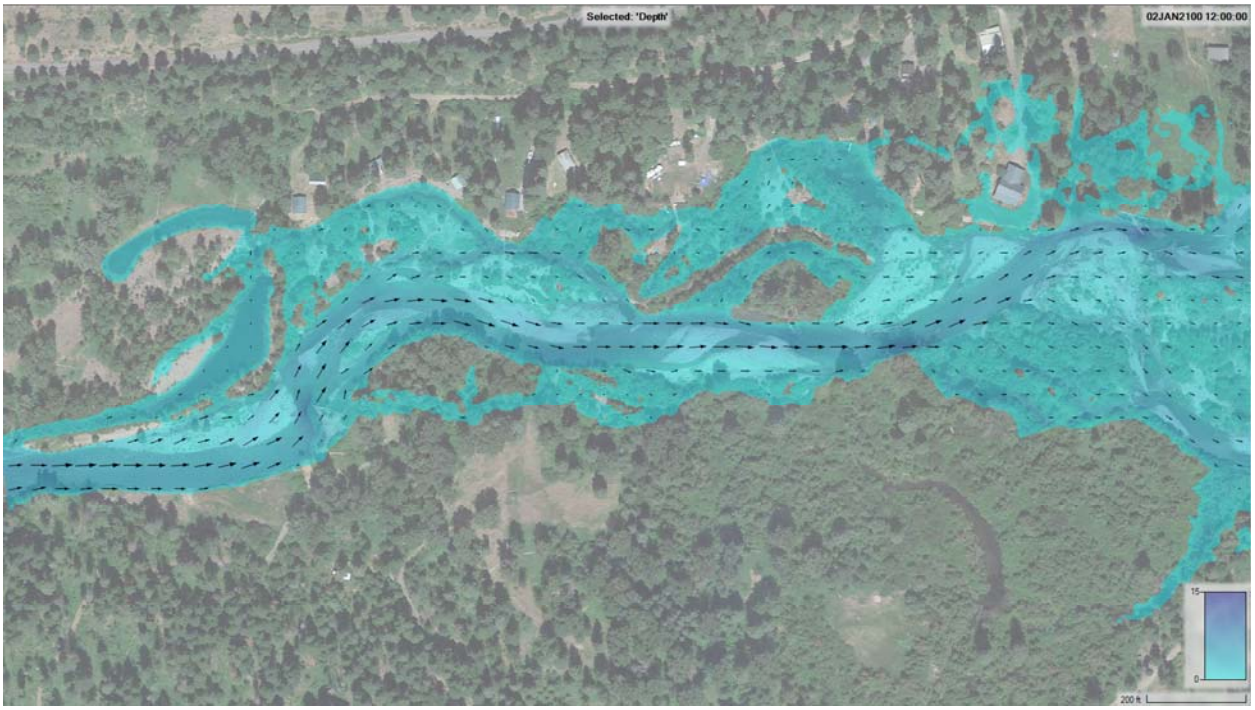
10-yr flood, 2,111 cfs



25-yr, 2,639 cfs



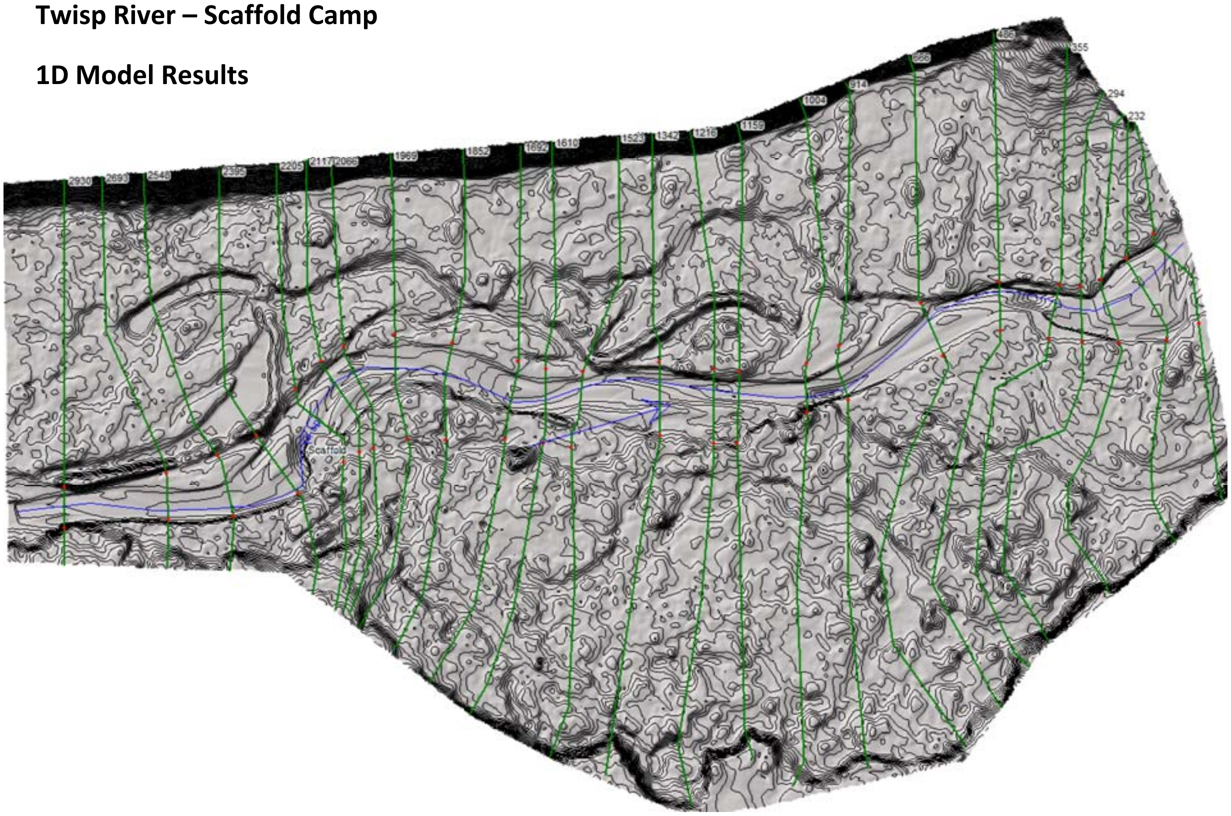
50-yr, 3,050 cfs

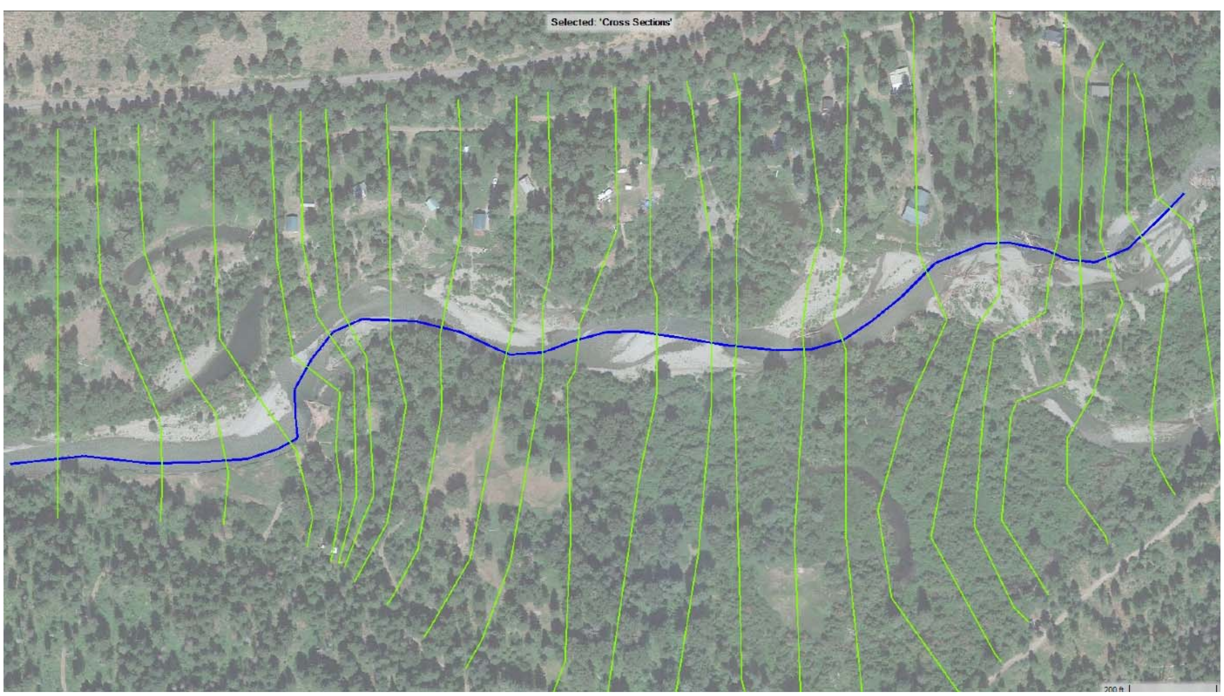


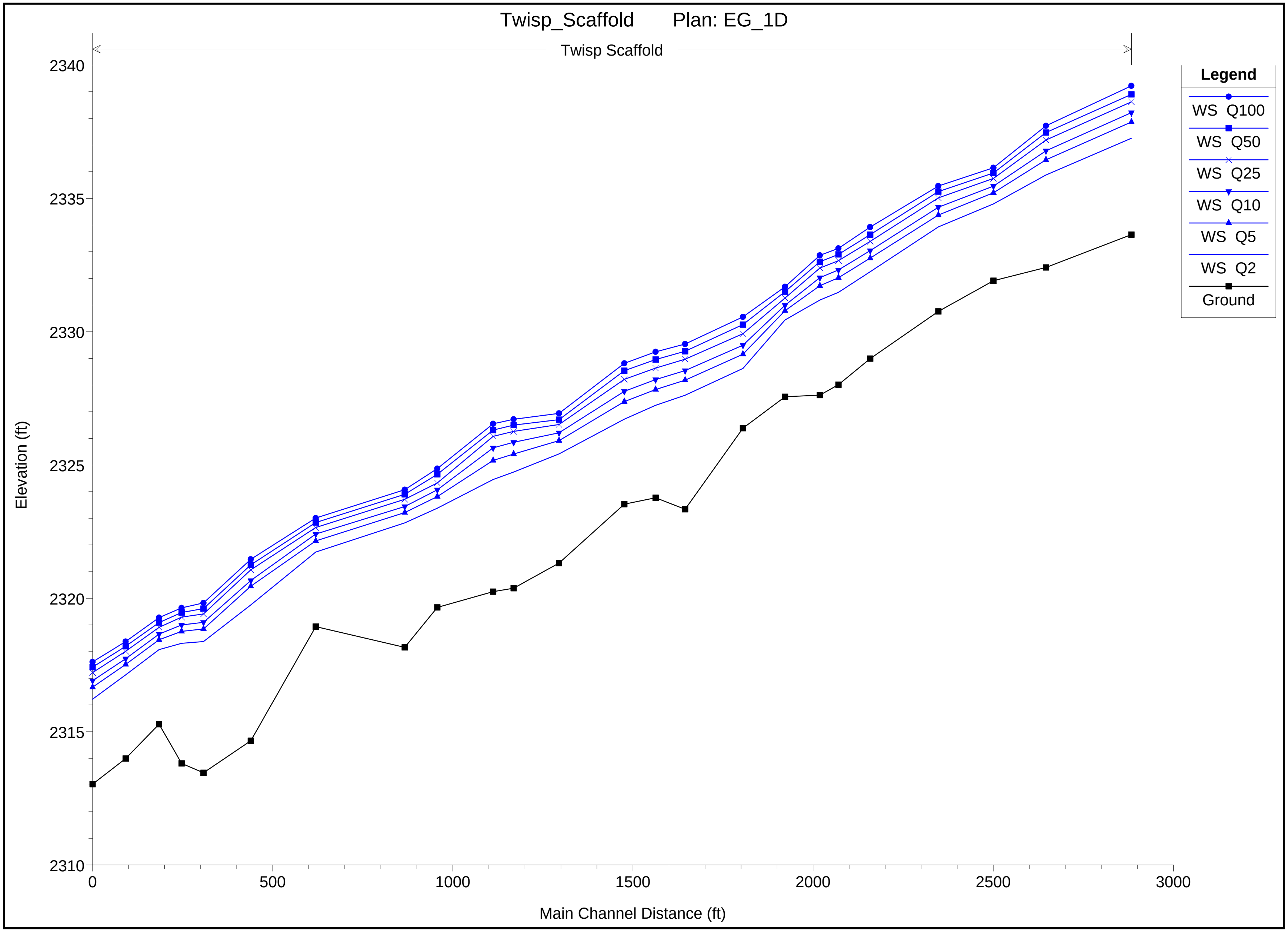
100-yr, 3,473 cfs

Twisp River – Scaffold Camp

1D Model Results







Twisp_Scaffold Plan: EG_1D
Twisp Scaffold
Elevation (ft)
Main Channel Distance (ft)
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2320
2325
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Legend
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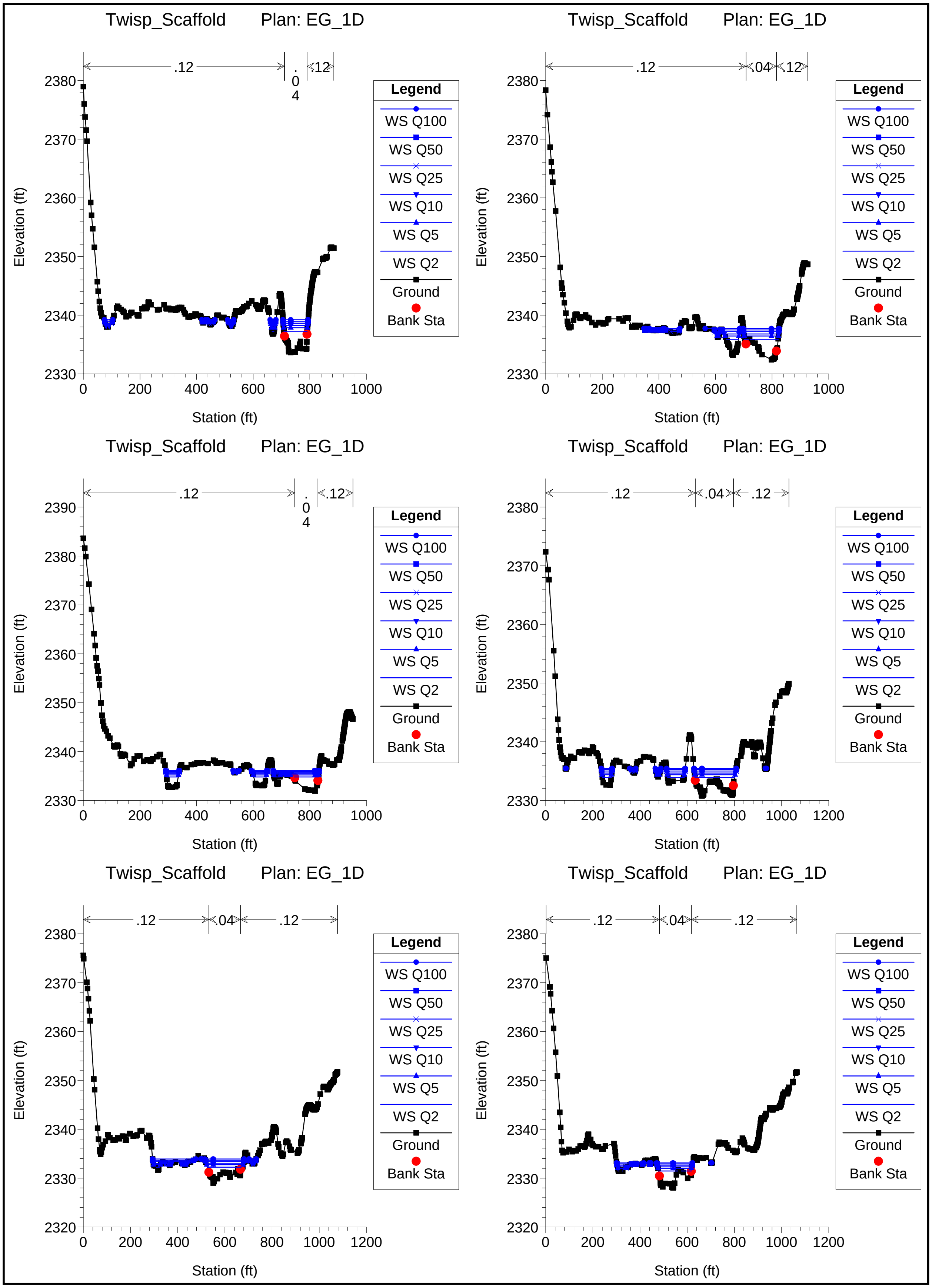
Ground



Twisp_Scaffold Plan: EG_1D
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WS Q10
WS Q5
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Ground
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Elevation (ft)
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Station (ft)
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Twisp_Scaffold Plan: EG_1D
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Elevation (ft)
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Twisp_Scaffold Plan: EG_1D
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Twisp_Scaffold Plan: EG_1D
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Twisp_Scaffold Plan: EG_1D
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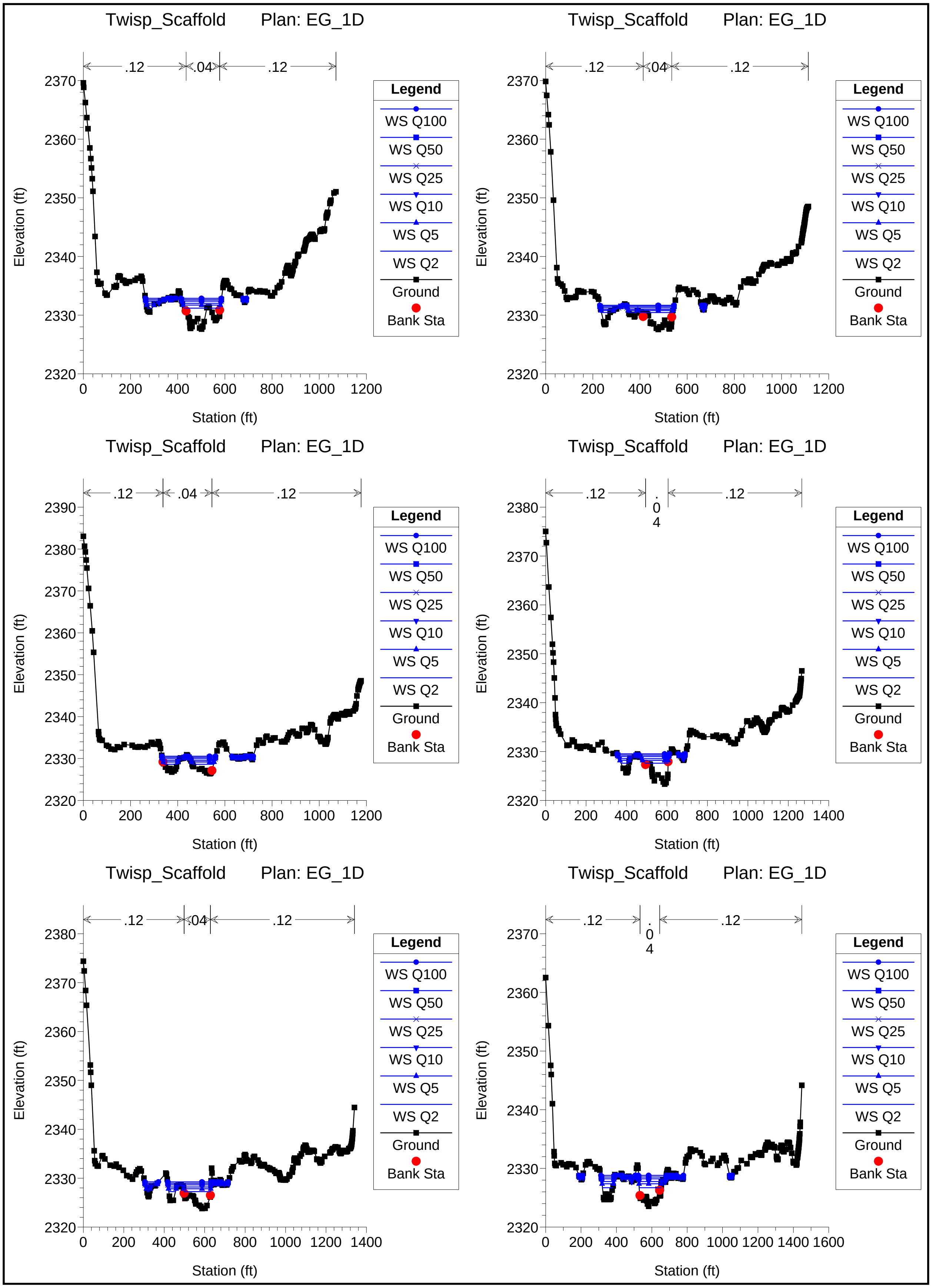

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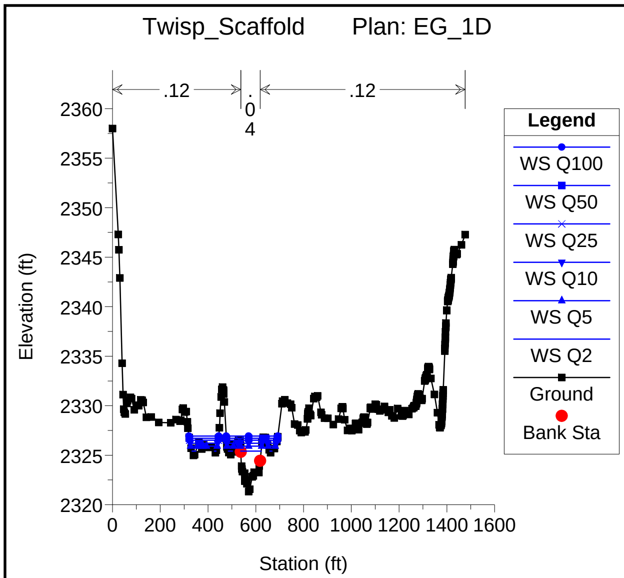
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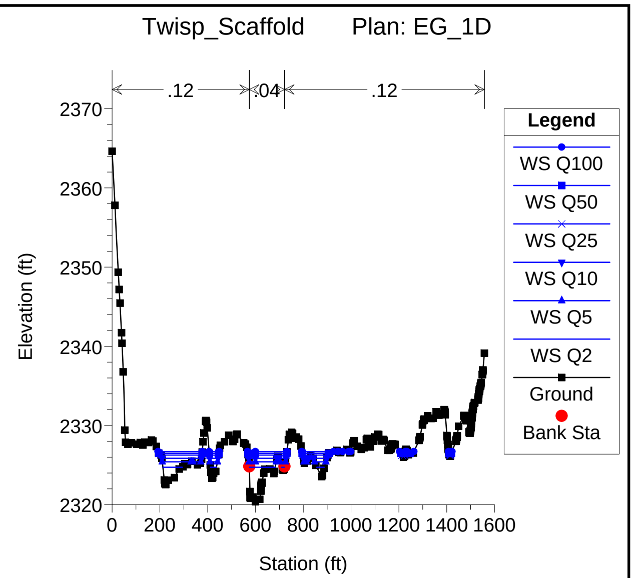
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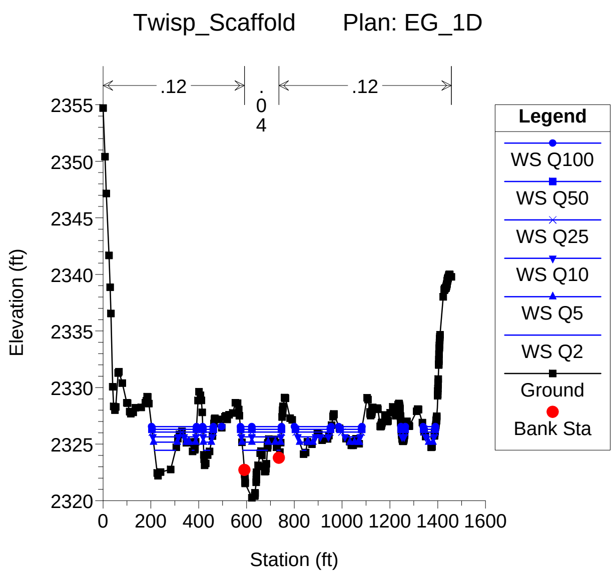
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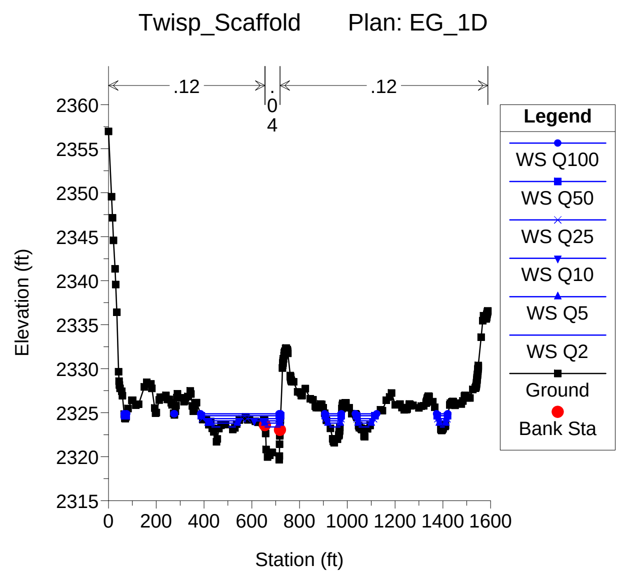
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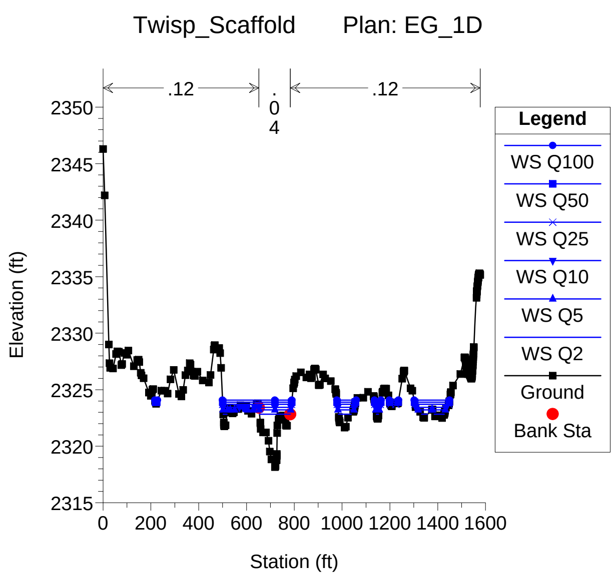
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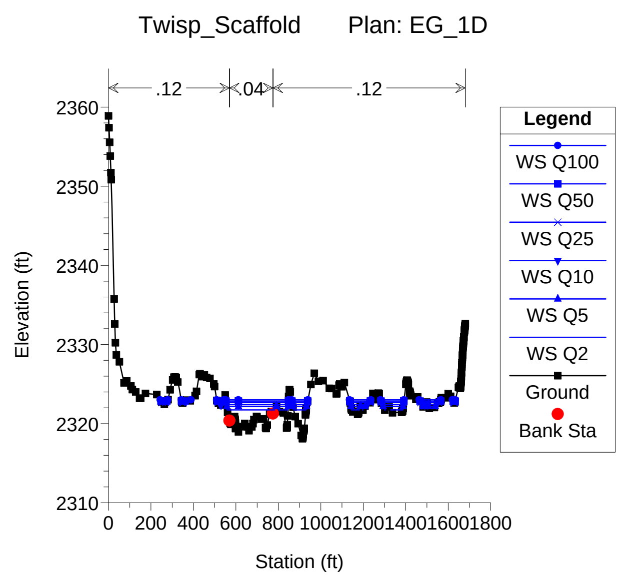
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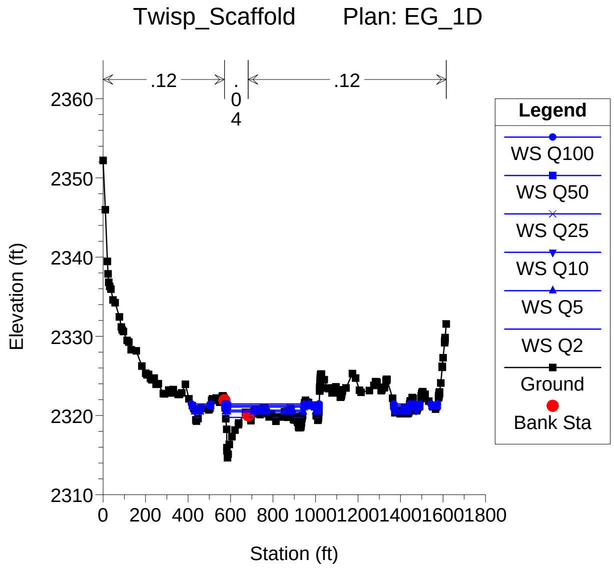
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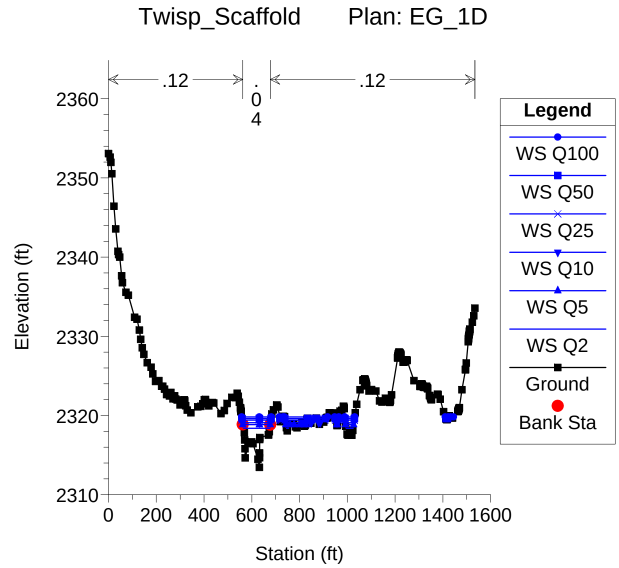
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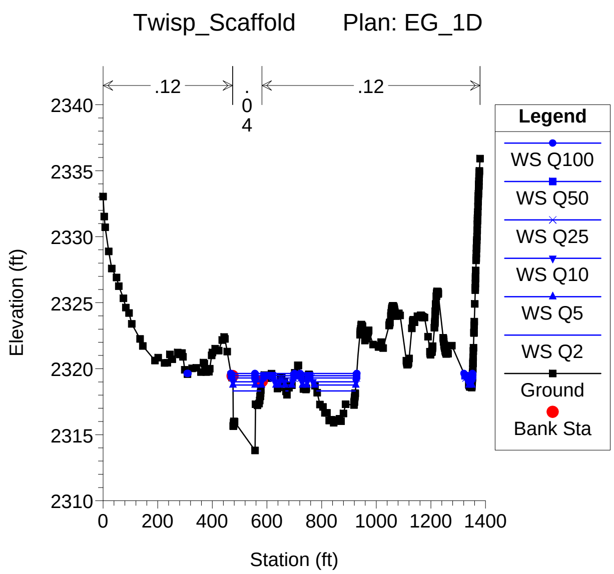
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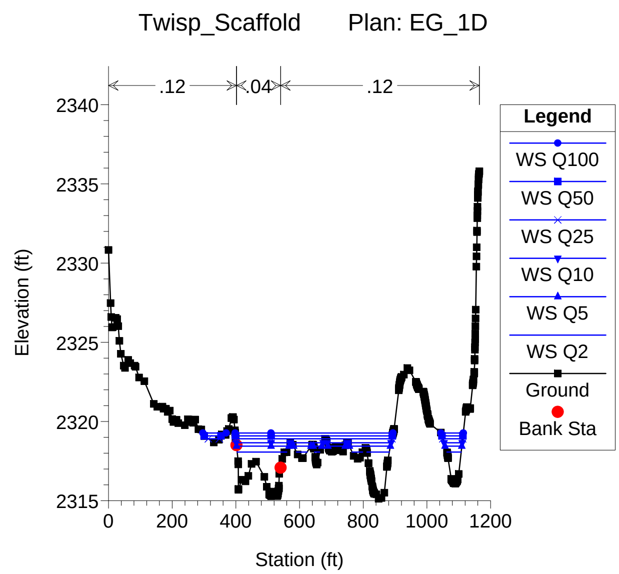
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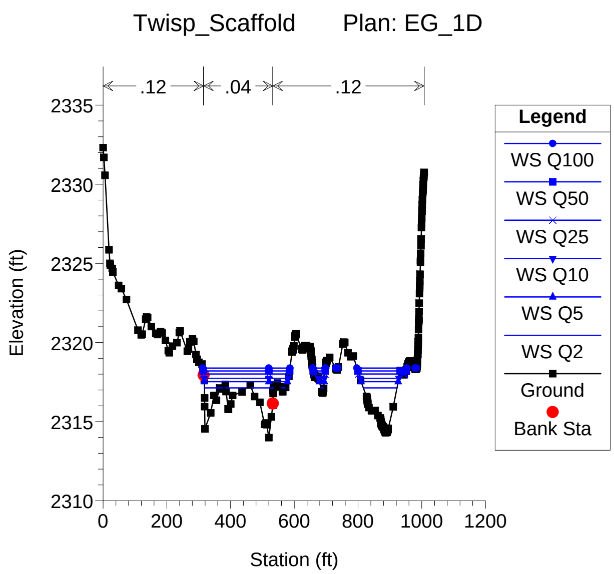
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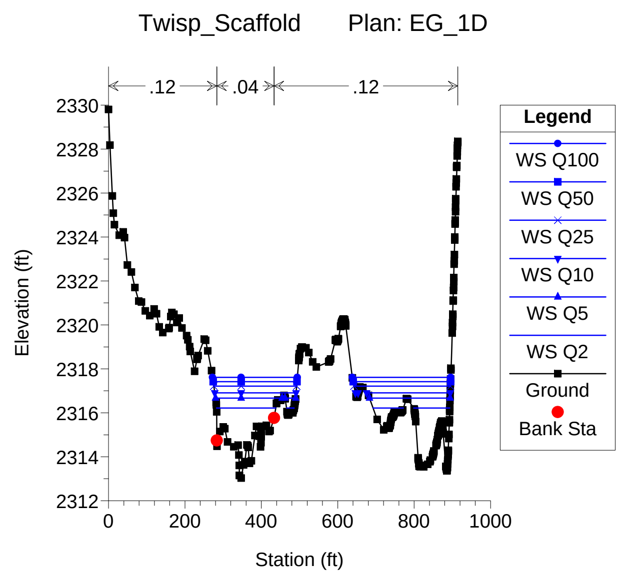
0 200 400 600 800 1000 1200
Station (ft)


Twisp_Scaffold Plan: EG_1D
.12
.04
.12
Legend
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
2330
2328
2326
2324
2322
2320
2318
2316
2314
2312
0 200 400 600 800 1000
Station (ft)

HEC-RAS Plan: EG_1D River: Twisp Reach: Scaffold

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Scaffold	2930	Q2	1152.00	2333.64	2337.26	2337.66	0.004972	5.12	227.74	88.94	0.54	0.85
Scaffold	2930	Q5	1714.00	2333.64	2337.86	2338.47	0.005709	6.25	283.88	95.42	0.59	1.18
Scaffold	2930	Q10	2111.00	2333.64	2338.21	2338.96	0.006233	6.97	320.06	115.54	0.63	1.43
Scaffold	2930	Q25	2639.00	2333.64	2338.62	2339.56	0.006859	7.82	372.82	146.87	0.67	1.74
Scaffold	2930	Q50	3050.00	2333.64	2338.90	2339.98	0.007304	8.43	417.39	173.16	0.70	1.97
Scaffold	2930	Q100	3473.00	2333.64	2339.22	2340.41	0.007383	8.87	477.21	200.64	0.71	2.14
Scaffold	2693	Q2	1152.00	2332.41	2335.87	2336.24	0.007368	5.06	285.39	155.74	0.63	0.92
Scaffold	2693	Q5	1714.00	2332.41	2336.45	2336.91	0.007247	5.76	380.40	175.13	0.65	1.11
Scaffold	2693	Q10	2111.00	2332.41	2336.78	2337.33	0.007144	6.23	441.24	186.18	0.66	1.25
Scaffold	2693	Q25	2639.00	2332.41	2337.19	2337.83	0.007034	6.77	524.69	227.87	0.67	1.41
Scaffold	2693	Q50	3050.00	2332.41	2337.47	2338.17	0.007036	7.15	594.66	285.00	0.67	1.53
Scaffold	2693	Q100	3473.00	2332.41	2337.72	2338.55	0.007438	7.70	674.76	358.97	0.70	1.73
Scaffold	2548	Q2	1152.00	2331.91	2334.79	2335.17	0.007916	5.42	324.22	188.02	0.66	1.04
Scaffold	2548	Q5	1714.00	2331.91	2335.21	2335.76	0.009286	6.62	408.21	218.63	0.73	1.46
Scaffold	2548	Q10	2111.00	2331.91	2335.46	2336.13	0.010135	7.36	465.84	242.66	0.78	1.75
Scaffold	2548	Q25	2639.00	2331.91	2335.75	2336.59	0.011153	8.25	538.81	261.98	0.83	2.12
Scaffold	2548	Q50	3050.00	2331.91	2335.95	2336.91	0.011738	8.84	594.12	276.94	0.86	2.38
Scaffold	2548	Q100	3473.00	2331.91	2336.15	2337.21	0.012295	9.40	649.09	288.78	0.89	2.65
Scaffold	2395	Q2	1152.00	2330.76	2333.93	2334.15	0.005524	3.92	360.80	276.04	0.53	0.58
Scaffold	2395	Q5	1714.00	2330.76	2334.37	2334.67	0.005367	4.52	487.87	294.21	0.54	0.72
Scaffold	2395	Q10	2111.00	2330.76	2334.67	2335.00	0.005185	4.83	575.47	304.92	0.55	0.79
Scaffold	2395	Q25	2639.00	2330.76	2335.02	2335.40	0.005039	5.21	686.53	327.60	0.55	0.87
Scaffold	2395	Q50	3050.00	2330.76	2335.25	2335.67	0.005050	5.50	764.94	339.44	0.56	0.95
Scaffold	2395	Q100	3473.00	2330.76	2335.46	2335.93	0.005158	5.82	838.04	364.39	0.57	1.04
Scaffold	2205	Q2	1152.00	2328.99	2332.25	2332.69	0.011314	5.36	221.98	156.57	0.75	1.12
Scaffold	2205	Q5	1714.00	2328.99	2332.76	2333.31	0.009776	5.99	311.20	201.04	0.73	1.27
Scaffold	2205	Q10	2111.00	2328.99	2333.04	2333.67	0.009565	6.44	375.70	259.36	0.73	1.41
Scaffold	2205	Q25	2639.00	2328.99	2333.38	2334.11	0.009271	6.94	480.05	341.57	0.74	1.56
Scaffold	2205	Q50	3050.00	2328.99	2333.64	2334.40	0.008862	7.20	570.38	362.65	0.73	1.63
Scaffold	2205	Q100	3473.00	2328.99	2333.92	2334.70	0.008146	7.33	675.62	386.52	0.71	1.64
Scaffold	2117	Q2	1152.00	2328.01	2331.47	2331.86	0.007658	4.99	232.72	127.54	0.63	0.91
Scaffold	2117	Q5	1714.00	2328.01	2332.02	2332.51	0.008008	5.63	319.71	174.20	0.67	1.10
Scaffold	2117	Q10	2111.00	2328.01	2332.31	2332.89	0.007987	6.11	372.38	190.63	0.68	1.24

HEC-RAS Plan: EG_1D River: Twisp Reach: Scaffold (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Scaffold	2117	Q25	2639.00	2328.01	2332.66	2333.34	0.008011	6.67	440.11	201.02	0.69	1.42
Scaffold	2117	Q50	3050.00	2328.01	2332.90	2333.66	0.008154	7.09	491.67	241.84	0.71	1.56
Scaffold	2117	Q100	3473.00	2328.01	2333.12	2333.97	0.008279	7.49	551.83	278.57	0.72	1.70
Scaffold	2066	Q2	1152.00	2327.62	2331.18	2331.49	0.005893	4.46	267.61	159.22	0.56	0.72
Scaffold	2066	Q5	1714.00	2327.62	2331.72	2332.12	0.006178	5.09	363.85	191.20	0.59	0.89
Scaffold	2066	Q10	2111.00	2327.62	2332.03	2332.49	0.006198	5.53	424.81	217.96	0.60	1.01
Scaffold	2066	Q25	2639.00	2327.62	2332.39	2332.93	0.006174	6.02	506.09	233.39	0.61	1.14
Scaffold	2066	Q50	3050.00	2327.62	2332.62	2333.24	0.006347	6.41	564.13	257.57	0.63	1.26
Scaffold	2066	Q100	3473.00	2327.62	2332.86	2333.54	0.006401	6.76	629.41	293.44	0.64	1.37
Scaffold	1969	Q2	1152.00	2327.56	2330.44	2330.81	0.008339	5.00	277.54	204.82	0.66	0.93
Scaffold	1969	Q5	1714.00	2327.56	2330.79	2331.34	0.010068	6.18	354.20	238.88	0.74	1.34
Scaffold	1969	Q10	2111.00	2327.56	2330.99	2331.68	0.011064	6.88	404.68	255.57	0.79	1.61
Scaffold	1969	Q25	2639.00	2327.56	2331.26	2332.09	0.011757	7.62	477.03	280.03	0.83	1.91
Scaffold	1969	Q50	3050.00	2327.56	2331.50	2332.39	0.011359	7.95	547.25	297.55	0.83	2.02
Scaffold	1969	Q100	3473.00	2327.56	2331.69	2332.67	0.011738	8.42	602.72	310.69	0.85	2.22
Scaffold	1852	Q2	1152.00	2326.38	2328.62	2329.27	0.022128	6.49	181.54	145.11	1.01	1.76
Scaffold	1852	Q5	1714.00	2326.38	2329.16	2329.85	0.016119	6.69	263.31	158.84	0.91	1.70
Scaffold	1852	Q10	2111.00	2326.38	2329.49	2330.22	0.013856	6.85	318.09	166.82	0.86	1.70
Scaffold	1852	Q25	2639.00	2326.38	2329.92	2330.67	0.011794	6.98	392.82	185.45	0.81	1.68
Scaffold	1852	Q50	3050.00	2326.38	2330.27	2331.00	0.011368	6.92	466.10	243.45	0.80	1.64
Scaffold	1852	Q100	3473.00	2326.38	2330.55	2331.29	0.010423	6.97	542.57	291.32	0.78	1.62
Scaffold	1692	Q2	1152.00	2323.34	2327.62	2327.88	0.004040	4.16	315.25	154.02	0.47	0.59
Scaffold	1692	Q5	1714.00	2323.34	2328.18	2328.55	0.004344	4.96	407.13	172.68	0.51	0.78
Scaffold	1692	Q10	2111.00	2323.34	2328.54	2328.97	0.004452	5.41	472.09	192.78	0.52	0.90
Scaffold	1692	Q25	2639.00	2323.34	2328.97	2329.49	0.004618	5.98	565.02	243.07	0.55	1.05
Scaffold	1692	Q50	3050.00	2323.34	2329.27	2329.85	0.004679	6.34	641.80	270.75	0.56	1.15
Scaffold	1692	Q100	3473.00	2323.34	2329.54	2330.18	0.004791	6.69	718.45	292.81	0.57	1.26
Scaffold	1610	Q2	1152.00	2323.77	2327.24	2327.50	0.005161	4.23	313.21	178.30	0.53	0.64
Scaffold	1610	Q5	1714.00	2323.77	2327.83	2328.17	0.004736	4.81	422.37	191.78	0.53	0.76
Scaffold	1610	Q10	2111.00	2323.77	2328.20	2328.59	0.004537	5.15	495.83	203.24	0.53	0.84
Scaffold	1610	Q25	2639.00	2323.77	2328.64	2329.10	0.004508	5.62	598.97	284.67	0.54	0.95
Scaffold	1610	Q50	3050.00	2323.77	2328.95	2329.45	0.004373	5.88	693.14	310.54	0.54	1.01
Scaffold	1610	Q100	3473.00	2323.77	2329.24	2329.78	0.004296	6.12	786.82	336.73	0.54	1.07

HEC-RAS Plan: EG_1D   River: Twisp   Reach: Scaffold (Continued)

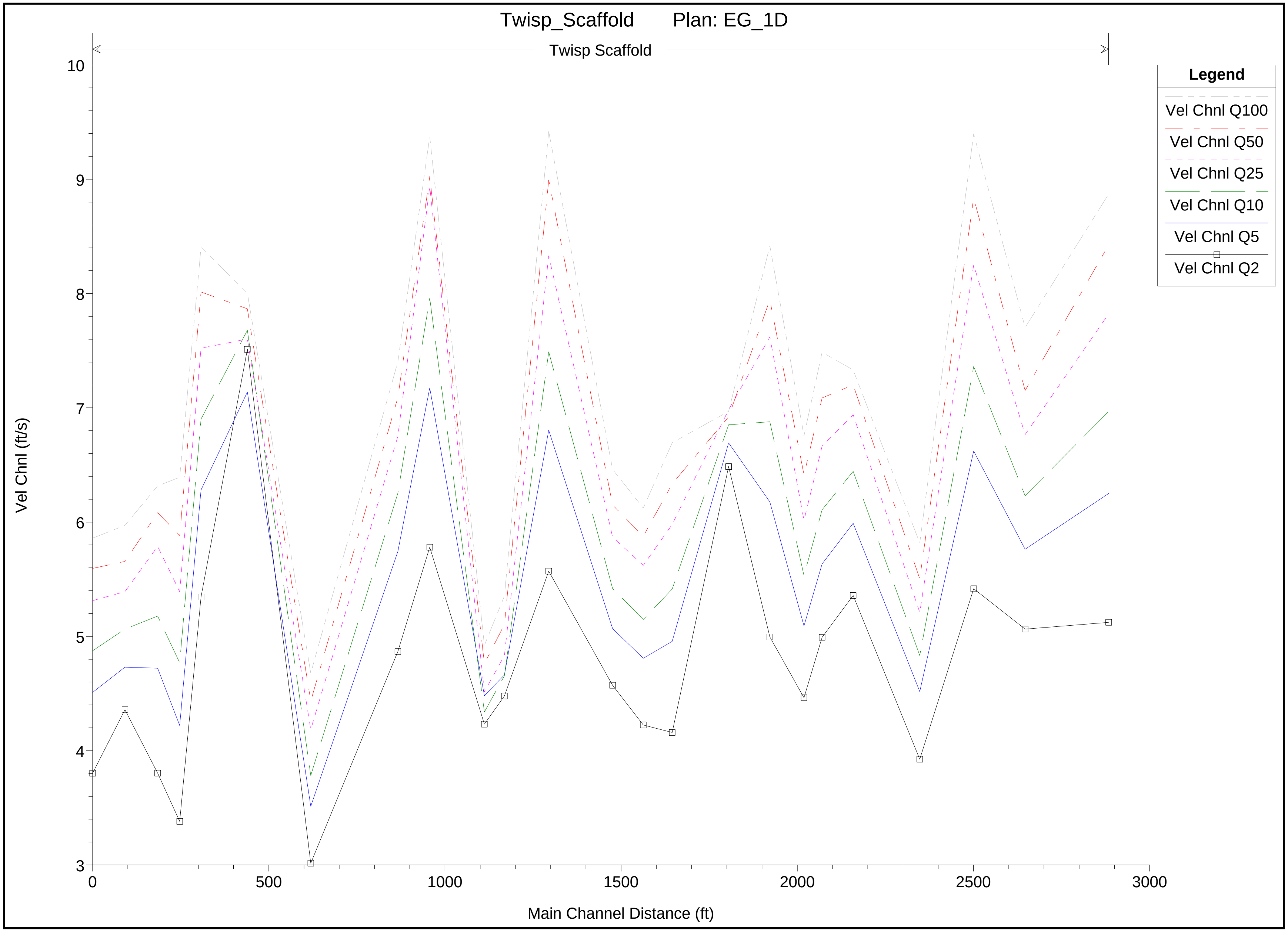
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Scaffold	1523	Q2	1152.00	2323.53	2326.72	2327.02	0.005788	4.57	317.54	180.67	0.56	0.74
Scaffold	1523	Q5	1714.00	2323.53	2327.38	2327.74	0.004918	5.07	439.73	189.73	0.54	0.83
Scaffold	1523	Q10	2111.00	2323.53	2327.76	2328.18	0.004706	5.42	514.91	202.23	0.54	0.91
Scaffold	1523	Q25	2639.00	2323.53	2328.21	2328.69	0.004613	5.87	617.98	268.02	0.55	1.02
Scaffold	1523	Q50	3050.00	2323.53	2328.54	2329.05	0.004515	6.15	717.82	346.31	0.55	1.09
Scaffold	1523	Q100	3473.00	2323.53	2328.81	2329.38	0.004544	6.46	826.38	425.42	0.56	1.18
Scaffold	1342	Q2	1152.00	2321.32	2325.41	2325.90	0.006587	5.57	217.22	135.09	0.62	1.03
Scaffold	1342	Q5	1714.00	2321.32	2325.91	2326.62	0.007741	6.80	304.91	229.47	0.69	1.45
Scaffold	1342	Q10	2111.00	2321.32	2326.21	2327.04	0.008291	7.49	382.22	284.10	0.72	1.71
Scaffold	1342	Q25	2639.00	2321.32	2326.52	2327.52	0.009110	8.33	474.73	312.26	0.77	2.05
Scaffold	1342	Q50	3050.00	2321.32	2326.70	2327.85	0.009943	8.99	533.82	325.58	0.81	2.35
Scaffold	1342	Q100	3473.00	2321.32	2326.94	2328.17	0.010074	9.42	612.24	341.14	0.82	2.52
Scaffold	1216	Q2	1152.00	2320.38	2324.74	2325.02	0.006333	4.48	360.16	258.34	0.57	0.74
Scaffold	1216	Q5	1714.00	2320.38	2325.41	2325.70	0.005105	4.66	567.77	379.02	0.53	0.74
Scaffold	1216	Q10	2111.00	2320.38	2325.85	2326.13	0.004334	4.66	747.73	430.39	0.50	0.71
Scaffold	1216	Q25	2639.00	2320.38	2326.26	2326.55	0.004130	4.83	935.82	490.68	0.50	0.74
Scaffold	1216	Q50	3050.00	2320.38	2326.49	2326.82	0.004162	5.10	1054.94	534.01	0.51	0.81
Scaffold	1216	Q100	3473.00	2320.38	2326.72	2327.06	0.004184	5.35	1182.43	618.53	0.51	0.87
Scaffold	1159	Q2	1152.00	2320.25	2324.46	2324.70	0.004476	4.23	397.16	253.13	0.50	0.62
Scaffold	1159	Q5	1714.00	2320.25	2325.17	2325.43	0.003925	4.48	615.68	396.77	0.48	0.66
Scaffold	1159	Q10	2111.00	2320.25	2325.64	2325.87	0.003912	4.34	847.28	577.32	0.48	0.62
Scaffold	1159	Q25	2639.00	2320.25	2326.07	2326.31	0.003450	4.52	1115.77	671.33	0.46	0.64
Scaffold	1159	Q50	3050.00	2320.25	2326.31	2326.57	0.003467	4.76	1278.51	701.75	0.47	0.70
Scaffold	1159	Q100	3473.00	2320.25	2326.54	2326.82	0.003376	4.92	1446.26	729.16	0.47	0.73
Scaffold	1004	Q2	1152.00	2319.66	2323.38	2323.86	0.005983	5.78	285.43	223.03	0.59	1.07
Scaffold	1004	Q5	1714.00	2319.66	2323.82	2324.53	0.007776	7.17	405.50	316.49	0.69	1.57
Scaffold	1004	Q10	2111.00	2319.66	2324.07	2324.92	0.008703	7.96	493.51	389.07	0.74	1.89
Scaffold	1004	Q25	2639.00	2319.66	2324.33	2325.36	0.009995	8.94	606.73	475.84	0.80	2.33
Scaffold	1004	Q50	3050.00	2319.66	2324.65	2325.65	0.009170	9.02	768.94	527.01	0.78	2.31
Scaffold	1004	Q100	3473.00	2319.66	2324.87	2325.90	0.009253	9.37	886.27	554.89	0.79	2.45
Scaffold	914	Q2	1152.00	2318.16	2322.83	2323.18	0.008223	4.87	288.48	272.50	0.65	0.89
Scaffold	914	Q5	1714.00	2318.16	2323.22	2323.69	0.008924	5.74	415.47	385.27	0.69	1.17

HEC-RAS Plan: EG_1D River: Twisp Reach: Scaffold (Continued)

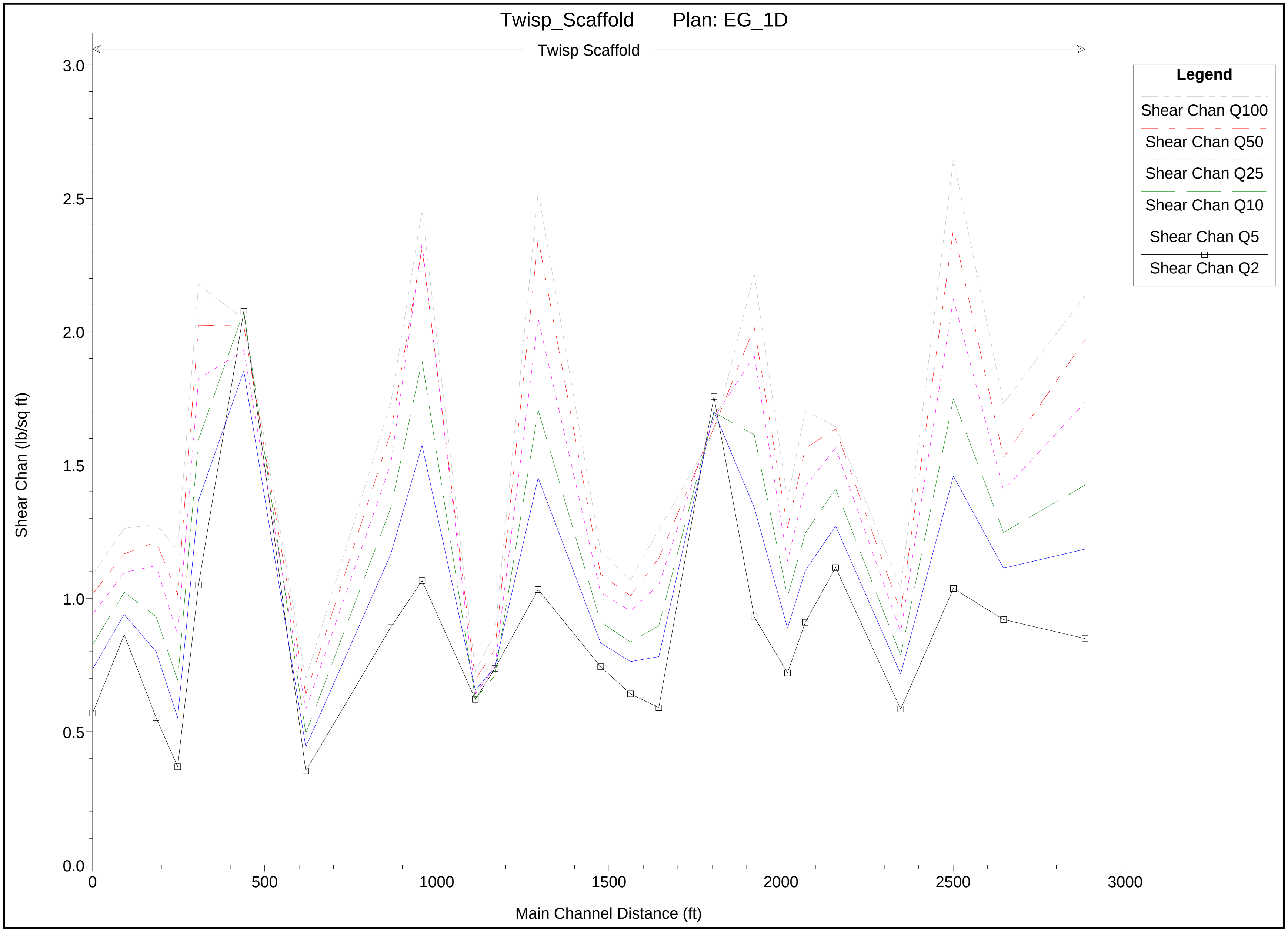
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Scaffold	914	Q10	2111.00	2318.16	2323.44	2324.00	0.009327	6.25	510.43	456.85	0.72	1.34
Scaffold	914	Q25	2639.00	2318.16	2323.71	2324.34	0.009383	6.75	647.21	539.79	0.74	1.51
Scaffold	914	Q50	3050.00	2318.16	2323.90	2324.57	0.009454	7.09	750.34	576.43	0.75	1.62
Scaffold	914	Q100	3473.00	2318.16	2324.07	2324.78	0.009503	7.40	852.96	597.20	0.76	1.73
Scaffold	666	Q2	1152.00	2318.94	2321.74	2321.86	0.003555	3.02	514.47	424.20	0.42	0.35
Scaffold	666	Q5	1714.00	2318.94	2322.15	2322.32	0.003541	3.51	714.23	541.58	0.44	0.44
Scaffold	666	Q10	2111.00	2318.94	2322.41	2322.60	0.003500	3.78	860.34	602.55	0.44	0.49
Scaffold	666	Q25	2639.00	2318.94	2322.66	2322.88	0.003731	4.19	1020.36	694.10	0.47	0.58
Scaffold	666	Q50	3050.00	2318.94	2322.84	2323.09	0.003807	4.43	1155.97	756.69	0.48	0.64
Scaffold	666	Q100	3473.00	2318.94	2323.01	2323.29	0.003909	4.68	1289.00	817.58	0.49	0.70
Scaffold	486	Q2	1152.00	2314.66	2319.75	2320.60	0.017897	7.51	185.01	172.37	0.96	2.08
Scaffold	486	Q5	1714.00	2314.66	2320.46	2321.16	0.015426	7.14	380.24	399.33	0.90	1.85
Scaffold	486	Q10	2111.00	2314.66	2320.67	2321.45	0.015686	7.68	469.66	449.06	0.92	2.08
Scaffold	486	Q25	2639.00	2314.66	2321.07	2321.79	0.012414	7.60	679.62	574.28	0.84	1.93
Scaffold	486	Q50	3050.00	2314.66	2321.26	2322.00	0.012196	7.87	789.77	605.76	0.84	2.02
Scaffold	486	Q100	3473.00	2314.66	2321.46	2322.21	0.011548	8.00	921.07	648.52	0.83	2.05
Scaffold	355	Q2	1152.00	2313.46	2318.38	2318.82	0.009026	5.34	232.36	147.37	0.68	1.05
Scaffold	355	Q5	1714.00	2313.46	2318.85	2319.44	0.009856	6.28	312.93	203.78	0.73	1.37
Scaffold	355	Q10	2111.00	2313.46	2319.10	2319.81	0.010379	6.90	370.86	259.25	0.76	1.60
Scaffold	355	Q25	2639.00	2313.46	2319.42	2320.25	0.010554	7.52	462.57	319.38	0.78	1.82
Scaffold	355	Q50	3050.00	2313.46	2319.61	2320.54	0.010962	8.01	529.28	357.76	0.81	2.02
Scaffold	355	Q100	3473.00	2313.46	2319.83	2320.83	0.011029	8.40	610.31	402.90	0.82	2.18
Scaffold	294	Q2	1152.00	2313.81	2318.31	2318.47	0.002137	3.38	509.69	250.89	0.35	0.37
Scaffold	294	Q5	1714.00	2313.81	2318.76	2319.00	0.002846	4.22	635.28	317.47	0.41	0.55
Scaffold	294	Q10	2111.00	2313.81	2319.00	2319.29	0.003375	4.77	714.44	347.50	0.45	0.69
Scaffold	294	Q25	2639.00	2313.81	2319.30	2319.67	0.003903	5.39	823.87	395.59	0.49	0.86
Scaffold	294	Q50	3050.00	2313.81	2319.47	2319.90	0.004426	5.88	896.68	445.41	0.53	1.01
Scaffold	294	Q100	3473.00	2313.81	2319.64	2320.15	0.004930	6.39	976.01	475.71	0.56	1.18
Scaffold	232	Q2	1152.00	2315.28	2318.08	2318.25	0.005313	3.80	460.13	355.02	0.52	0.55
Scaffold	232	Q5	1714.00	2315.28	2318.45	2318.72	0.006386	4.72	616.19	480.71	0.58	0.80
Scaffold	232	Q10	2111.00	2315.28	2318.66	2318.98	0.006748	5.18	723.16	527.55	0.61	0.93
Scaffold	232	Q25	2639.00	2315.28	2318.91	2319.31	0.007307	5.79	864.78	588.35	0.65	1.12
Scaffold	232	Q50	3050.00	2315.28	2319.09	2319.52	0.007355	6.08	972.86	612.34	0.66	1.21

HEC-RAS Plan: EG_1D River: Twisp Reach: Scaffold (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Scaffold	232	Q100	3473.00	2315.28	2319.28	2319.73	0.007249	6.32	1090.04	639.54	0.66	1.28
Scaffold	139	Q2	1152.00	2313.99	2317.13	2317.36	0.014030	4.36	357.76	319.93	0.77	0.86
Scaffold	139	Q5	1714.00	2313.99	2317.52	2317.80	0.012042	4.73	500.25	392.30	0.74	0.94
Scaffold	139	Q10	2111.00	2313.99	2317.74	2318.05	0.011239	5.06	586.03	405.43	0.74	1.02
Scaffold	139	Q25	2639.00	2313.99	2318.01	2318.37	0.010200	5.39	702.78	436.16	0.72	1.10
Scaffold	139	Q50	3050.00	2313.99	2318.20	2318.60	0.009801	5.66	785.88	455.91	0.72	1.17
Scaffold	139	Q100	3473.00	2313.99	2318.38	2318.83	0.009698	5.97	870.30	483.25	0.73	1.26
Scaffold	47	Q2	1152.00	2313.03	2316.22	2316.39	0.006011	3.80	451.09	348.89	0.54	0.57
Scaffold	47	Q5	1714.00	2313.03	2316.67	2316.92	0.006000	4.51	620.08	413.13	0.57	0.74
Scaffold	47	Q10	2111.00	2313.03	2316.91	2317.20	0.006004	4.87	724.07	438.88	0.58	0.83
Scaffold	47	Q25	2639.00	2313.03	2317.22	2317.56	0.006003	5.31	862.63	468.93	0.59	0.94
Scaffold	47	Q50	3050.00	2313.03	2317.42	2317.79	0.006009	5.60	957.72	474.15	0.60	1.02
Scaffold	47	Q100	3473.00	2313.03	2317.62	2318.02	0.006005	5.86	1051.52	479.18	0.60	1.09



Twisp_Scaffold Plan: EG_1D
Twisp Scaffold
Legend
Vel Chnl Q100
Vel Chnl Q50
Vel Chnl Q25
Vel Chnl Q10
Vel Chnl Q5
Vel Chnl Q2
Vel Chnl (ft/s)
Main Channel Distance (ft)
10
9
8
7
6
5
4
3
0
500
1000
1500
2000
2500
3000


Twisp_Scaffold Plan: EG_1D
Twisp Scaffold
Legend
Shear Chan Q100
Shear Chan Q50
Shear Chan Q25
Shear Chan Q10
Shear Chan Q5
Shear Chan Q2
Shear Chan (lb/sq ft)
Main Channel Distance (ft)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
500
1000
1500
2000
2500
3000