

*Confederated Tribes of the
Umatilla Indian Reservation*

Tucannon River

*Large Woody Debris Restoration and
Floodplain Connection Project
Tucannon River Project Areas 1 and 3
60% Design Report*

December 2013



TETRA TECH



December 4, 2013

Eric Hoverson
Tucannon Fisheries Habitat Project Leader
Confederated Tribes of the Umatilla Indian Reservation (CTUIR)
Walla Walla Community College
Water & Environmental Center, Office 485
500 Tausick Way
Walla Walla, WA 99362

Subject: Preliminary Design Development (60%) for Floodplain Restoration and Large Woody Debris Enhancement Work on the Tucannon River – Project Areas 1 and 3

Dear Mr. Hoverson:

Tetra Tech is pleased to submit the enclosed Preliminary Design Development (60%) for the Floodplain Restoration and Large Woody Debris Enhancement Project (Project) on the Tucannon River. This submittal has been prepared in accordance with our Contract dated September 23, 2013. The enclosed Preliminary Design (60%) incorporates the initial Project design presented to Tetra Tech by the CTUIR, field survey data, existing fish utilization data, and geomorphic and hydrologic analyses for Project Areas 1 and 3.

As discussed in the report, the proposed designs are aimed towards improving in-stream and riparian habitat complexity, which will in turn provide better spawning and rearing habitat for threatened salmonids. By addressing key limiting factors and integrating the watershed context, the Project supports the CTUIR River Vision to promote a dynamic river and floodplain system with natural variability and long-term viability of salmonid populations.

We look forward to discussing the Preliminary Design Development (60%) with the CTUIR during our upcoming meeting. If you have any questions, please do not hesitate to call me at (425) 482-7622, or by cell at (503) 358-7079.

Sincerely,

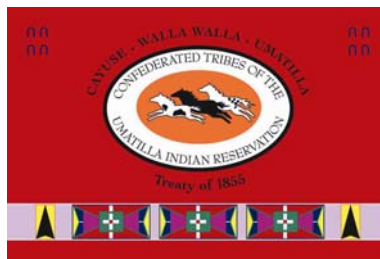
A handwritten signature in black ink, appearing to read 'C. James', written over a light blue horizontal line.

Chris James
Project Manager
Tetra Tech, Inc.

Tucannon River Floodplain Restoration and Large Woody Debris Enhancement Project

Preliminary (60%) Design Report:
Project Areas 1 and 3

Submitted to:



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December 2013

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1.0 INTRODUCTION

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Fisheries Habitat Program has a vested interest in achieving and maintaining a high-quality ecological condition for aquatic species in the Tucannon River subbasin. The watershed is identified as a geographical area of traditional, ceded use by the CTUIR. This document contains the Preliminary (60%) Design Report for the Tucannon River Floodplain Restoration and Large Woody Debris Enhancement Project (Project). The Project designs presented in this report include large woody debris (LWD) and boulder additions (sometimes referred to as fish rocks), as well as floodplain reconnection approaches in two sections of the Tucannon River previously identified as areas of primary concern for aquatic habitat restoration.

The upper Tucannon River provides spawning and rearing habitat for four Endangered Species Act (ESA) listed salmonids: Snake River summer steelhead- (*Oncorhynchus mykiss*), spring and fall Chinook salmon (*O. tshawytscha*), and bull trout (*Salvelinus confluentus*). Human activities in the Tucannon River subbasin have transformed the river from a branching channel with a connected, diverse riparian zone, to a moderately incised and confined single-thread channel with a degraded and disconnected riparian zone. These impacts have resulted in severely reduced in-stream habitat complexity, pool frequency, and floodplain connectivity, which limits adequate spawning and rearing habitat for the ESA listed species. Additionally, much of the surrounding watershed burned in the School Fire of 2005, which impacted over 50,000 acres of forest and riparian areas along the Tucannon River. Some of the most severe fire damage occurred in Hixon Canyon, located in the upper Tucannon River Watershed. Because of this, the Tucannon River offers significant potential for listed species population recovery and enhancement if the in-stream habitat and floodplain conditions are improved.

The development of the Project is a collaborative effort between the CTUIR and the Washington Department of Fish and Wildlife (WDFW), the USDA Forest Service (Forest Service), the Nez Perce Tribe, and the Snake River Salmon Recovery Board (SRSRB). Project partners will provide technical assistance throughout Project development and have helped secure resources (e.g. restoration trees and boulders) for Project implementation.

1.1 PROJECT LOCATION

The proposed large woody debris (LWD) restoration and floodplain connection Project is located in Project Area 1 (PA 1) and Project Area 3 (PA 3) of Reach 10 of the Tucannon River, which is the uppermost reach identified in the Tucannon Geomorphic Assessment (Anchor 2011). Figure 1-1 shows both Project area extents between the Panjab Creek Bridge and Camp Wooten. High-resolution aerial imagery for each Project area can be viewed in Section 2.3, Figure 2-3 (PA 1) and Figure 2-6 (PA 3).

The Project areas are located within the Umatilla National Forest and the WDFW Wooten Wildlife Area and include portions of Township 9 North, Range 41 East, Section 32, Township 8 North, Range 41 East, Section 5, and Township 9 North, Range 41 East, Sections 20, 29, and 30.

Project Area 1

PA 1 extends from River Mile (RM) 49.45 to RM 50.1 (0.65 miles) with the upstream extent at Panjab Bridge (Figure 1-1).

Project Area 3

PA 3 extends from RM 46.75 to RM 48.1 (1.35 miles), from the Camp Wooten Natural Resources Learning Center (Camp Wooten) to the confluence with the Little Tucannon River (Figure 1-1).

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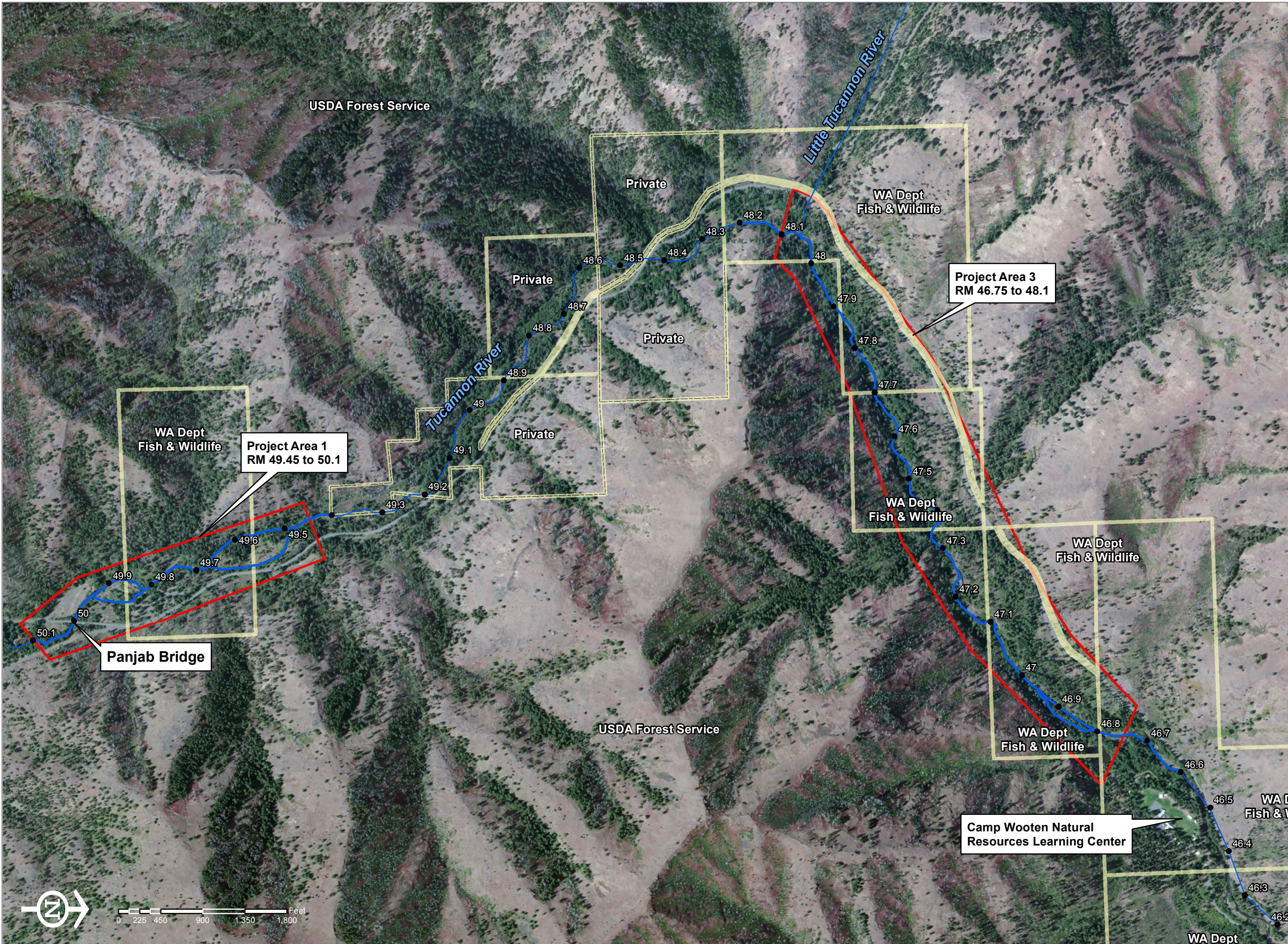


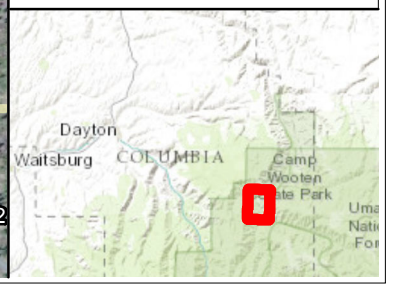
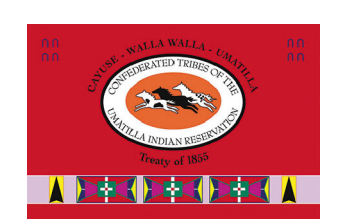
Figure 1-1. Tucannon River Project Areas 1 and 3 Vicinity

River Miles

Columbia County Parcels

Project Area Extents

Projection: Washington State Plane South NAD 83



1.2 PROJECT GOAL AND OBJECTIVES

The goal of the restoration and enhancement designs included in this report is to improve in-stream habitat complexity and riparian connectivity within the Project areas, which will in turn provide better spawning and rearing habitat for ESA-listed species. There is an overall lack of pool habitat and simplified channel diversity/complexity. The majority of available aquatic habitat is comprised of fast-water habitat types such as rapids and riffles. These characteristics are consistent with typical incised and straightened channels. The four main Project objectives are to:

1. Increase in-stream habitat complexity and cover,
2. Increase floodplain connectivity,
3. Increase the number of and the quality of habitat in secondary channels, and
4. Ensure that Project activities do not negatively impact Camp Wooten facilities.

In order to meet the Project goal and objectives, restoration designs were developed that address limiting factors while improving riverine habitat for ESA-listed salmonids. Restoration actions will be guided by the CTUIR River Vision (Jones et al. 2008). The CTUIR River Vision seeks to promote a dynamic river and floodplain system with natural variability, address ecological processes rather than localized manipulations that may not take into account the causes of the degradation, and plan projects in relation to larger-scale watershed impacts. Table 1-1 provides the linkage from limiting factors to restoration objectives and River Vision Touchstones, and the associated metrics that can be evaluated for Project designs and post-implementation effectiveness monitoring.

Table 1-1. Limiting Factors, Associated Restoration Objectives, River Vision Touchstones, and Evaluation and Monitoring Metrics

Limiting Factors (NOAA equivalent)	Restoration Objective	River Vision Touchstone	Metrics
<p>In-Channel Characteristics (6.2: Channel Structure and Form: Instream Structural Complexity)</p>	<ul style="list-style-type: none"> • Restore geomorphic processes • Increase habitat diversity in the channel • Improve habitat quantity and quality • Increase instream habitat structures • Arrest channel downcutting through structure installation 	<p>Primary: Aquatic Biota Secondary: Geomorphology</p>	Channel geometry (bankfull width, bankfull depth, width/depth ratio), longitudinal profile
			Sinuosity (Lc/Lv)
			LWD Counts
			Pool frequency or spacing
			Percent pools
			Residual pool depth (dmax/dtail)
<p>Floodplain Connectivity (5.2: Peripheral and Transitional Habitats: Floodplain Condition) Riparian (4.1: Riparian condition: Riparian Vegetation)</p>	<ul style="list-style-type: none"> • Increase floodplain and secondary channels • Increase channel sinuosity • Add large wood to channels and floodplains to promote roughness, deposition, and vegetation establishment • Increase floodplain cross-sectional area • Restore riparian vegetation 	<p>Primary: Connectivity, Geomorphology Secondary: Riparian Vegetation</p>	Percent of floodplain disconnected
			Entrenchment ratio or confinement ratio (Wfp/Wbf)
			Floodplain relative elevation
			Channel Complexity Index
			Size, density, and cover of native or site appropriate species

Table 1-1. Limiting Factors, Associated Restoration Objectives, River Vision Touchstones, and Evaluation and Monitoring Metrics

Limiting Factors (NOAA equivalent)	Restoration Objective	River Vision Touchstone	Metrics
Sediment (7.2: Sediment Conditions: Increased Sediment Quantity)	<ul style="list-style-type: none"> • Restore geomorphic processes • Establish equilibrium conditions • Reduce fine sediment supply • Increase substrate quality 	Primary: Geomorphology Secondary: Aquatic Biota	Threshold grain size and transport rate
			Meander belt width
			Aggradation rate

Several previous studies have identified the preferred types of restoration activities for addressing the limiting factors in the Project areas. Results from a geomorphic assessment commissioned by the Columbia Conservation District (CCD) (Anchor 2011) and an Ecosystem Diagnosis and Treatment (EDT) analysis (CCD 2004, Appendix J) concluded that increased pools and LWD were needed to address the primary limiting factor of habitat quantity. The following recommendations for restoration activities, included in Anchor (2011), are based on the restoration framework actions developed by Roni et al. (2002):

1. Protect and maintain natural processes.
2. Connect disconnected habitat.
3. Address anthropogenic, confining infrastructure impairing natural processes/floodplain connectivity.
4. Restore riparian processes and areas lacking canopy cover. Utilize best forest management practices.
5. Improve in-stream habitat conditions. Add LWD to force pools and maintain channel complexity.

1.3 REPORT ORGANIZATION

The remainder of the report is organized into the following Sections with Attachments:

- Section 2.0 describes the existing conditions in the Project areas including: hydrology, geomorphology, physical habitat features, and fish utilization and limiting factors as determined from a review of existing data and reports.
- Section 3.0 describes the preliminary design (60%), including design elements, hydraulic analysis results, and preliminary stability calculations.
- Section 4.0 lists the known Project constraints.
- Section 5.0 lists references used.
- Attachment A contains the preliminary design (60%) with plan view and detail sheets.
- Attachment B contains draft Project construction specifications (60%).
- Attachment C contains a planning level estimate of construction costs (60%).

2.0 EXISTING CONDITIONS

Based on the Project goal and objectives, an assessment was conducted to evaluate existing conditions in the two Project areas. Surveys at the downstream end of PA 3 were intended specifically for evaluating the potential for project impacts at Camp Wooten. For PA 1, surveys were used to evaluate existing hydrology, hydraulics, sediment mobility, channel morphology, and habitat characteristics and fish use for the development of Project designs.

Data used in this analysis included topographic surveys, longitudinal and cross section surveys, specific habitat characteristics, high-resolution aerial photography, light detection and ranging (LiDAR) imagery, surface sediment samples, and HEC-RAS hydraulic model results (See Section 3.2). With this information, an investigative analysis of existing conditions was conducted to perform reach-scale geomorphic assessments, and provide information for the development of preliminary designs for the Project. The results have been interpreted in combination with the hydraulic model (See Section 3.2) to develop the preliminary designs described in Section 3.0 and shown in Attachment A.

The existing conditions analysis was developed with Real-Time Kinematic (RTK) Global Positioning System (GPS) topographic survey data collected in October 2013. Data collected during the surveys included channel features such as the thalweg profile, cross sections, and in-stream structures. Topographic surveys were conducted for the entire length of PA 1 and the lowermost reach of PA 3.

2.1 HYDROLOGY

The Tucannon River is a tributary of the Snake River and is located in southeastern Washington. The watershed area encompasses 431 square miles (sq mi) in Columbia and Garfield Counties. The Tucannon River originates in the Blue Mountains, located in the Umatilla National Forest, and flows generally northwest to its confluence with the Snake River near Starbuck, Washington. The PA 1 and PA 3 reaches are located in the upper watershed, with the downstream end of the reach at RM 46.75, and 49.45, respectively. The upper watershed is generally conifer forest, with sparse undergrowth in the valley floors and shrub-steppe habitat in the steeper upper slopes. Recent forest fires have impacted the Tucannon River basin: School Fire (2005), Columbia Complex Fire (2006), and the Hubbard Fire (2009). The drainage area for PA 1 is 65.14 sq mi, and the drainage area for PA 3 is 77.65 sq mi, a relatively small proportion of the watershed. A complete description of the hydrologic analysis methods and results is provided in the Hydrology and Hydraulics Report (Tetra Tech 2013). The following provides a summary.

Several nearby streams with USGS and/or Washington Department of Ecology (Ecology) stream gages were evaluated as candidate reference gages for gage transfer. Initially, the Ecology gage on Pataha Creek (35F050) was investigated as a possibility for a gage transfer. Pataha Creek is a tributary to the Tucannon River with its confluence with the Tucannon at approximately RM 12.5. The Ecology gage has been measuring streamflow in Pataha Creek at SR 261 for the past 10 years. However, these data were not used because, in our opinion, the quality of the data collected at this location are suspect and typically a much longer period of record (on the order of several decades) is needed to estimate peak flows for 100-year events. Based on a hydraulic analysis conducted for the State Route 261 culvert as part of a fish passage design project (at the gage location), the site hydraulics showed that the culvert hydraulics are very complicated in the vicinity of the staff gage location (Tetra Tech, 2011). The analysis predicted the occurrence of a hydraulic jump at the outlet of the structure which may not allow accurate depth measurements (and hence flow estimates) during high flow conditions. Also, recent construction activity in the vicinity of the gage also informed our decision to not select the Ecology gage at Pataha.

Peak flow rates were estimated for the 1.05- (approximate bankfull), 2-, 10-, 25-, 50- and 100-year flood frequency for the Tucannon River at PA 1 and PA 3 using the unit-discharge gage-transfer method outlined in Sumioka et al. (1998). Peak flow at the United States Geological Survey (USGS) streamflow gage (14013000 Mill Creek near Walla Walla) was selected as the reference streamflow gage because it has basin characteristics similar to the PA 1 and PA 3 tributary subbasins within the Tucannon River basin. Basin characteristics are shown in Table 2-1. Peak flow estimates for the 2-year recurrence interval discharge were 4,995 cubic feet per second (cfs) in PA 1 and 5,541 cfs in PA 3. Estimated peak flow estimates for all recurrence intervals are shown in Table 2-2.

Table 2-1. Basin Characteristics for Comparison^{1/}

Basin Characteristic	Mill Creek Gage Near Walla Walla (USGS 14013000)	PA 1	PA 3
Tributary Area (sq mi)	60	65	78
Average Basin Slope (%)	48	41	41
Percent of Area with Slope Greater than 30 Percent (%)	87	71	72
Average Elevation (feet NGVD)	3,930	4,900	4,750
Forest Coverage (%) ^{2/}	60	73	71
Mean Annual Precipitation (inches)	40	37	35

^{1/} Basin characteristics report accessed from StreamStats (USGS 2013).

^{2/} Computed from the National Land Cover Dataset (NLCD) 2001 canopy data.

Table 2-2. Estimated Peak Flow Recurrence Intervals for PA 1 and PA 3

Recurrence Interval (years)	Mill Creek Gage Near Walla Walla (USGS 14013000) (cfs)	PA 1 (cfs)	PA 3 (cfs)
1.05 (approximate bankfull)	370	390	433
2	894	942	1,045
10	2,100	2,213	2,455
25	2,990	3,151	3,495
50	3,790	3,994	4,430
100	4,740	4,995	5,541

It should be noted that estimated peak flow rates for the Tucannon River at the confluence of the Little Tucannon River were previously completed by Anchor (2011). The results of that analysis showed a significantly lower 2-year peak flow (664 cfs) and a higher 100-year peak flow (6,498 cfs) than was calculated using the gage transfer from Mill Creek. These data were evaluated and deemed inadequate for use in our design as they based their analysis on a gage transfer from Pataha Creek.

Three other gages were investigated for the possibility of a gage transfer. These gages were chosen for comparison based on their vicinity to the Project area. These gages are as follows:

- USGS Mill Creek near Walla Walla, WA – 14013000
- USGS South Fork Palouse River at Pullman, WA – 13348000
- USGS Tucannon River near Starbuck, WA – 13344500

As a first screen, the characteristics of each basin were compared to the basin characteristics of the Project areas to determine if they would be suitable for a gage transfer. From this comparison, the South Fork Palouse River gage data were not used as the basin was too dissimilar to the Project basin.

Secondly, a basin size comparison was performed on the remaining options. As outlined in Sumioka et al. (1998), the drainage area of the unged site must be between 50 and 150 percent of the drainage area

of the gaged site. This comparison shows that although the gage located on the Tucannon River near Starbuck would seem to be the most likely candidate for a gage transfer, the Project drainage areas do not fit within the allotted percentage range. Therefore, the data from the Tucannon River gage were not used for the gage transfer.

Peak flow rates were also estimated using regression equations developed by Sumioka et al. (1998) for estimating peak flows in ungaged basins. These peak flow rates were then compared to the peak flow rates of the gage transfer from Mill Creek. By comparing the regression flow rates to the gage transfer flow rates, it shows that the gage transfer produces a higher set of peak flow rates. Although the peak flow rates from the gage transfer are higher than those calculated from the regressions equation (7-11% for the 2-year peak flow and 20-23% for the 100-year peak flow), they fall well below the standard error of prediction percent (80% for the 2-year peak flow and 56% for the 100-year peak flow) developed by Sumioka et al. (1998). For the purposes of this design, it is assumed that utilizing a higher peak flow rate will result in a higher factor of safety. This higher factor of safety within the design is acceptable, considering the concerns of impacting the existing infrastructure that is located within a close proximity to the Project areas. For this reason, it was assumed that the Mill Creek flood frequency would provide better estimates of the flood frequency in the Tucannon River basin.

2.2 GEOMORPHOLOGY

The channel morphology in the majority of each Project area can be classified as mostly plane-bed with forced pool segments where functional LWD is present. The channel is generally single thread, with the main exception being the downstream segment of PA 3 (at Camp Wooten), where the active channel is wider and braided. Reach average channel gradients range from 1.1 percent in PA 3 to 1.4 percent in PA 1. LWD jams and gravel deposits of significant size are present, but infrequent. Overall, there is a lack of gravel bars and LWD, particularly in straight, single-thread reaches with relatively uniform fast water and little hydraulic complexity (See Figure 2-1). Accumulations of LWD persist in areas of high temporary sediment storage, split flow, and side channels.

In the Project areas, much of the channel is narrow and moderately incised, resulting in the floodplain being perched above the active channel at most flows. This phenomenon is largely the result of previous riparian forest harvesting and in-channel LWD clearing, which removed LWD from the system and especially the large-diameter mature trees that serve as key members for stable LWD jams. This practice reduced channel roughness and resulted in channel straightening, incision, and bed surface coarsening. In this condition, the sediment transport capacity (the sediment load that can be transported), exceeds the sediment supply (from upstream sediment sources and bank erosion). This topic is discussed further in the field survey results for PA 1 below. The result is that most of the sediment supplied to the channel is transported through these reaches and lands in depositional zones downstream where the floodplain is accessible and lateral movement is possible.



Figure 2-1. Photograph of typical existing channel conditions.

The current riparian stand is in relatively good condition with a mix of mature deciduous and conifer trees, dominated by the conifer species Doug fir, Ponderosa Pine, and White fir that have been regenerating for many decades. While riparian trees will provide functional LWD in the future as recruitment occurs, the recruitment process requires decades to centuries for the trees to mature and the desired in-channel recovery to take place.

Project Area 1

Channel thalweg and representative cross sections were surveyed throughout the entire PA 1 Project reach (3,442 feet) during topographic surveys in October 2013 (See Figure 2-3 in Section 2.3). From these data, reach average, minimum and maximum channel dimensions were calculated (Table 2-3). The average bankfull width for the PA 1 reach is 50 feet and the average bankfull depth is 1.5 feet. The reach average maximum depth at bankfull stage is estimated at 2.4 feet. These summary characteristics are estimated from cross sections in riffle and glide habitat units. The existing conditions sinuosity as calculated from the thalweg profile in PA 1 is 1.2.

Table 2-3. Cross Section Channel Dimensions for PA 1

Channel Dimensions	Mean (ft)	Minimum (ft)	Maximum (ft)
Bankfull Width	50	34	60
Mean Bankfull depth	1.5	1.3	1.9
Maximum Bankfull Depth	2.4	2.0	3.0
X- Sec Bankfull Area	73	54	91
Hydraulic Radius	1.5	--	--
Width-to-Depth Ratio	34	18	43

Reach average hydraulic characteristics (channel slope, average velocity, discharge, bed shear stress, and stream power) were estimated for bankfull stage (identified during field surveys) in PA 1. Table 2-4 contains a summary of reach average hydraulic characteristics and the minimum and maximum at individual cross sections. As stated above, topographic survey data were not collected for the entire length of PA 3 and therefore the hydraulic data are not summarized in this Section; however, hydraulic modeling was completed for PA 3 and the results are described in Section 3.2 and contained in Tetra Tech (2013).

The hydraulic characteristics were estimated using a 1-dimensional cross section model based on an estimated channel roughness value (Manning’s n). The methods used to estimate the Manning’s n value for this reach are contained in the hydraulic modeling section (Section 3.2). The hydraulic data was also used to estimate the grain size at the threshold of motion which for PA 1 is 62 millimeters (mm).

Table 2-4. PA 1 Summary of Hydraulic Characteristics at Bankfull Flows

Hydraulics Variables	Mean	Minimum	Maximum
Discharge Rate (cfs)	350	--	--
Channel Slope (%)	1.4	--	--
Average Velocity (ft/sec)	4.8	4.4	5.9
Average Shear Stress (lbs/ft ²)	1.3	1.1	1.6
Unit Stream Power (lbs/ft/sec)	6	5	10
Threshold Grain Size (mm)	62	56	78

Channel bed surface sediments were sampled at two sites in PA 1. Samples were collected using pebble counts following the methods in Bunte and Abt (2001). The average characteristic grain sizes and the surface sediment compositions for the two sites are contained in Table 2-5. The channel bed surface is predominantly cobble-sized (63 %) with a median grain size (D50) of 85 mm. As shown in Table 2-4, the threshold grain size for PA 1 is 62 mm. The fact that the threshold grain size (62 mm) is much smaller than the median surface grain size (85 mm) in PA 1 supports the theory that transport conditions in the current channel configuration are not favorable for the formation of stable bars containing spawning sized gravels.

Table 2-5. Tucannon River Channel Materials composition for PA 1

Characteristic Grain Size	Grain Size (mm)	Composition	Percentage (%)
D16	46	Silt/Clay	0
D35	68	Sand	1
D50	85	Gravel	30
D65	110	Cobble	63
D84	150	Boulder	6
D95	270	Bedrock	0

Project Area 3

Channel thalweg and representative cross sections were surveyed throughout the lower portion of PA 3 (2,721 feet) during the October 2013 topographic surveys (See Figure 2-6 in Section 2.3 for the survey extent). The primary purpose for the survey of PA 3 was for the collection of topographic data to be used for the hydraulic modeling of existing and proposed conditions near Camp Wooten (see Section 3.2). The remainder of the PA 3 reach has been evaluated and results documented in the field observations of Hoverson (2013). In addition to the site-specific topographic surveys, the entire site was walked and field observations made to refine LWD and boulder addition designs during the 2013 field surveys (see Attachment A).

Upstream of the PA 3 survey reach, the channel is a relatively narrow, incised, fast water segment with coarse boulder and cobble substrate (Figure 2-2). In the survey reach, the stream transitions to a relatively wide and braided segment at the downstream end with finer substrate and an island gravel bar (Figure 2-5). The changes in the survey reach are an example of the transition to a depositional zone where the floodplain is accessible and lateral movement is possible, as described previously.



Figure 2-2. Photograph of typical channel conditions in the confined reach of PA 3

2.3 PHYSICAL HABITAT FEATURES

In general, both Project areas have a limited quantity of high-quality habitat features and habitat diversity. The majority of the stream channel exhibits a relatively simplified form with a cobble-to-boulder dominated channel bed. Quality spawning areas with appropriately sized gravels are limited. Pools are infrequent, relatively shallow, and typically have little cover, which results in low quality holding areas for migrating adults. There are active secondary channels in both Project areas that likely provide some high-flow refuge for juveniles. However, there are significant opportunities to improve high-flow refuge and low-flow cover for juveniles through in-channel, secondary channel, and off-channel restoration and enhancement actions. Lack of quality habitat was identified as one of the priority limiting factors that should be addressed in restoration actions. Lack of quality pools was noted for both steelhead and Spring Chinook salmon (SRSRB 2011 and Anchor 2012).

Project Area 1

Physical habitat conditions were observed during field surveys in 2013. Habitat units (pools, glides riffles, and rapids) and the location of existing LWD were identified during the channel profile field survey. Figure 2-3 displays the habitat units identified for PA 1 and Table 2-6 contains the length of channel in each habitat unit category as well as the percent of the total length.

Pools are infrequent and relatively small in this steep and narrow section. Eight pools were identified that covered less than 15 percent 3,537 foot survey reach, with an average pool spacing of 411 feet (Table 2-6). The mean residual pool depth for these pools was 1.8 feet, ranging from 0.2 feet to 3.3 feet. Panjab Bridge at the upstream end of the project area is backwatered by a large rock weir that creates a deep pool upstream of the bridge. Overhanging riparian vegetation for cover habitat is limited in the Project area. The upper canopy forest is a mix of deciduous and conifers with mid- and understory shrubs such as willow and dogwood.

Table 2-6. PA 1 Habitat Units from Thalweg Profile Survey

Habitat Unit ^{1/}	Length (ft)	Percent of Area (%)
Pool	487	14
Glide	297	9
Riffle	2605	76
Rapid (> 4% gradient)	20	<1
Mean Pool-Pool Spacing (ft)		
	411	

^{1/} Habitat units were classified following the methods of Bisson et al. (2006) and Columbia Habitat Monitoring Protocol (CHaMP) (Bouwes et al. 2011).

During the topographic surveys, LWD pieces over 12 inches in diameter were tallied and their location surveyed. Though not recorded, there was a very limited amount of LWD less than 12 inches diameter observed in the reach. Some of the tallied LWD tallied were positioned in LWD and boulder groin structures installed during past projects (See Figure 2-4). In total, 50 pieces of LWD were surveyed over the PA 1 reach, resulting in a LWD density of 1.4 pieces per 100 feet (4.6 pieces per 100 meters).

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Path: P:\194-4861 - Confederated Tribes of the Umatilla Indian Reservation-Tucannon River Substation\CIS\Maps\Tucannon_Habitat PA 1.mxd

**Figure 2-3.
Tucannon River
Project Area 1**

Habitat Units

- Rapid
- Riffle
- Glide
- Pool

Projection:
Washington State
Plane South NAD 83

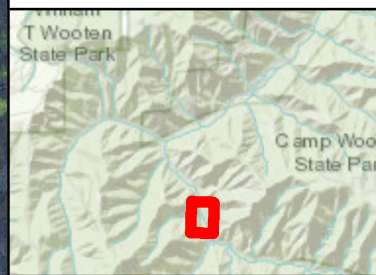




Figure 2-4. Photograph of existing LWD and boulder groin structure.

Project Area 3

The PA 3 reach is a moderately confined single channel through much of the project area; however, the lower third of the project area is less confined, with a moderately braided channel, resulting in two flow paths and low to moderate flows with a depositional gravel bar between them, as shown in the photograph in Figure 2-5. This segment is where the topographic surveys and habitat classifications were made. Figure 2-6 displays the habitat units for the segment of PA 3 surveyed, and Table 2-8 contains the length of channel in each of the habitat unit categories and the percent of the total area surveyed.



Figure 2-5. Photograph of the head of the island bar located at the lower segment of PA 3

The slope for the downstream end of PA3 (where the topographic survey was completed) is 1.1 percent. Six pools were identified with typical pool spacing at approximately 250 feet, representing 20 percent of the available physical habitat (Table 2-7). Average pool depth is 1.2 feet. The majority of the channel is characterized by riffle habitat. The most recent sediment sample from the surrounding area is just upstream in PA1 (Table 2-7).

Table 2-7. PA 3 Habitat Units from Thalweg Profile Survey

Habitat Unit ^{1/}	Length (ft)	Percent of Area (%)
Pool	289	21
Glide	300	21
Riffle	824	58
Rapid (> 4% gradient)	0	0
Mean Pool-Pool Spacing (ft)	250	

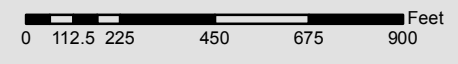
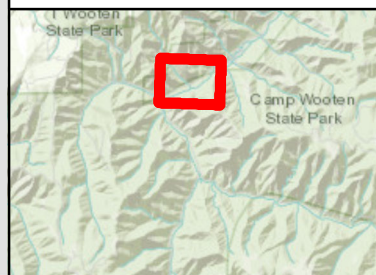
^{1/} Habitat units were classified following the methods of Bisson et al. (2006) and Columbia Habitat Monitoring Protocol (CHaMP) (Bouwes et al. 2011).

Figure 2-6.
Tucannon River
Project Area 3

Habitat Units

-  Riffle
-  Glide
-  Pool

Projection:
Washington State
Plane South NAD 83



Wood abundance throughout the portion of PA 3 not surveyed is generally low. Though localized accumulations occur, the reach lacks complexity that would generally be developed through more distributed wood accumulation, allowing the channel more access to floodplain terraces and more developed surface-subsurface flow-paths (Hoverson 2013). The photograph in Figure 2-7 shows the typical habitat throughout the unsurveyed portion of PA 3.



Figure 2-7. PA 3 reach upstream of the topographic survey reach.

2.4 FISH UTILIZATION

The Tucannon River supports 29 species of fish that include 20 native species and nine exotics (NPPC 2001). Exotic species consist of warm water tolerant fish that occur mostly in the lower river sections. Focal species being addressed by this project include four ESA-listed Snake River salmonid populations: Summer steelhead, spring Chinook salmon, fall Chinook salmon, and bull trout. Life history characteristics of the focal species are described below, and expected fish periods of utilization within the PA 1 and PA 3 reaches are summarized in Table 2-8. Pacific and River lamprey also occur in the Tucannon River and are considered species of concern.

Summer Steelhead

Summer steelhead populations within the Tucannon watershed are part of the Snake River Basin steelhead distinct population segment (DPS), which received Threatened status in 1997. Most of the summer steelhead in the Tucannon River are the smaller Snake River “A” run stock that spend only one year in the ocean. They begin entering freshwater from June to August. Adults may enter the Tucannon in September, but spawning does not occur until the spring, peaking in April through mid-May (CCD 2004). Juveniles emerge in late May to June, and typically reside in freshwater for 1-2 years before out migrating in the spring. A small percentage may reside 3-4 years in freshwater. While summer steelhead are present throughout the mainstem, the greatest densities of spawning and juvenile rearing both occur downstream of PA1 and PA3, at RM 15.3 to RM 42 and RM 18 to RM 45 respectively (Anchor 2012).

Spring Chinook Salmon

Spring Chinook salmon populations within the Tucannon watershed are part of the Snake River spring/summer Chinook evolutionary significant unit (ESU) that received Threatened status in 1992.

Adult Chinook spawners enter the lower Tucannon from late April to early July, with most returning as age 4 and smaller percentages as age 3 or 5. Spawning occurs from late August to late September, between RM 22.9 up to the confluence of Sheep Creek (RM 55). The majority of spring/summer Chinook salmon redds (66 percent) occur between RM 37.5 and RM 50.3 (Gallinat and Ross 2010). Juveniles emerge in the spring and rear in freshwater for 12 to 15 months. Juvenile rearing occurs from roughly RM 15.3 up to the headwaters, with the greatest concentration between RM 26.6 and RM 45 (Anchor 2012). Juvenile outmigration consists entirely of age 1 fish, and timing is bimodal. Peak timing of early outmigrants occurs in the fall (October to freeze up) and the late outmigrants leave during spring freshets peaking in April to late May (SRSRB 2011). Recent data indicates that for brood years 1983 to 2003, average survival to smolt stage was less than six percent (Gallinat and Ross 2010).

Fall Chinook Salmon

Fall Chinook salmon populations within the Tucannon watershed are part of the Snake River fall Chinook ESU that received Threatened status in 1992. Fall Chinook salmon spawn in the lower main stem of the river, from the mouth to RM 12.3. Juveniles do not overwinter in the Tucannon River and out-migrate after emergence (Anchor 2012).

Bull Trout

Bull trout populations within the Tucannon are part of the Columbia River DPS and received Threatened status in 1998 (USFWS 2002). Both fluvial and resident bull trout are present, and they require colder water than most other salmonids. Spawning occurs in the upper reaches of the Tucannon River and several major tributaries in late August through early October. Post-spawn adults migrate downstream and during winter months where they reside from the hatchery at RM 37 downstream to the reservoir influenced area of the lower Tucannon and Snake River (Faler et al. 2006). Juvenile rearing occurs from Tumul Creek up to the headwaters, where they prefer habitat containing boulders, overhead cover, woody debris, undercut banks, and surface turbulence (Martin 1992). Some subadults migrate downstream and overwinter in the lower reaches. Bull trout have been extirpated in some portions of the Snake River Washington Recovery Unit, and local populations are described as fragmented and isolated to headwater locations due to natural or manmade barriers (USFWS 2002). WDFW surveys through the early 2000's indicated a large population in the Tucannon River, but a pronounced decline was observed since then, with redd counts dropping from over 100 in 2002 and 2003, to less than 20 in 2007 (Mendel et al. 2008). The results of these and other data led to USFWS designation of the Tucannon Critical Habitat Subunit for bull trout which includes the lower 44 miles (USFWS 2010).

Lamprey

Little is known about lamprey distribution in the Tucannon watershed. Their overall status is unclear, but populations are generally considered depressed. Juvenile lamprey have been captured in smolt traps located at RM 1.9 by WDFW staff (CCD 2004). The NMFS lists Pacific lamprey as a species of concern. CTUIR has begun investigations on the status of lamprey in the Snake River and Walla Walla systems (CCD 2004).

Table 2-8. Tucannon River Fish Periods of Occurrence in Reach PA 1 and PA 3 (RM's 47-50) by Species and Life History Stage.

Species	Life Stage	Jan		Feb		Mar		Apr		May		June		Jul		Aug		Sept		Oct		Nov		Dec	
		1-15	16-31	1-15	16-28	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31
Chinook Salmon	Adult migration																								
	Adult Spawning																								
	Incubation/emergence																								
	Juvenile summer rearing																								
	Juvenile winter rearing																								
	Juvenile emigration																								
Summer Steelhead	Adult migration																								
	Adult Spawning																								
	Incubation/emergence																								
	Juvenile summer rearing																								
	Juvenile winter rearing																								
	Juvenile emigration																								
Bull trout	Adult emigration (kelts)																								
	Adult migration																								
	Adult Spawning																								
	Incubation/emergence																								
	Juvenile summer rearing																								
	Juvenile winter rearing																								
Juvenile migration																									

Notes: Lighter shades are periods of marginal use. Fall chinook salmon not found in upper reaches of the Tucannon River

2.5 FISH HABITAT LIMITING FACTORS

The causes of habitat degradation within the Tucannon River subbasin and factors limiting production of focal species are well documented (CDD 2004, SRSRB 2011, USFS 2002, USFWS 2002). Causes of salmonid population declines frequently listed include both in-basin and out of basin variables:

- Hydroelectric power generation
- Hatcheries
- Harvest (both of fish and beaver removal)
- Agricultural activities such as farming, grazing, and irrigation diversions
- Obstructions
- Logging operations
- Urbanization
- Recreational uses
- Fires
- Exotic species (both aquatic and terrestrial)

The USFWS Bull Trout Draft Recovery Plan (USFWS 2002) describes overall factors limiting bull trout production in the Snake River Washington Recovery Unit. These include construction of low head dams, crop production and irrigation withdrawals, livestock grazing, logging, hydropower production, introduction and management of nonnative species, urbanization and transportation networks. Reach specific limiting factors are discussed in more detail in the following documents.

The USFS Tucannon Ecosystem Analysis (USFS 2002) describes the upper reaches of the Tucannon as good to excellent spawning and rearing habitat for spring Chinook salmon, steelhead and bull trout. However, they indicate pool habitat, large woody debris, floodplain connectivity, riparian conditions and sediment are factors of concern. Riparian zones are impacted by camping activities and dikes constructed to protect investments, including Camp Wooten. Sediment production is related to adjacent road systems.

The Tucannon Subbasin Plan (CCD 2004) used EDT analysis to assess habitat conditions as related to 16 major attribute classes, and rated potential benefits of restoration activities in the Tucannon River for steelhead and Chinook salmon. Bull trout were not included in the analysis, but it is assumed that improving conditions for steelhead and Chinook salmon will benefit bull trout production as well. The Hatchery to Little Tucannon and Mountain Tucannon were listed among the top five geographic areas for highest priority restoration. The impacted life history stages for both areas included:

- Fry (STS and CHS)
- Subyearling rearing (STS and CHS)
- Overwintering (STS and CHS)
- Yearling (STS)
- Pre-spawning (CHS)

Table 2-9 summarizes EDT results for the project reach and vicinity (Tumalum Creek to Panjab Creek) as identified in the Snake River Subbasin Plan for Southeast Washington (SRSRB 2011). EDT ranked protection and restoration benefits as medium for spring Chinook salmon and high for steelhead. Key habitat quantity was ranked high for both species. Notably, channel stability was ranked low, and sediment load was unranked. Large wood, confinement, riparian function and key habitat quantity (pools

and glides) were the primary limiting factors identified in the geographic areas that include PA 1 and PA 3. However, as noted below, site specific data within the project area indicates that channel stability and sediment are factors of concern.

Table 2-9. Summary of EDT Protection and Restoration Benefits, and Habitat Attribute Rankings^{1/} for the Tucannon River between Tualum Creek to Panjab Creek RMs 38 to 50 (adapted from SRSRB 2011)

Species	Benefit		Attribute Class Priority for Restoration															
	Protection Benefit	Restoration Benefit	Channel Stability	Chemicals	Competition (hatchery)	Competition (other sp.)	Flow	Food	Habitat Diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Spring Chinook	M	M	L				L	L	M	L						L		H
Steelhead	H	H	L		L		L		L	L	L		L		L			H

^{1/}Habitat attribute rankings are scored as High (H), Medium (M), or Low (L).

Under direction of the Federal Columbia River Power System (FCRPS) Biological Opinion (BiOP) for 2008/2010, the US Army Corps of Engineers (USACE) and Bureau of Reclamation (BOR) organized Expert Panel Workshops to identify and update habitat conditions, limiting factors and recovery potential within the various basins. Analysis was first completed in 2009, and then updated in 2012 after evaluation of restoration work completed or scheduled (FCRPS 2012). The Upper Tucannon River-Pataha up to Panjab Creek area was classified as TUC1A for Chinook and TUS1A for steelhead. In the 2012 evaluations, only 38% and 53% of the habitat was identified as fully functional for Chinook and steelhead, respectively. Limiting factors using standardized NOAA definitions and assigned overall weighting are summarized in Table 2-10. The 5 highest ranked limiting factors for both species were: 1) Peripheral and Transitional Habitats (Floodplain Condition); 2) Channel Structure and Form (Instream Structural Complexity); 3) Riparian Condition (Riparian Vegetation); 4) Water Quality (Temperature); and 5) Sediment Conditions (Increased Sediment Quantity).

Table 2-10. Expert Panel Weighting of Limiting Factors for Chinook (TUC1A) and Steelhead (TUS1A) in the Upper Tucannon-Pataha to Panjab Creek geographic area (FCRPS 2012).

NOAA Standardized Limiting Factors	LF Weight (%)	
	Chinook	Steelhead
1.1: Habitat Quantity: Anthropogenic Barriers	5%	5%
2.3: Injury and Mortality: Mechanical Injury	2%	2%
4.1: Riparian Condition: Riparian Vegetation	10%	10%
5.2: Peripheral and Transitional Habitats: Floodplain Condition	30%	30%
6.1: Channel Structure and Form: Bed and Channel Form	0%	0%
6.2: Channel Structure and Form: Instream Structural Complexity	30%	30%
7.2: Sediment Conditions: Increased Sediment Quantity	7%	8%
8.1: Water Quality: Temperature	10%	10%
8.4: Water Quality: Turbidity	1%	0%
9.2: Water Quantity: Decreased Water Quantity	5%	5%
10.4: Population Level Effects: Life history Changes	0%	0%

Based on review of the documents listed above, the major factors limiting the viability of the Tucannon River steelhead, spring/summer Chinook salmon and bull trout populations within the subbasin include: 1) elevated bank erosion and sediment levels; 2) lack of large woody debris; 3) anthropogenic confinement; and 4) poor riparian function. The resulting impacts include low habitat diversity and channel stability, reduction in overall habitat quantity and key habitat types (complex pools, spawning gravels, and off-channel habitat), elevated summer water temperature, and reduced flows. Sediment loads are generally identified as elevated in most of the subbasin reaches and are due to a variety of causes. Lack of large woody debris as result of harvest, removal and low recruitment are reflected in low ratings for key habitat quantity (pools). Confinement and floodplain isolation are due in part to heavy recreational uses of the area (campgrounds), along with dikes or levees and impacts from large flood events. Poor riparian conditions are a result of several activities that include agricultural practices in the lower system, and timber harvest and fires in the upper portions of the subbasin.

Surveys conducted in 2013 led to the conclusion that all of the factors listed above applied specifically within the project area, with the following exceptions: a) Summer water temperatures are within Washington Department of Ecology TMDL standards in the upper reaches of the Tucannon River (although it should be noted any improvements within the project area may translate downstream), and b) reduced flows are not considered an issue since there are no known water withdrawals, however, changes in timing of flows could be altered as a result of recent fires. In addition, we also observed two previously installed in-stream structures that may be acting as upstream barriers for juvenile salmonids located immediately below the Panjab Bridge. Jump heights at these structures were approximately twelve to eighteen inches and were identified for further evaluation. These primary limiting factors within PA 1 and PA 3 and the connection to restoration objectives, River Vision Touchstones, and specific metrics for evaluation and monitoring are summarized in Section 1.0, Table 1-1.

3.0 PRELIMINARY DESIGN (60%)

The overall intent of adding LWD and boulders is to strategically place structures that will promote the development of natural channel processes including bank erosion, pool scour, and sediment-sorting. Restoration of these processes will aid in the formation of critical habitat features such as complex pools, cover, off-channel habitat and velocity refugia, and spawning gravels. The benefits include the formation and concentration of complex mainstem habitat elements and a more complex channel network by initiating flow diversion and promoting channel migration.

Project designs, particularly in PA 3, were developed from the preliminary design report from Hoverson (2013) for habitat restoration and LWD placement in PA 3. The report provided the foundation for design specifics and function of proposed LWD structures.

There are several different types of proposed design structures, each with a specific purpose and expected function. Some structures are designed to aggrade the channel to reconnect the floodplain and activate secondary channels, while others are designed to increase habitat complexity (pool volume and depth, velocity and gravel partitioning), provide cover, and/or act to catch mobile LWD and provide infrastructure protection. Each specific location where LWD and boulder additions are proposed was evaluated in the field. These locations were chosen strategically to encourage floodplain interaction, promote bar formation, and enhance stability of existing natural structures. The exact siting, size of elements, orientation, and anticipated function were evaluated to create site-specific designs at each location. Depending on site conditions, the resulting designs range from small groupings of LWD that accomplish a localized function to large LWD structures designed to aggrade and realign the channel, reconnecting isolated floodplain areas and secondary channels. Over time, structures are intended to retain sediment and reverse some of the effects of channel entrenchment at the reach scale.

The following section contains a description of Project activities in PA 1 and PA 3. The preliminary (60%) design plan sheets are contained in Attachment A. Draft design specifications are contained in Attachment B. A planning level engineer's estimate of construction costs is presented in Attachment C.

3.1 DESIGN ELEMENTS

In order to accomplish the Project objectives of LWD restoration and floodplain connection, the design was focused on a site-specific approach to the placement of the LWD in both Project areas. Placement and design was based on guidelines from regulating agencies as well as field experience and observations of naturally formed wood structures. Agency guidelines included the WDFW Stream Habitat Restoration Guidelines (Cramer 2012) and the Integrated Streambank Protection Guidelines (2003).

Project Area 1

A total of 114 whole trees (12 to 18+ inch dbh, 20 to 60 feet long) with root wads and limbs intact, along with 8 base member logs (20 inch dbh, 25 feet long) will be utilized to construct the LWD structures at 21 locations throughout the PA 1 reach. The largest trees and base logs will be utilized at key sites (Sites 2, 5, 9, and 13) that have been designed to backwater existing structures, encourage changes in thalweg alignment, activate floodplains or secondary channels, stabilize stream banks, protect infrastructure, and reduce jump heights at existing structures. These structures include 11 to 20 LWD pieces each, with some portions of the structures buried, and other portions placed above the bankfull height to counteract buoyancy forces on the structure. They are arranged in naturally stable configurations and include 5 to 7 boulders averaging 3 feet by 3 feet, acting as anchors. These structures will be constructed using ground equipment. The materials for the remaining structures in PA 1 can be placed either by heavy equipment or by helicopter, depending on further analysis of costs and consideration of ground disturbance with machinery.

The remaining LWD placement formations range from simple, single-piece LWD designs to more complex, 8-piece engineered log jam structures with a few boulder anchors. They require minimal, if any, excavation, and additional stability of some trees may be achieved by wedging them between existing shoreline trees. No cabling or pinning of structures is planned, but racking material (broken limbs or tops) may be added to wedge key members in place. These structures are intended to function in a variety of ways, including to form complex pool and glide habitat, supplement and fortify existing LWD structures, assist with floodplain/secondary channel activation, create additional backwater/alcove (refuge) or fringe habitat, add roughness elements, trap additional debris, and encourage point bar development and gravel partitioning.

Single trees (Sites 18, 20, and 21) are located in secondary channels where flows and velocities will be restricted; therefore, soft placement, with parts of the trees outside the bankfull channel, will suffice in these areas. Two-piece structures (Sites 6, 7b, 14a-c, 15-17, and 19) are placed in crossover formation (one on top of the other) with rootwads upstream that act as natural anchors. The top member will weigh down the bottom tree for additional stability, and tree tips are placed at varying angles downstream.

Structures made up of 3 to 8 pieces (Sites 1, 3, 4, 7a, 8, and 10 through 12) are moderately complex structures using larger trees. These structures include crossover formations as noted above, and some include channel spanning members that are placed low in the channel bed, and weighted with top members to hold their position. Channel spanning trees combined with others assist with debris accumulation and aggradation in entrenched areas of the stream.

Site specific characteristics and general functions of the LWD designs for PA 1 are summarized in Table 3-1. Specific locations are shown on the 60% Design Plans (Attachment A). In addition, not noted in Table 3-1 are 45 boulders (fish rocks) scattered throughout the PA 1 reach to be placed for pocket water habitat creation. These fish rocks create varying water depths, substrate and velocity, thereby increasing habitat diversity within long, uniform riffle sections. Scour pockets often form around the boulders that provide cover and forage habitat for fish during low flows, and resting habitat during high flows. Boulders also provide cover in the form of interstitial spaces between adjacent elements, and they create water velocity gradients, where slow water velocities occur in close proximity to faster ones (i.e. feeding lanes). One cluster of 8 boulders is proposed below the existing U-weir near Station 32+00 to help alleviate an 18 inch jump height and improve upstream migration of juveniles.

Table 3-1. PA 1 LWD Structure Location, Material Quantities, and Intended Function

Site Number	Station	Number of Trees	Number of Boulders	Function
1	0+50	3	0	Increase Habitat Complexity Sediment Retention
2	5+40	14	5	Infrastructure Protection Increase Habitat Complexity Sediment Retention
3	8+40	3	0	Increase Habitat Complexity
4	11+50	8	2	Floodplain Connection Increase Habitat Complexity Sediment Retention
5	13+50	11	5	Increase Habitat Complexity Secondary Channel Initiation Sediment Retention
6	14+25	2	0	Increase Habitat Complexity
7a & 7b	16+25	5	3	Existing Structure Fortification Increase Habitat Complexity Backwater/Alcove Enhancement
8	19+40	4	0	Increase Habitat Complexity Stabilize/Enhance Secondary Channel
9	20+50	20	8	Infrastructure Protection Increase Habitat Complexity Bank Stabilization
10	21+50	4	0	Existing Structure Fortification Increase Habitat Complexity
11	25+50	12	0	Increase Habitat Complexity

Table 3-1. PA 1 LWD Structure Location, Material Quantities, and Intended Function

Site Number	Station	Number of Trees	Number of Boulders	Function
12	26+80	4	3	Existing Structure Fortification Increase Habitat Complexity Sediment Retention
13	29+00	15	7	Increase Habitat Complexity Secondary Channel Initiation Backwater Existing Structure
14a,14b,14c	31+00	6	0	Increase Habitat Complexity Backwater Existing Structure
15	SC 8+50	2	0	Increase Habitat Complexity
16	SC 9+50	2	0	Increase Habitat Complexity
17	SC 0+75	2	0	Increase Habitat Complexity
18	SC 1+75	1	0	Increase Habitat Complexity
19	SC 3+00	2	0	Increase Habitat Complexity
20	SC 4+50	1	0	Increase Habitat Complexity
21	SC 5+00	1	0	Increase Habitat Complexity

Project Area 3

A total of 190 whole trees with root wads and limbs intact and 6 base member trees will be used to construct the LWD structures at 24 locations throughout the PA 3 reach. Trees sizes in this reach will all be 18-inch or larger dbh and 40 to 60 ft. long. As with PA 1, several LWD placement formations ranging from simple, single-piece LWD designs to complex, 34-piece engineered log jam structures will be assembled.

The structures at Site 1a and 1b (lowest structures in the reach) are considered critical to protecting existing infrastructure. The materials comprising this site will be constructed using heavy equipment. Trees on these structures will be placed both within the wetted channel to provide improved habitat complexity, and with portions placed above the bankfull height to counteract buoyancy forces on the structures. Additionally, boulders averaging 3 feet by 3 feet in dimension will be added to these structures to function as ballast and additional reinforcement within the structure. The structure is placed at the upstream end of an island and is intended to control flow and debris into the right half of a split channel, and reduce erosion potential on the right bank above Camp Wooten.

The materials for the remaining 23 LWD structures in PA 3 will be placed via helicopter due to poor access and to reduce impacts to the stream channel and riparian areas (as an example, see Figure 3-1). Selection of helicopter placement for most of the LWD was chosen to minimize the implementation footprint as well as preserve desired whole tree characteristics such as retention of limbs, root wads and tree length. Placement formations and functions are similar to those described in PA 1 above, consisting of single trees up to 34-piece complexes. Some notable differences from PA 1 include:

- Greater use of channel spanning logs in more entrenched sections (Sites 3-7a, 8, 14, 15, 17-19).
- More structures to create fringe habitat on channel margins (Sites 2, 10-13, 16).
- Three structures to enhance and maintain existing islands and split channels (Sites 13, 20, 21).

Site specific characteristics of the LWD designs and general functions for PA 3 are shown in Table 3-2. Note that these tables show only the boulders to be used in the LWD structures, and do not include the 12 additional fish rocks to be utilized for the pocket water habitat in PA 3. These will all be placed in the

lower sections of the reach in long, uniform riffle sections. Specific locations are shown on the 60% Design Plans (Attachment A).

Table 3-2. PA 3 LWD Structure Location, Material Quantities, and Intended Function

Site Number	Station	Number of Whole Trees	Number of Boulders	Function
1a & 1b	3+00	34	10	Infrastructure Protection
2a, 2b, 2c	5+00	5	0	Increase Habitat Complexity Sediment Retention
3	6+40	6	0	Debris Regulation Increase Habitat Complexity Sediment Retention
4	11+75	11	0	Increase Habitat Complexity Sediment Retention
5	14+50	5	0	Increase Habitat Complexity Sediment Retention
6	18+50	9	2	Debris Regulation Increase Habitat Complexity Sediment Retention
7a & 7b	21+50	13	0	Increase Habitat Complexity Sediment Retention
8	25+50	13	0	Floodplain Connection Increase Habitat Complexity
9	28+50	5	0	Existing LWD Structure Fortification
10	29+00	3	0	Increase Habitat Complexity Sediment Retention
11	30+50	6	0	Increase Habitat Complexity Sediment Retention
12	31+50	4	0	Increase Habitat Complexity Backwater/Alcove Enhancement
13	32+50	5	0	Increase Habitat Complexity Sediment Retention
14	37+25	8	0	Debris Regulation Existing LWD Structure Fortification Increase Habitat Complexity Sediment Retention
15	44+00	5	0	Debris Regulation Existing LWD Structure Fortification Sediment Retention
16	45+00	6	0	Increase Habitat Complexity Sediment Retention Backwater/Alcove Enhancement
17	50+00	9	2	Increase Habitat Complexity Sediment Retention
18	53+75	6	0	Increase Habitat Complexity Sediment Retention
19	54+75	8	0	Debris Regulation Increase Habitat Complexity Sediment Retention
20	61+00	8	0	Increase Habitat Complexity Sediment Retention

Table 3-2. PA 3 LWD Structure Location, Material Quantities, and Intended Function

Site Number	Station	Number of Whole Trees	Number of Boulders	Function
21	63+00	4	0	Increase Habitat Complexity Sediment Retention
22	65+00	7	0	Increase Habitat Complexity Sediment Retention
23	71+00	6	0	Increase Habitat Complexity
24	72+50	10	0	Increase Habitat Complexity Sediment Retention



Figure 3-1. Photograph of helicopter-placed LWD and boulders in PA 10, completed in 2012 (WDFW 2012a).

3.2 HYDRAULIC ANALYSIS

Stream hydraulic characteristics in PA1 and PA3 were estimated using the HEC-RAS river analysis system model (USACE 2010) for existing and proposed conditions. HEC-RAS is a backwater computer model developed by the U.S. Army Corps of Engineers (Corps) and is commonly used for analyzing the hydraulics of streams, rivers and other open channel systems. It is a one-dimensional model that estimates depth, velocity, hydraulic radius and other flow characteristics for steady- and unsteady-state flow conditions. HEC-RAS was implemented in the mix-flow condition, steady-state mode applying the peak flow rates estimated by gage transfer methods (See Section 2.1).

The existing condition hydraulics model was developed for both Project areas using representative cross sections from topographic surface built by combining survey data. The survey base map was developed by supplementing the bare earth data collected from the aerial LiDAR survey with the topographic survey data (See Section 2.0). Cross sections were taken from the combined surface in AutoCAD Civil 3D and

exported into HEC-RAS for hydraulic modeling. The cross sections were located to capture significant features of the stream and floodplain (channel bends, grade controls, side channels, etc.). Manning's roughness coefficients for the active channel, side channels, and floodplain were calculated based on a USGS calculation process (Arcement and Schneider 1992). In conjunction with the hydraulics model, flood inundation maps were produced to show the water surface elevations extrapolated across both the existing condition surface and the proposed surface.

A complete description of the hydraulic analysis methods and results including cross section plots showing for existing and proposed conditions are provided in the Hydrology and Hydraulics Report (Tetra Tech 2013). The following section summarizes those results and includes the flood inundation results for select flows.

Project Area 1

The intent of the hydraulic modeling for PA 1 was to evaluate water surface elevations at various flows with the proposed LWD configuration and excavations to evaluate the effects on floodplain connectivity and the potential impact on high flow inundation in the proposed campground location.

The existing bridge at Panjab Road at RM 50.0 (Attachment A: station 32+30) two weirs at river station 30+10 and 31+90, and a spanning log weir near river station 6+11 were included in the model, due to their significant impact on the stream fluid mechanics. The full bridge routines were used to model the Panjab Bridge and the instream weirs were modeled as inline structures with weir embankments. While the model only estimates their effect on the reach (due to limitations of the model and the complexity of the stream system), they were included to demonstrate their impact of raising the water surface at their locations.

The existing conditions HEC-RAS model was revised to analyze the proposed structure placement at PA1. The PA 1 HEC-RAS model included the four larger proposed LWD structures (LWD2, LWD5, LWD9, and LWD13) that are expected to have significant impacts to the local flow condition (See Attachment A: sheets C-12, C-14, C-16, C-18). The LWD structures were simulated in the model as a "blocked obstruction" at the cross sections associated with the LWD structures. The blocked obstruction was used to approximate the size, location, and effect of the LWD structure on the stream reach. The proposed LWD structures were evaluated by comparing flow depth, total velocity, channel velocity, left and right overbank velocity, and flow top width for the existing and proposed conditions.

The revised HEC-RAS model was also used to analyze the activation of specific side channels at low flow events. Included in the model were three proposed areas of excavation, one located just downstream of the bridge at river station 29+20, and another located downstream at river station 13+70. The hydraulic analysis showed that minor excavation will be required half way through the secondary channel at 27+50 to initiate flow into the upper side channel during low flow events (Tetra Tech 2013). A higher volume of excavation is required at the side channel at river station 13+70 to remove what is most likely road fill that serves as barrier to low flow events. In the proposed model, the side channel at river station 13+70 will be activated by excavating an opening mimicking the inlet of a nearby upstream secondary channel on the left bank (looking downstream) with the inlet near station 16+19 (Tetra Tech 2013). This secondary channel is a good model for a reference condition because it is highly functional in baseflow conditions. The excavation, paired with a large proposed LWD structure located at the inlet, was modeled to establish a depth where the channel would be activated during a low flow condition.

Floodplain inundation depths and secondary channel connection were modeled for a range of flows from the flow at the time of the field surveys (approximately baseflow) to the estimated 100-year flow event. Figure 3.2 contains estimated flood inundation depths during bankfull flows (390 cfs) for existing and proposed conditions. Figures 3.3 and 3.4 contain the flood inundation depths for the 10-year flood (2,213 cfs) event and the 100-year flood event (4,995 cfs) respectively. The secondary channels near station 13+70 and station 28+90 are connected to the main channel at bankfull flow in the proposed condition

and not the existing conditions due to the proposed excavation (Figure 3-2). The proportion of flow in the downstream secondary channel near station 13+70 was estimated for baseflow conditions (approximated by the flow at the time of survey) to be approximately 30 percent of the total flow (Tetra Tech 2013). The water depths are intermittent in the secondary channel at bankfull flows downstream of station 6+11 because the depth of flow is being extrapolated from the main channel. The addition of a spilt-flow model may be required at the 90 percent design phase to evaluate the hydraulics in the secondary channels.

The potential impact of Project activities on the proposed campground was also evaluated. The proposed campground site is located on the terrace immediately downstream of Panjab Bridge on the right bank near station 27+00 to 31+00. At bankfull flow (390 cfs), the proposed campground is not inundated under either the existing or proposed conditions (which raise water surface elevation by 0.3 foot) (Figure 3-2). Under existing and proposed conditions, flow does enter the area in the 10-year flood event (2,213 cfs) and most of the area is inundated by the 100-year event (4,995) (Figures 3-3 and 3-4). Modeling results show a 1.1-foot increase in water surface elevation at 10-year flood event flow under proposed conditions, and no change in elevation at the 100-year event flow level.

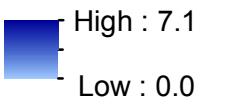
Model results show that the LWD structure placement and secondary channel excavation provide a more active and connected floodplain, which promotes the complex channel configuration highly desirable for establishing the variety of habitats conducive to improving fish and wildlife utilization.

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Figure 3-2.
Tucannon River
Project Area 1

**Bankfull
Flood Inundation**

Bankfull
Flow Depth (ft)



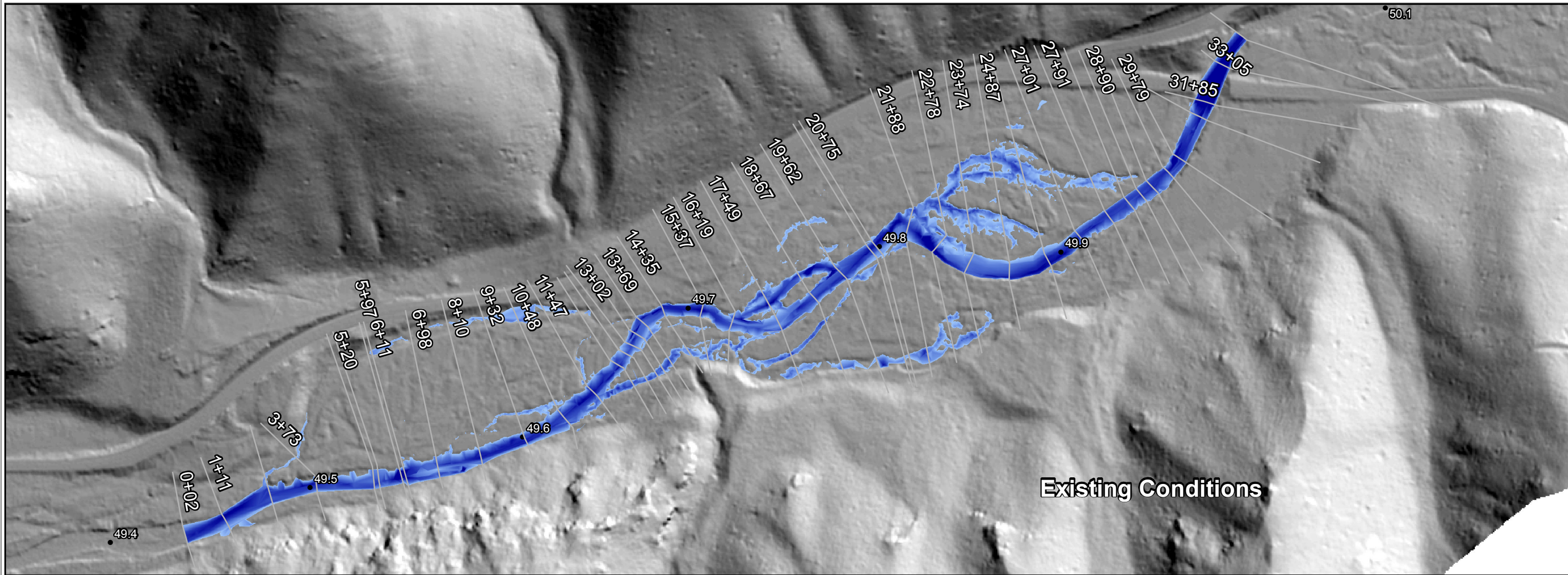
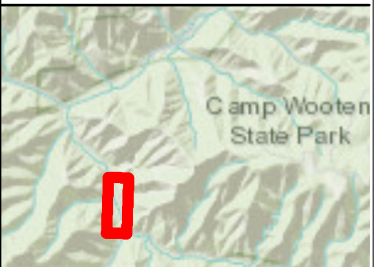
River Mile



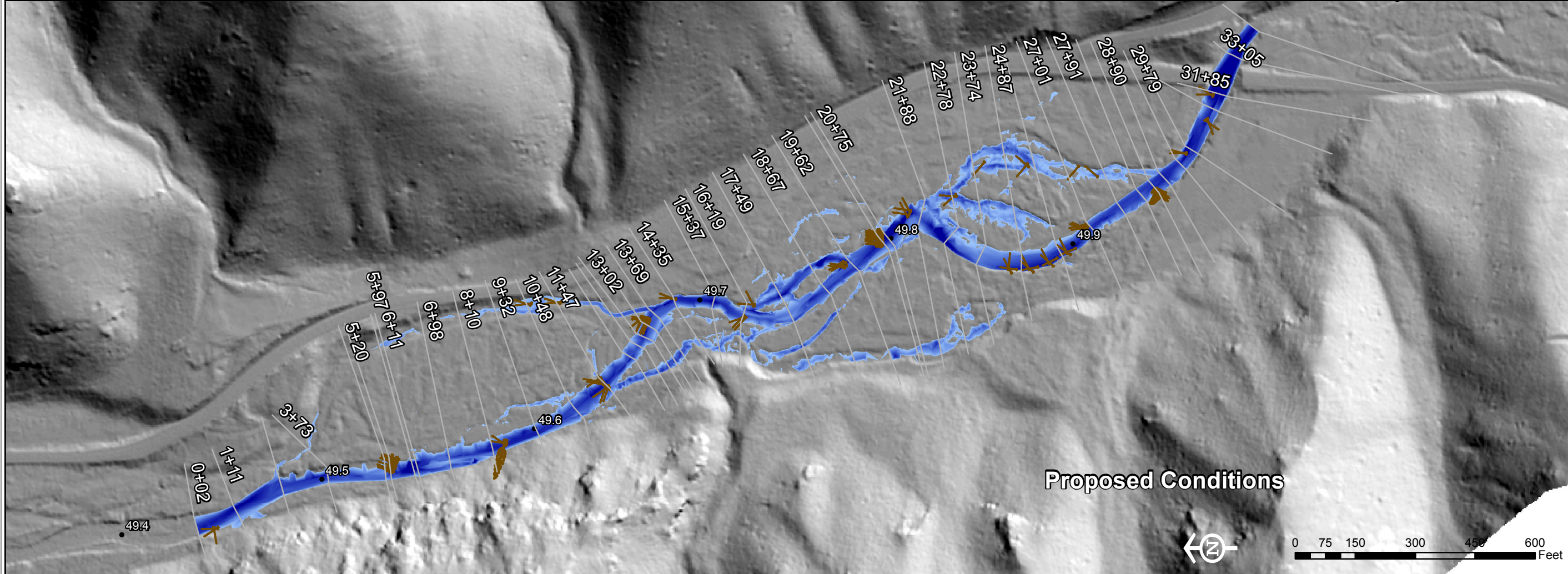
Proposed
Structures



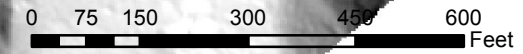
Projection:
Washington State
Plane South NAD 83



Existing Conditions



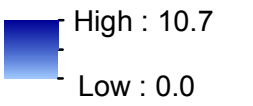
Proposed Conditions



**Figure 3-3.
Tucannon River
Project Area 1**

**10-Year
Flood Inundation**

10-Year
Flow Depth (ft)



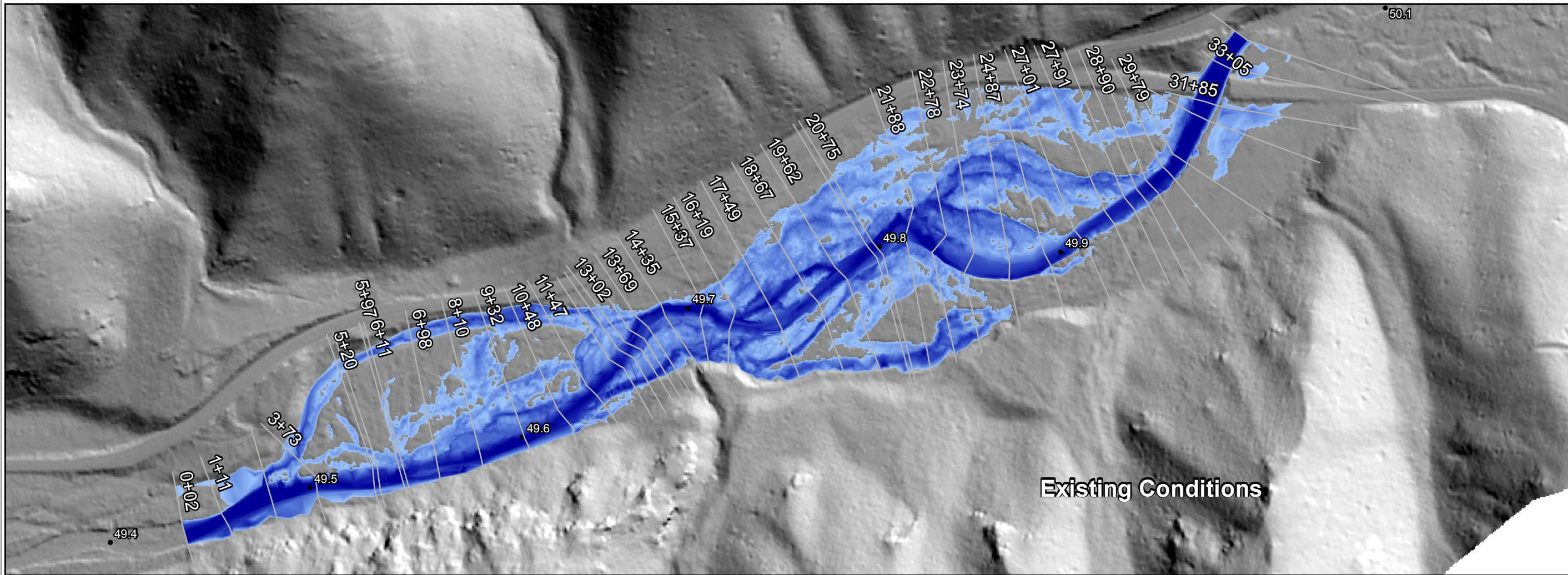
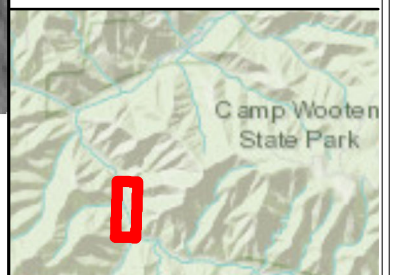
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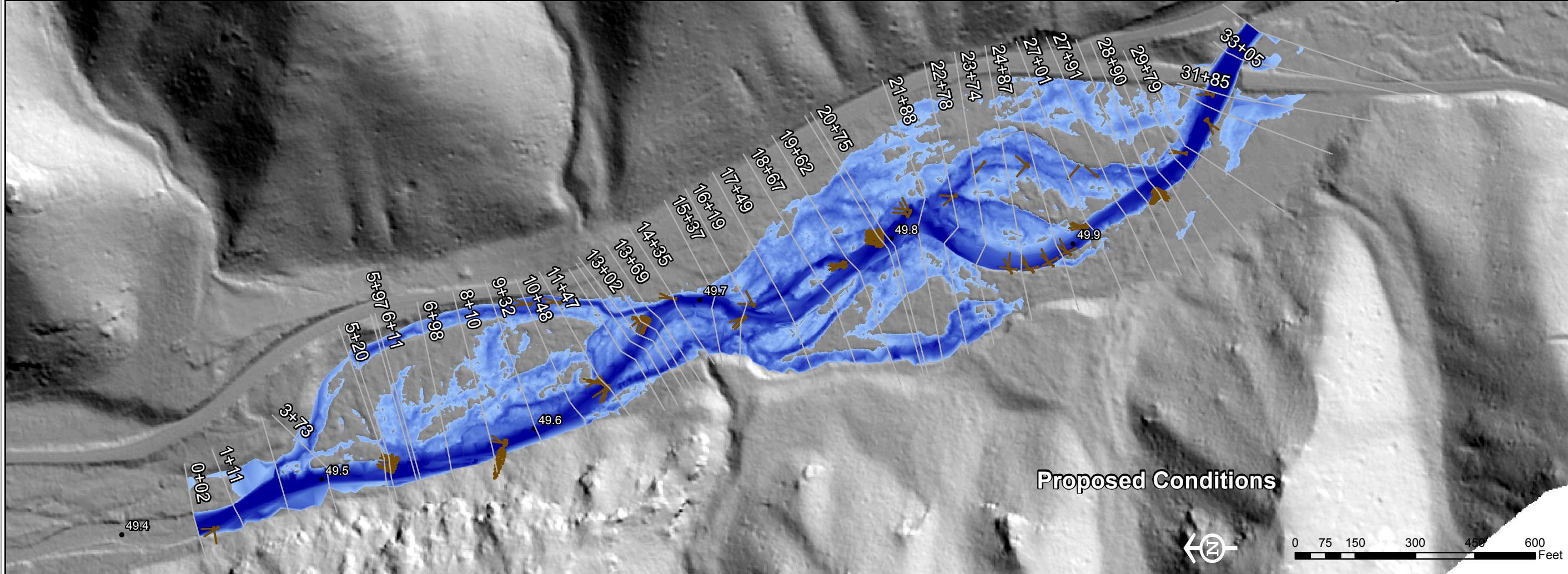
Proposed
Structures



Projection:
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Plane South NAD 83



Existing Conditions



Proposed Conditions

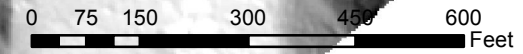
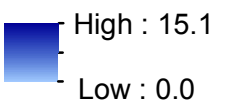


Figure 3-4.
Tucannon River
Project Area 1

100-Year
Flood Inundation

100-Year
 Flow Depth (ft)



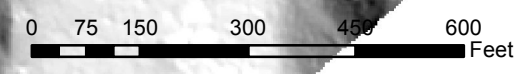
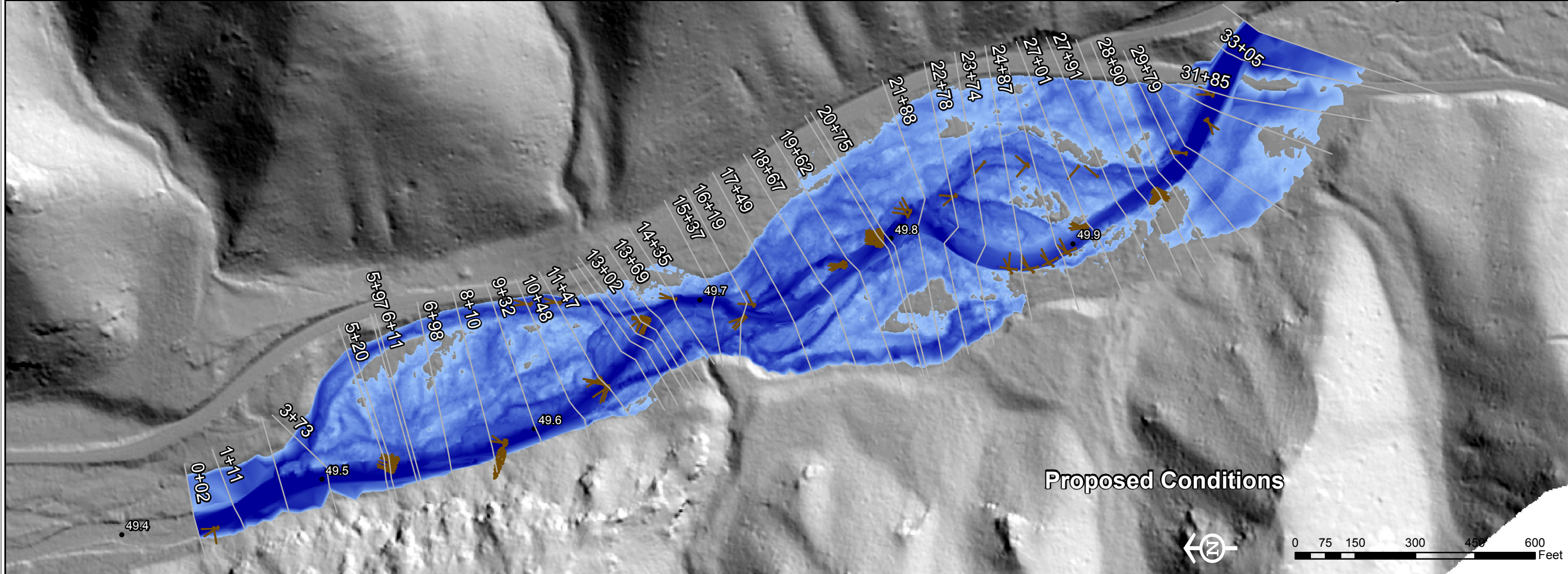
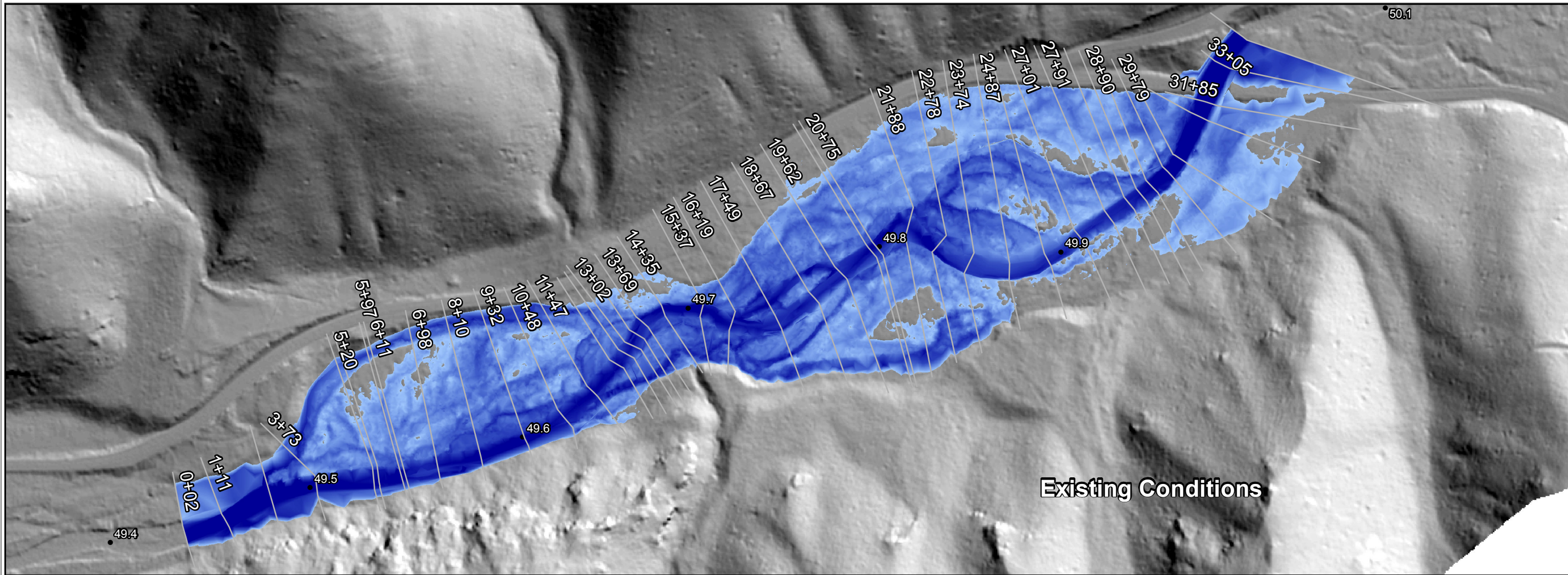
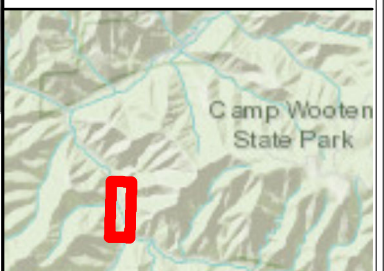
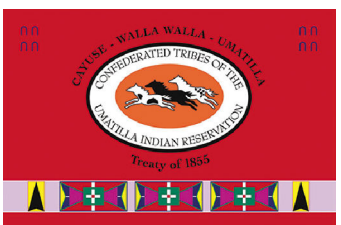
River Mile



Proposed
 Structures



Projection:
 Washington State
 Plane South NAD 83



Project Area 3

The intent of the hydraulic modeling for PA 3 was to evaluate water surface elevations at various flows with the proposed LWD configurations to evaluate the potential impact on high flow inundation of the pond at Camp Wooten. The existing channel geometry and roughness were not modified in PA 3, as the proposed hydraulic conditions were mainly concerned with the higher flow events in this area. A significant existing LWD structure was included (station 6+40), as it greatly impacts the lower and middle flow events. The PA 3 HEC-RAS model also included two large proposed LWD structures (LWD1a and LWD1b) near station 3+30 because it was expected to have significant impacts to the local flow condition

Model results indicate that Project activities will not impact the water surface elevation at this site significantly at any flows (Tetra Tech 2013). At bankfull flow (433 cfs), the change from existing to proposed conditions is 0.1 foot and there is no change between existing and proposed water surface elevation at the 10-year flood event (2,455 cfs) or 100-year flood event (5,541 cfs). At bankfull flow, the pond at Camp Wooten is not inundated under either the existing or proposed conditions (Figure 3-5). Flow does enter the area in the 10-year flood event and most of the area is inundated by the 100-year event (Figure 3-6 and 3-7). The LWD structures (LWD1a, LWD1b, and LWD2a, LWD2b, LWD2c) are designed to divert flows away from Camp Wooten, stabilize the location of the channel at this site, while maintaining channel complexity, improving habitat conditions and not raising the water surface elevation significantly (Appendix A: sheet C-9).

Although the modeled flow in the vicinity of the pond at Camp Wooten is relatively shallow and low velocity, there is still a considerable flooding risk for Camp Wooten under existing conditions. Further analysis in the 90 percent design development phase could evaluate the potential for a setback levee that could build on existing high topography along the upstream edge of the pond at Camp Wooten (Figure 3-7). This information could be used to evaluate the costs and benefits associated with reducing the flooding risk at this location.

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Figure 3-5. Tucannon River Project Area 3

Bankfull Flood Inundation

Bankfull
Flow Depth (ft)

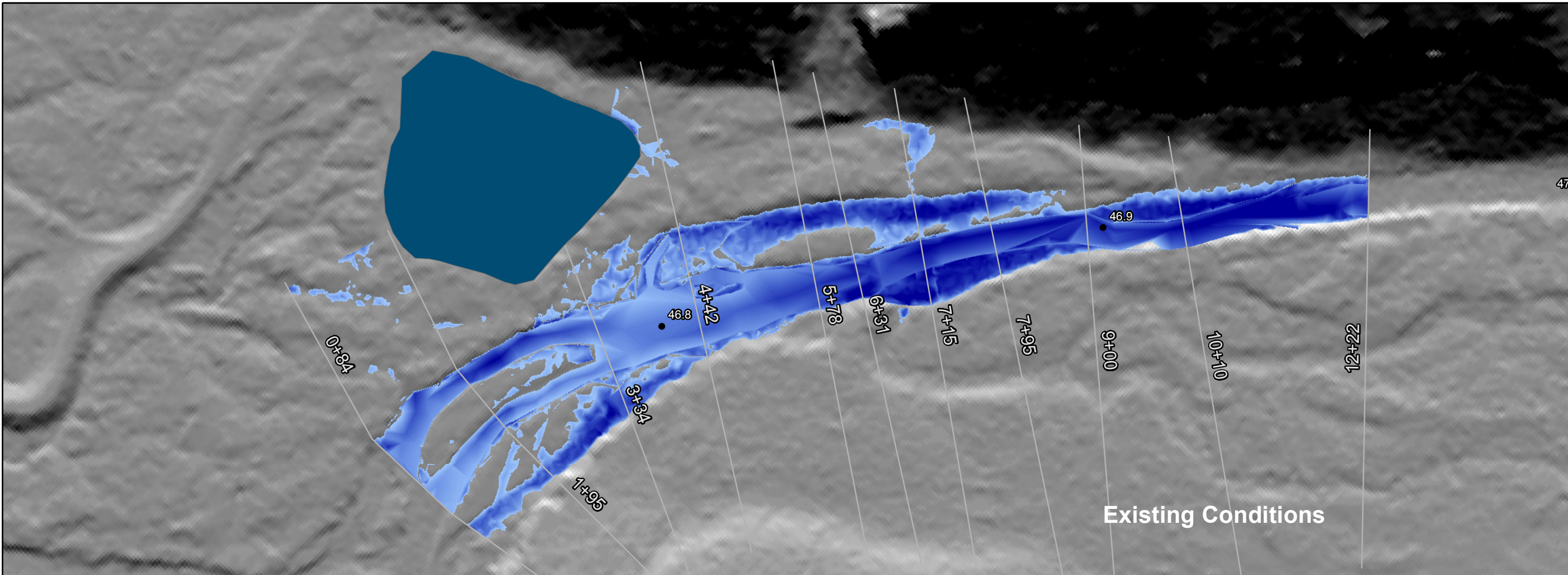
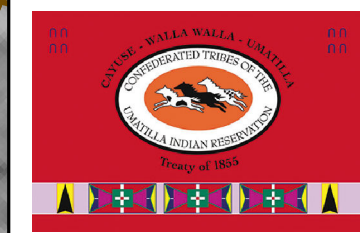
High : 5.1
Low : 0.0

Open Water

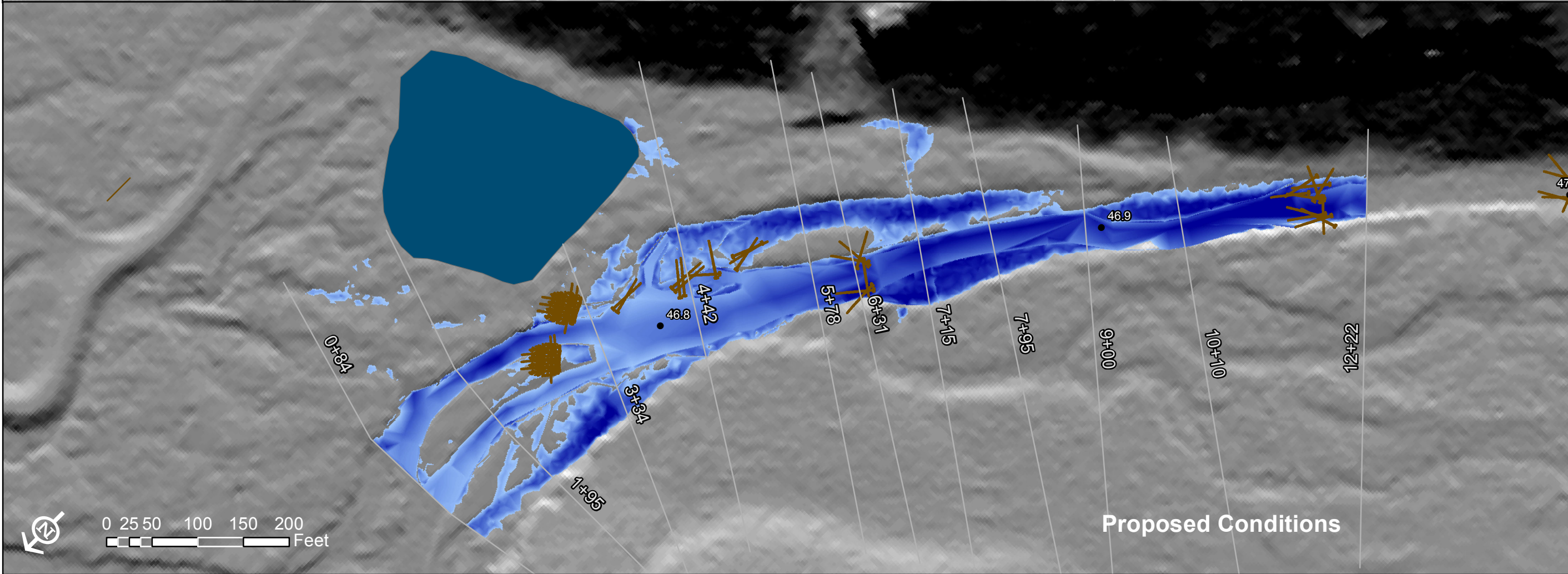
River Mile

Proposed
Structures

Projection:
Washington State
Plane South NAD 83



Existing Conditions



Proposed Conditions

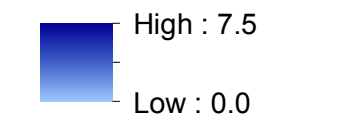


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Figure 3-6.
Tucannon River
Project Area 3

10-Year
Flood Inundation

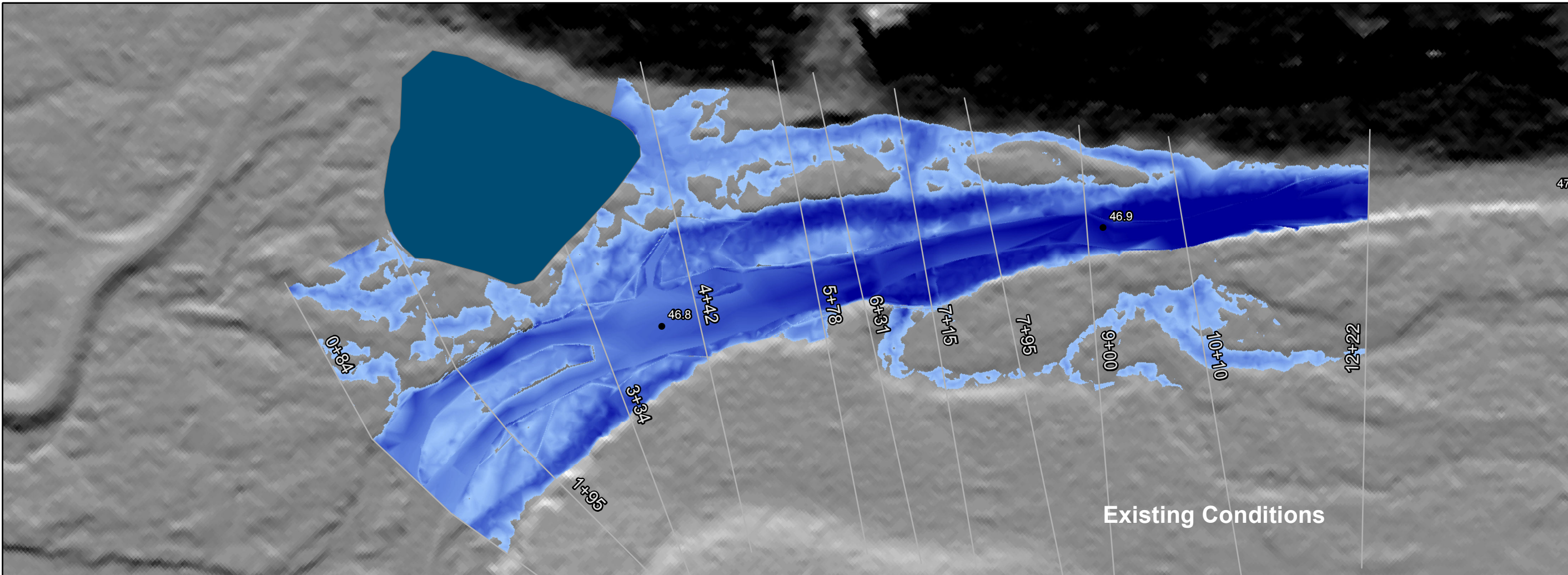
10-Year
Flow Depth (ft)



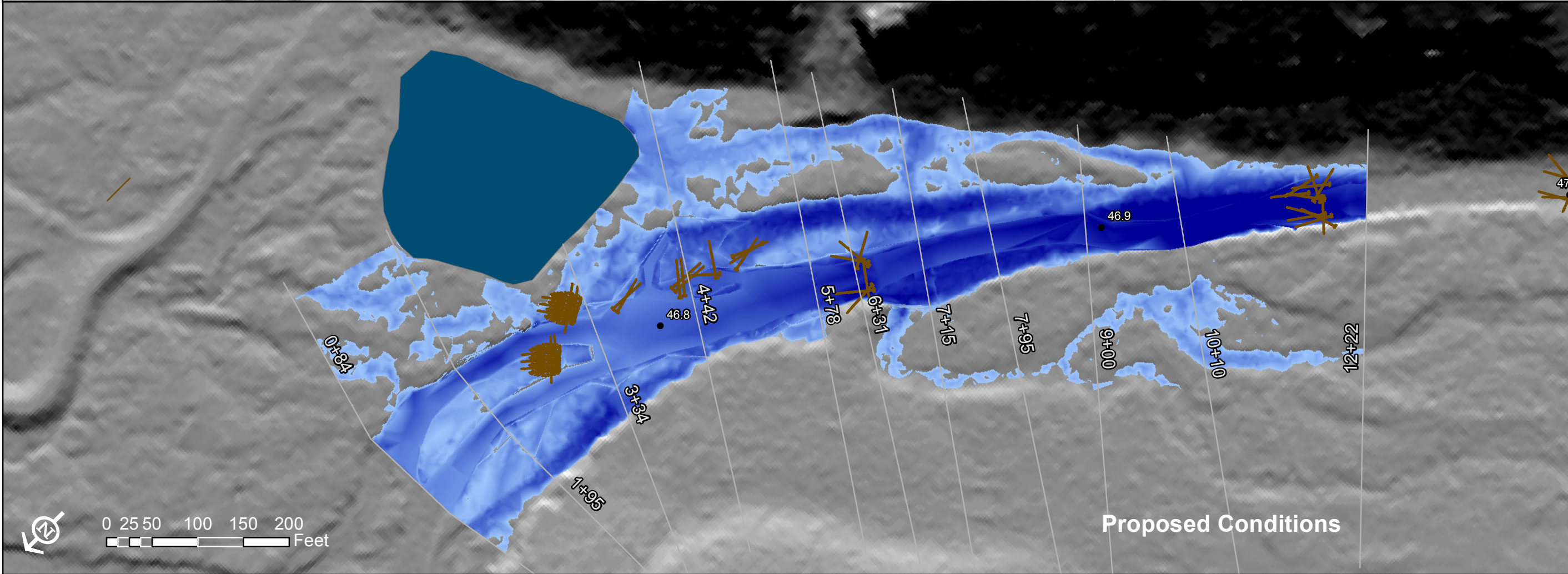
Open Water

River Mile
Proposed Structures

Projection:
Washington State
Plane South NAD 83



Existing Conditions



Proposed Conditions

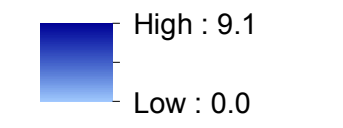


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Figure 3-7. Tucannon River Project Area 3

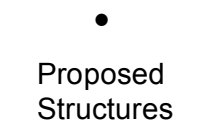
100-Year Flood Inundation

100-Year
Flow Depth (ft)

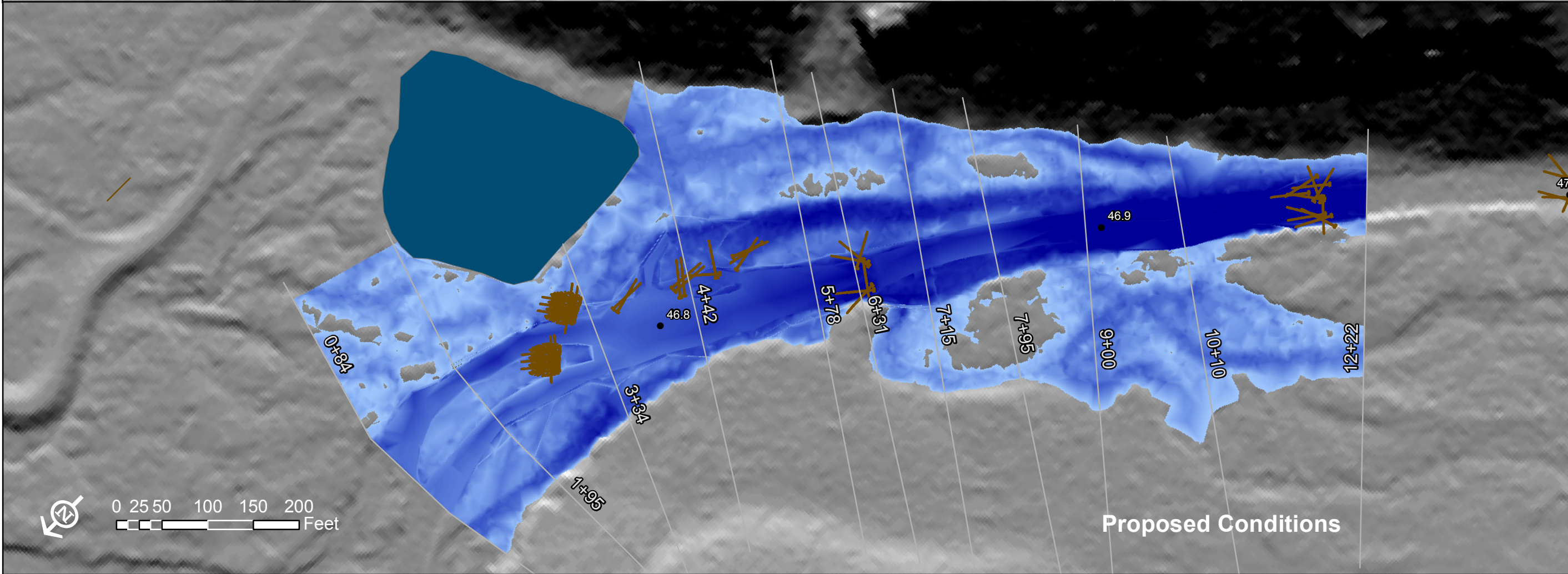
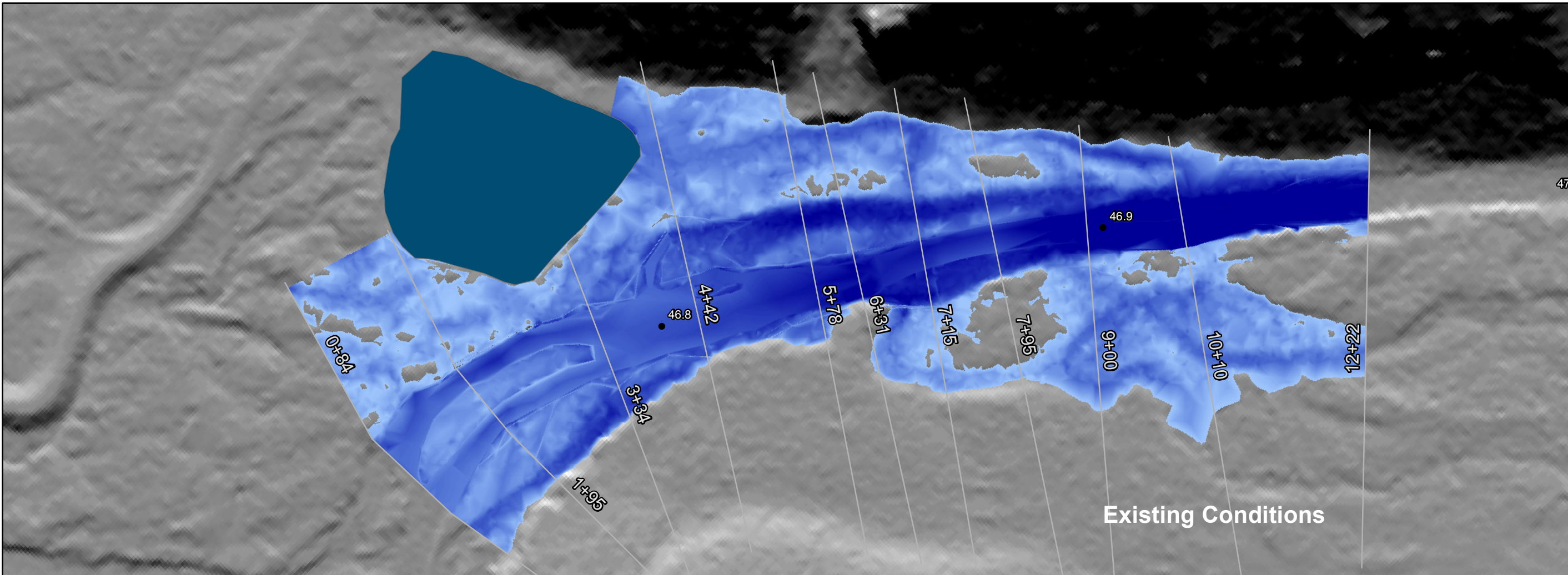


Open Water

River Mile



Projection:
Washington State
Plane South NAD 83



3.3 PRELIMINARY STABILITY CALCULATIONS

As is the case with wood that has been naturally recruited into the wetted channel, some limited movement of the design LWD structures is expected during high flood flow events. This mobility was considered during the LWD design process and accounted for within the design. Infrastructure protection structures designed to arrest or temper excessive wood movement were placed at strategic locations in the Project reaches. These structures are located at the downstream end of both PA's, with one additional structure located next to the campground in PA 1. These structures have been designed with buried log pilings, stacked layers of logs, boulder ballast, and gravel/cobble backfill. Placing the stacked logs in a complex geometry will assist the structures in acting as a single structure rather than individual logs.

Preliminary structural stability has been evaluated for buoyancy for each of these infrastructure protection structures by acknowledging that both vertical and horizontal forces act upon the structure during the 100-year peak flow event. The vertical forces include the drag and buoyant force of the water acting upon the structure, and the opposing gravitational force from the structure's mass. A more rigorous structural stability evaluation will be performed with the next design phase after the final configuration of and location of structures has been established.

Gravitational forces are equivalent to the weight of the structure elements and must be greater than the buoyant forces to be stable. The buoyant force acting on the structure is equal to the weight of the displaced water volume and drag is the force directed on the structure due to the impact of the flowing water.

A factor of safety is computed as the ratio of weight to buoyant and drag forces. For the preliminary analysis, a factor of safety greater than one is assumed to be stable. Generally, a higher factor of safety is desired. The stability analysis provides a conservative estimate of stability because of the simplifying assumptions that ignore structure embedment and the effect of piles and other anchoring mechanisms on stability. Additionally, the design flows are assumed to be at the high end of the peak flow estimate. Factor of safety will be evaluated in greater detail for the next design phase.

Calculating the volume of the submerged structures tends to be difficult, as most structures have complex geometries. Thevenet et al. (1998) suggest that this volume can be calculated by measuring the outer dimensions (length, width, height) of the submerged portion of the structure and multiplying it by a porosity factor. The porosity factor suggested is 10 percent for wood jams. The depth of the submerged portion of the structure is dependent upon the water surface of the design event and must be calculated using the cross section of the stream where the structure is to be placed. This depth of water calculation has been estimated using HEC-RAS. The depth of water used for the buoyancy force calculation was derived from the 100-year flood flow events.

Table 3-3 shows that each of the infrastructure protection structures is stable for the given flood flow event.

Table 3-3. Preliminary Stability Calculations for LWD at 100-yr Flood Flow

Structure	Station	Buoyancy Force (lbs)	Gravitational Force (lbs)	Factor of Safety
PA 1 - LWD 1	5+40	46,888	53,203	1.1
PA 1 - LWD 9	20+50	56,962	66,164	1.2
PA 3 - LWD 1	3+00	116,279	124,181	1.1

4.0 PROJECT CONSTRAINTS

The project designs have been developed to account for known physical, biological, and legal constraints. Physical constraints include the proximity of the road to the river, the proximity of private property downstream of PA 1 that cannot be accessed or negatively influenced, and, as noted earlier, the proximity of campgrounds (PA 1) and Camp Wooten (PA 3) to the river. There are also two existing weirs located in the PA 1. In PA 3, lack of terrestrial access for placing the LWD will require the use of helicopters. Downstream of PA 3, an undersized bridge located at Camp Wooten has been considered in developing appropriate LWD placement.

There are several potential risks related to the stability of placed LWD, including the downstream transport of logs outside of the Project areas and the eventual decay and deterioration of the logs. In general, these risks are minimized by organizing structures in stable configuration and designing specific structures that are intended to catch mobile debris.

Biological and legal constraints identified for both Project areas include the in-water work window for ESA-listed species (July 16 to August 15) and other permitting requirements. Monetary constraints may influence the Project design depending on the agreed upon approach. Our team will work closely with the CTUIR and Project partners to find innovative solutions to these and other yet unidentified constraints.

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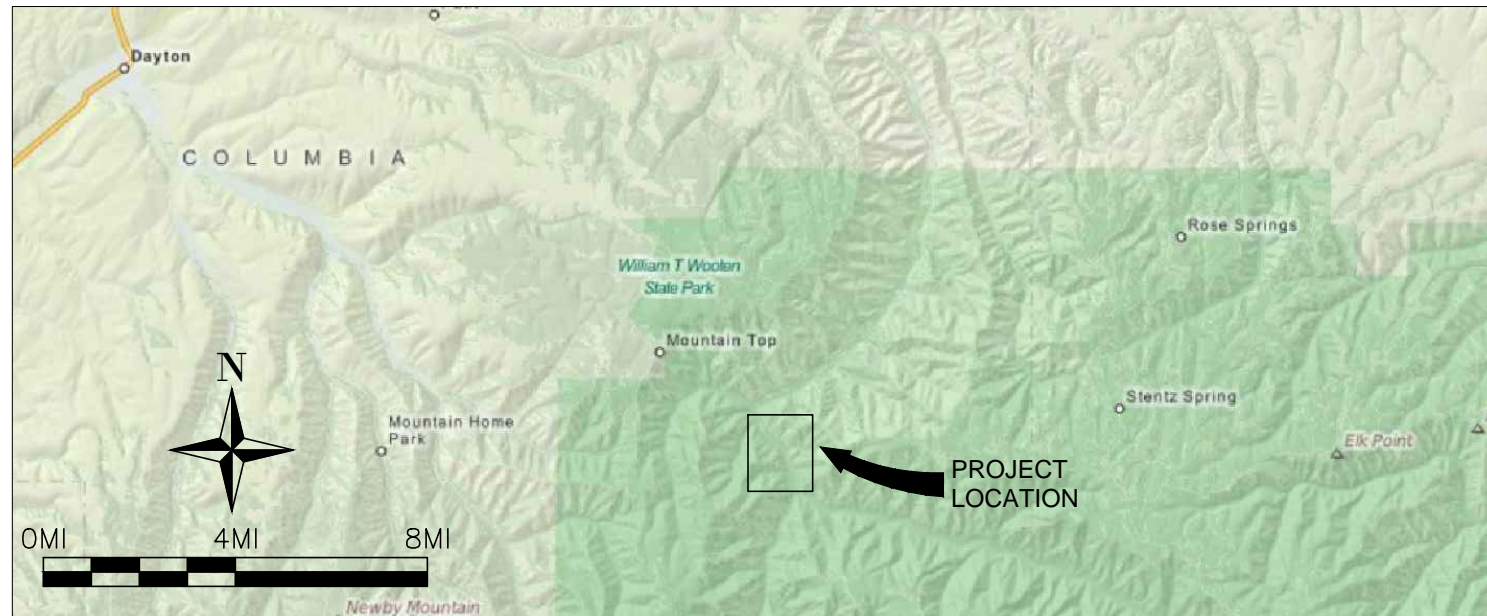
ATTACHMENT A – DRAFT PRELIMINARY (60%) DESIGN DRAWINGS

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION TUCANNON RIVER FLOODPLAIN RECONNECTION PROJECT AREA 1 - RIVER MILE 49.45 TO 50.10



SOURCE: GOOGLMAPS

VICINITY MAP



SOURCE: MAPQUEST

LOCATION MAP

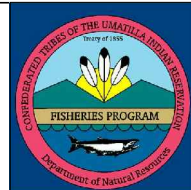
ABBREVIATIONS			
CL	CLEARING LIMITS	RD	ROAD
CP	CONTROL POINT	RT	RIGHT
CTUIR	CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION	SPEC	SPECIFICATIONS
CONST	CONSTRUCTION	STA	STATION
D/S	DOWNSTREAM	TEMP	TEMPORARY
DIA	DIAMETER	TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
DWG	DRAWING	TYP	TYPICAL
EA	EACH	USFS	UNITED STATES FOREST SERVICE
EL	ELEVATION	USFW	UNITED STATES FISH AND WILDLIFE SERVICE
EXST	EXISTING	U/S	UPSTREAM
FG	FINISHED GRADE		
FT OR'	FOOT		
LT	LEFT		
LWD	LARGE WOODY DEBRIS		
MAX	MAXIMUM		
MIN	MINIMUM		
NO OR #	NUMBER		
NTS	NOT TO SCALE		
PL	PROPERTY LINE		
PT	POINT		

DRAWING INDEX	
<u>GENERAL</u>	
G1	COVER SHEET
<u>CIVIL</u>	
C1	EXISTING CONDITIONS
C2	MATERIAL SITE MAP OVERVIEW
C3 - C4	TESC & ACCESS
C5	DESIGN OVERVIEW
C6 - C11	PROPOSED DESIGN
C12 - C24	DETAILS

60% DRAFT DESIGN - NOT FOR CONSTRUCTION

DATUM:
HORIZONTAL DATUM: HARN (HPGN) Washington State Plane, South Zone, US Foot
VERTICAL DATUM: North American Vertical Datum (NAVD) 88

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\GENERAL SHEETS\PA1.DWG
PLOT DETAILS: VANBUCKEN, INCH
December 4, 2013 9:48 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
COVER SHEET

DWG. NO.:	G-1
CREATED:	SHEET: 1 OF 25
08/16/2013	SCALE: NTS



NOTES:

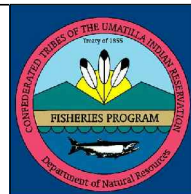
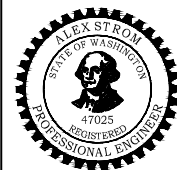
1. PRESERVE ALL CONTROL POINTS.
2. CAMP GROUND BORDERS ARE APPROXIMATE AND SHOWN FOR INFORMATION ONLY.

LEGEND:

- PROPERTY BOUNDARY
- ⊗ 49.4 RIVER MILE
- BANKFULL CHANNEL
- EXISTING LW D
- EXISTING FISH ROCK
- EXISTING CAMPGROUND (APPROX.)
- PROJECT AREA
- ⊗ CONTROL POINTS
- - - EXISTING CONTOUR MAJOR - 20FT
- EXISTING CONTOUR MINOR - 5FT

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\EXISTING CONDITIONS PA1.DWG December 4, 2013 9:49 AM

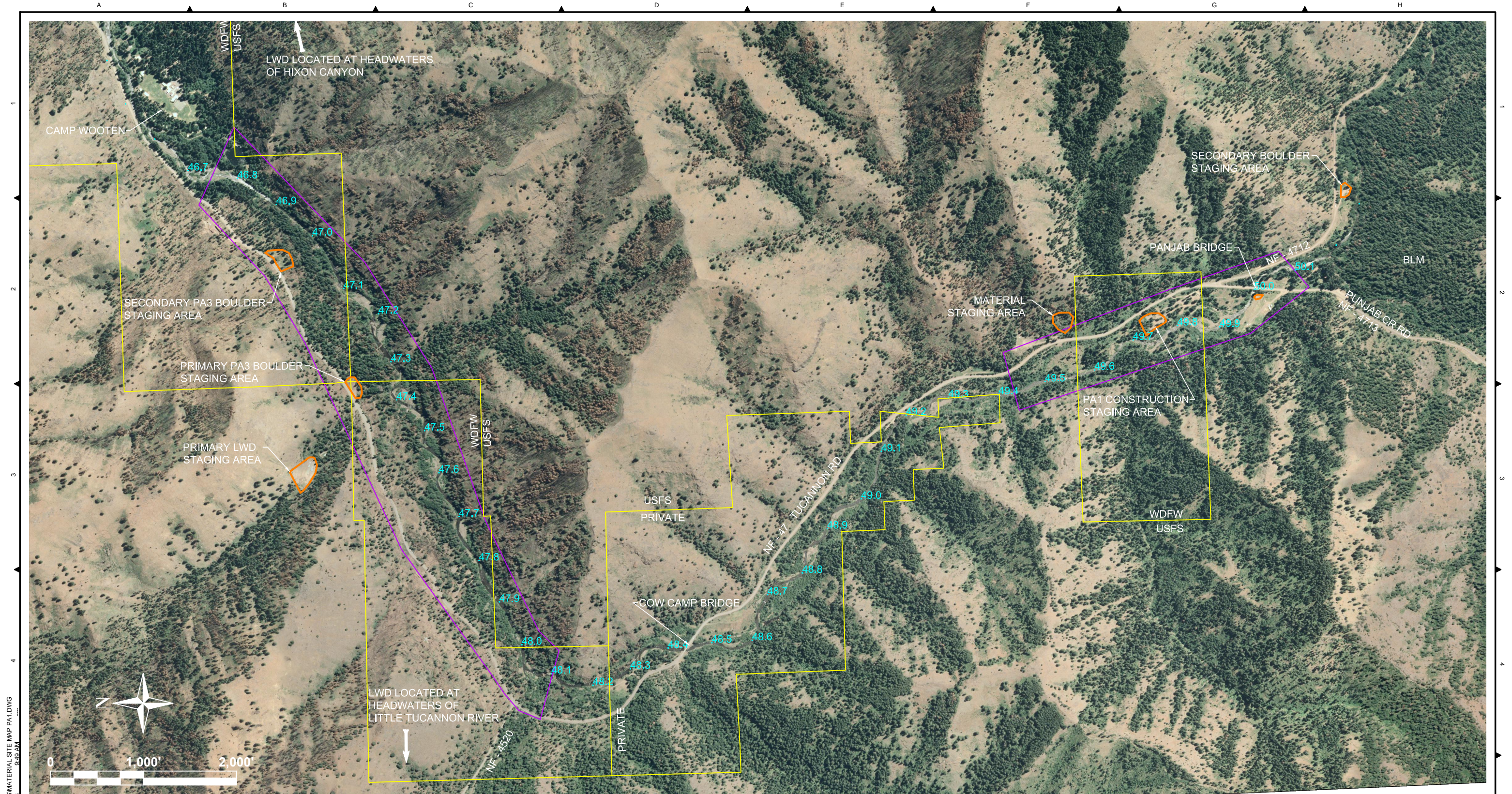
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Bothell, Washington 98011
Phone: 425-482-7600 Fax: 425-482-7652



PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
EXISTING CONDITIONS

DWG. NO.:		C-1	
CREATED:	08/16/2013	SHEET: 2 OF 25	SCALE: 1" = 200'



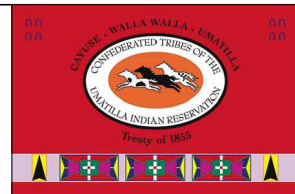
NOTES:

1. LWD TO BE FLOWN OR TRANSPORTED BY HAUL TRUCK FROM THE HEADWATERS OF THE LITTLE TUCANNON RIVER OR PRIMARY LWD STAGING AREA TO THE MATERIAL STAGING AREA.

LEGEND:

- PROPERTY BOUNDARY
- STAGING AREA
- 49.4 RIVER MILE
- PROJECT AREA

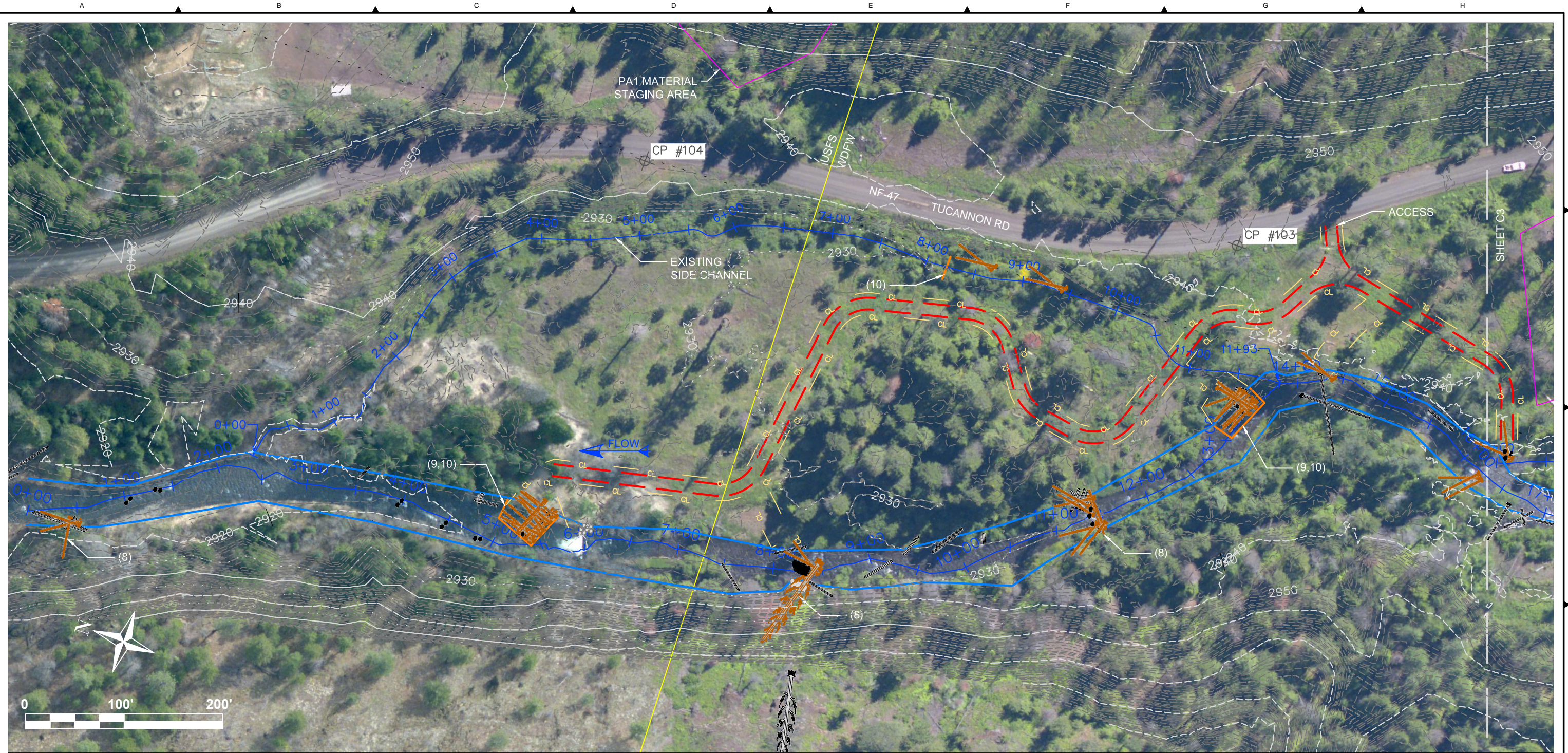
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\MATERIAL SITE MAP PA1.DWG
 PLOT DETAILS: VANBUCKLEN, INCH
 December 4, 2013 9:49 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

**CTUIR
 TUCANNON RIVER
 FLOODPLAIN RECONNECTION
 PROJECT AREA 1
 MATERIAL SITE MAP
 OVERVIEW**

DWG. NO.:		C-2
CREATED:	SHEET: 3 OF 25	
08/16/2013	SCALE: 1" = 1,000'	



NOTES:

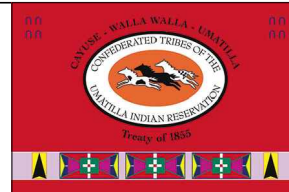
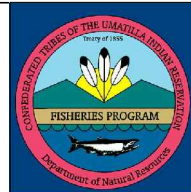
1. ALL IN-WATER WORK SHALL ONLY OCCUR BETWEEN JULY 16 AND AUGUST 15.
2. ALL IN-WATER EXCAVATION WORK SHALL INSTALL A COFFERDAM TO ISOLATE WORK AREA.
3. ISOLATED WORK AREAS REQUIRE FISH SALVAGE PRIOR TO INITIATION OF CONSTRUCTION.
4. FISH SALVAGE OPERATIONS TO BE CONDUCTED BY QUALIFIED FISH BIOLOGIST.
5. ALL ACCESS ROADS SHALL BE SUBSOILED/SCARIFIED UPON COMPLETION OF ALL WORK ACTIVITIES.

6. ALL AREAS WITHIN THE CLEARING LIMITS AND STAGING AREAS SHALL BE SCARIFIED AND HYDRO-SEEDING UPON COMPLETION OF ALL WORK ACTIVITIES.
7. WILLOW STAKES WILL BE PLACED BY OWNER AT PROPOSED LWD.
8. PROPOSED MATERIAL TO BE PLACED BY HELICOPTER.
9. PLACE COFFERDAM DURING CONSTRUCTION. SEE SHEET C-24.
10. PLACE FIBER ROLL, SILT FENCE OR EQUIV. DURING CONSTRUCTION. SEE SHEET C-24.

LEGEND:

- PROPOSED LWD
- EXISTING LWD
- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- ⊗ CONTROL POINTS
- EXISTING CONTOUR MAJOR - 10FT
- EXISTING CONTOUR MINOR - 2FT
- PROPERTY BOUNDARY
- SHEET BOUNDARY
- BANKFULL CHANNEL
- TEMPORARY EROSION CONTROL
- CONSTRUCTION ACCESS ROAD EDGE
- CL— CLEARING LIMITS
- MATERIAL STAGING AREA

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\TESC PA1.DWG 10:42 AM December 4, 2013



PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
TESC & ACCESS

DWG. NO.:		C-3	
CREATED:	08/16/2013	SHEET:	4 OF 25
		SCALE:	1" = 100'



NOTES:

1. ALL IN-WATER WORK SHALL ONLY OCCUR BETWEEN JULY 16 AND AUGUST 15.
2. ALL IN-WATER EXCAVATION WORK SHALL INSTALL A COFFERDAM TO ISOLATE WORK AREA.
3. ISOLATED WORK AREAS REQUIRE FISH SALVAGE PRIOR TO INITIATION OF CONSTRUCTION.
4. FISH SALVAGE OPERATIONS TO BE CONDUCTED BY QUALIFIED FISH BIOLOGIST.
5. ALL ACCESS ROADS SHALL BE SUBSOILED/SCARIFIED UPON COMPLETION OF ALL WORK ACTIVITIES.

6. ALL AREAS WITHIN THE CLEARING LIMITS AND STAGING AREAS SHALL BE SCARIFIED AND HYDRO-SEEDING UPON COMPLETION OF ALL WORK ACTIVITIES.
7. WILLOW STAKES WILL BE PLACED BY OWNER AT PROPOSED LWD.
8. PROPOSED MATERIAL TO BE PLACED BY HELICOPTER.
9. PLACE COFFERDAM DURING CONSTRUCTION. SEE SHEET C-24.
10. PLACE FIBER ROLL, SILT FENCE OR EQUIV. DURING CONSTRUCTION. SEE SHEET C-24.

LEGEND:

- PROPOSED LWD
- EXISTING LWD
- SHEET BOUNDARY
- BANKFULL CHANNEL
- TEMPORARY EROSION CONTROL
- CONSTRUCTION ACCESS ROAD EDGE
- CL— CLEARING LIMITS
- MATERIAL STAGING AREA
- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- ⊗ CONTROL POINTS
- EXISTING CONTOUR MAJOR - 10FT
- EXISTING CONTOUR MINOR - 2FT

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\PROJECT SHEET FILES\TESC PA1.DWG 10:24 AM December 4, 2013

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PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
TESC & ACCESS

DWG. NO.:		C-4
CREATED:	08/16/2013	SHEET: 5 OF 25
		SCALE: 1" = 100'



- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED LWD
 - EXISTING LWD

- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- CONTROL POINTS
- PROPOSED CONTOUR MAJOR - 5FT
- EXISTING CONTOUR MAJOR - 5FT

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December 4, 2013 11:58 AM

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ALEX STROM
STATE OF WASHINGTON
47025
REGISTERED
PROFESSIONAL ENGINEER

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION
FISHERIES PROGRAM
Department of Natural Resources

GA'WEE - WA'AA WA'AA - UMATILLA
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION
Treaty of 1855

PLAN SET SIZE ANSI B (11x17)		DRW	DSG	ENG	CHK	APP
REV.	DATE	REVISION DESCRIPTION				
-	12/04/13	NJV	NJV	ATS	GMS	ATS
-	08/16/13	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DESIGN OVERVIEW

DWG. NO.:		C-5	
CREATED:	08/16/2013	SHEET: 6 OF 25	SCALE: 1" = 200'



- NOTES:**
1. FOR BOULDER PLACEMENT DETAILS SEE SHEET C23.
 2. FOR LWD STRUCTURE DETAILS SEE SHEETS C12 - C23.
 3. PROPOSED LWD STRUCTURES AND FISH ROCKS SHALL BE PLACED AS DIRECTED BY FIELD ENGINEER.

- LEGEND:**
- PROPERTY BOUNDARY
 - - - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED LWD
 - EXISTING LWD

- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- ⊗ CONTROL POINTS
- PROPOSED CONTOUR MAJOR - 5FT
- - - EXISTING CONTOUR MAJOR - 5FT
- PROPOSED CONTOUR MINOR - 1FT
- - - EXISTING CONTOUR MINOR - 1FT

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\PROPOSED DESIGN PA1.DWG December 4, 2013 11:23 AM

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PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
PROPOSED DESIGN

DWG. NO.: C-6	
CREATED: 08/16/2013	SHEET: 7 OF 25 SCALE: 1" = 50'



- NOTES:**
1. FOR BOULDER PLACEMENT DETAILS SEE SHEET C23.
 2. FOR LWD STRUCTURE DETAILS SEE SHEETS C12 - C23.
 3. PROPOSED LWD STRUCTURES AND FISH ROCKS SHALL BE PLACED AS DIRECTED BY FIELD ENGINEER.

- LEGEND:**
- PROPERTY BOUNDARY
 - - - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED LWD
 - EXISTING LWD

- LEGEND:**
- PROPOSED FISH ROCK
 - EXISTING FISH ROCK
 - ⊗ CONTROL POINTS
 - PROPOSED CONTOUR MAJOR - 5FT
 - - - EXISTING CONTOUR MAJOR - 5FT
 - PROPOSED CONTOUR MINOR - 1FT
 - - - EXISTING CONTOUR MINOR - 1FT

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PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
PROPOSED DESIGN

DWG. NO.: C-7	
CREATED: 08/16/2013	SHEET: 8 OF 25 SCALE: 1" = 50'



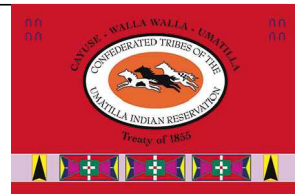
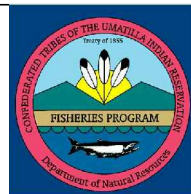
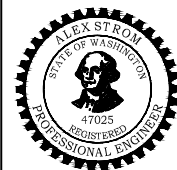
NOTES:

1. FOR BOULDER PLACEMENT DETAILS SEE SHEET C23.
2. FOR LWD STRUCTURE DETAILS SEE SHEETS C12 - C23.
3. PROPOSED LWD STRUCTURES AND FISH ROCKS SHALL BE PLACED AS DIRECTED BY FIELD ENGINEER.

LEGEND:

- PROPERTY BOUNDARY
- - - SHEET BOUNDARY
- BANKFULL
- PROPOSED LWD
- EXISTING LWD
- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- ⊗ CONTROL POINTS
- PROPOSED CONTOUR MAJOR - 5FT
- - - EXISTING CONTOUR MAJOR - 5FT
- PROPOSED CONTOUR MINOR - 1FT
- - - EXISTING CONTOUR MINOR - 1FT

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 December 4, 2013



PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 FLOODPLAIN RECONNECTION
 PROJECT AREA 1
 PROPOSED DESIGN

DWG. NO.: C-8	
CREATED: 08/16/2013	SHEET: 9 OF 25 SCALE: 1" = 50'



NOTES:

1. FOR BOULDER PLACEMENT DETAILS SEE SHEET C23.
2. FOR LWD STRUCTURE DETAILS SEE SHEETS C12 - C23.
3. PROPOSED LWD STRUCTURES AND FISH ROCKS SHALL BE PLACED AS DIRECTED BY FIELD ENGINEER.

LEGEND:

- PROPERTY BOUNDARY
- SHEET BOUNDARY
- BANKFULL
- PROPOSED LWD
- EXISTING LWD

- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- CONTROL POINTS
- PROPOSED CONTOUR MAJOR - 5FT
- EXISTING CONTOUR MAJOR - 5FT
- PROPOSED CONTOUR MINOR - 1FT
- EXISTING CONTOUR MINOR - 1FT

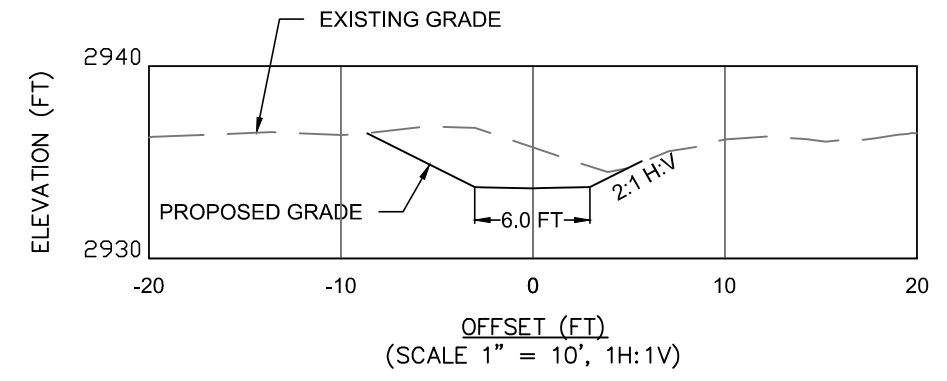
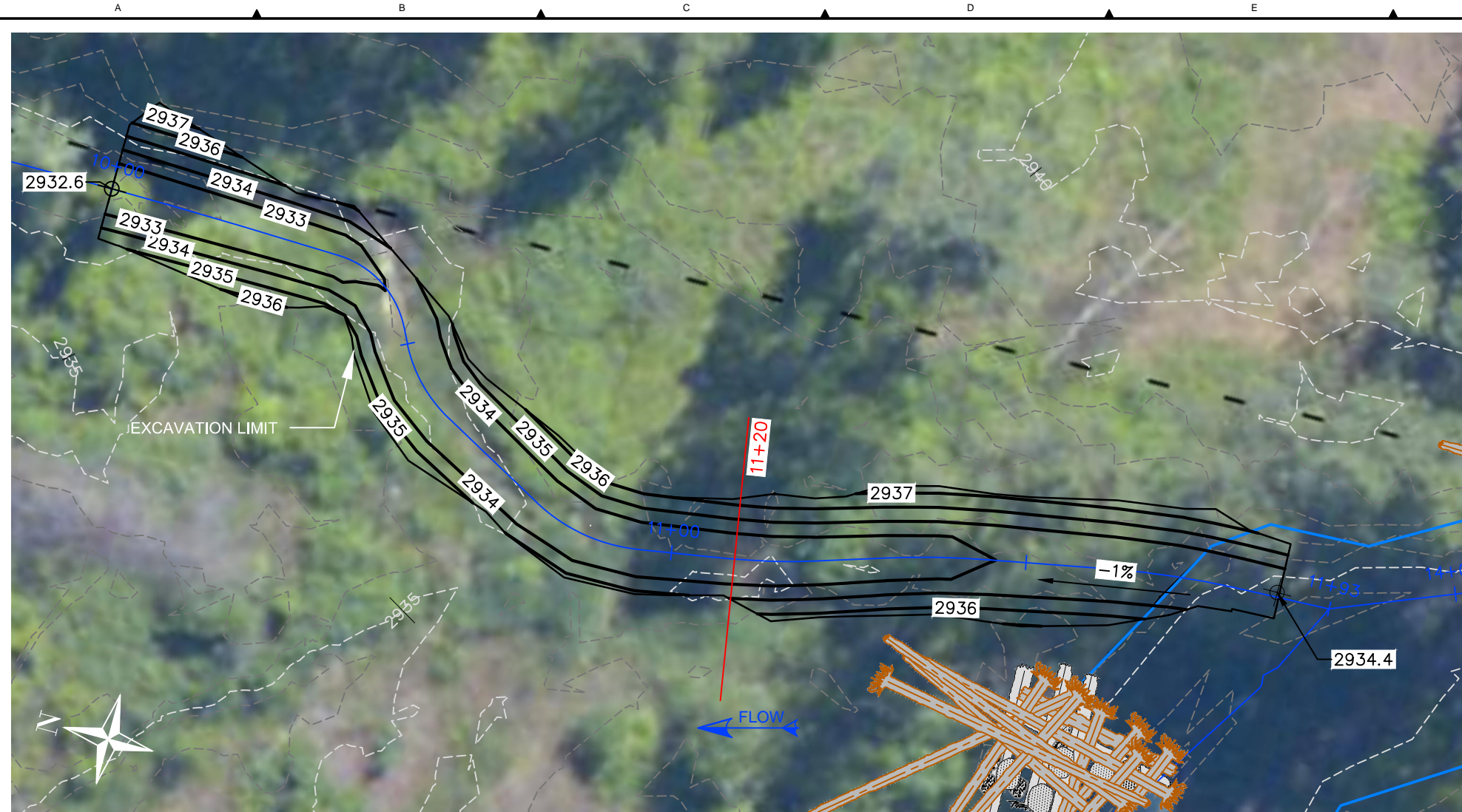
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REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
PROPOSED DESIGN

DWG. NO.: C-9	
CREATED: 08/16/2013	SHEET: 10 OF 25 SCALE: 1" = 50'



(B) SIDE CHANNEL EXCAVATION 14+00 - CROSS SECTION
SCALE: 1" = 10

(A) SIDE CHANNEL EXCAVATION 14+00
SCALE: 1" = 20

- NOTES:**
- SIDE CHANNEL INLET (A/C10) EXCAVATED TO 1 FOOT ABOVE THALWEG, SLOPED TO A CONSISTENT PROFILE AND CONSISTENT SIDE SLOPE TO DAYLIGHT INTO EXISTING GROUND.
 - EXCAVATIONS END AT EXISTING SIDE CHANNEL LOW POINTS.

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED LWD
 - EXISTING LWD
 - PROPOSED FISH ROCK
 - EXISTING FISH ROCK
 - CONTROL POINTS
 - PROPOSED CONTOUR MAJOR - 5FT
 - EXISTING CONTOUR MAJOR - 5FT
 - PROPOSED CONTOUR MINOR - 1FT
 - EXISTING CONTOUR MINOR - 1FT

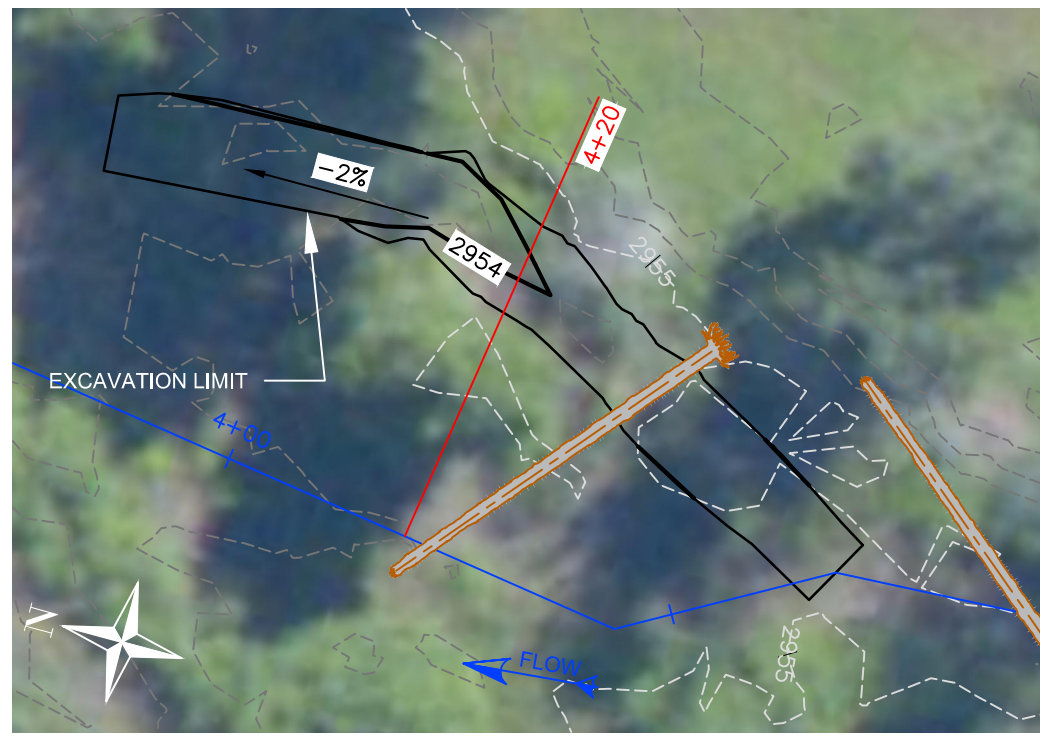
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PLOT DETAILS: VANBUCKEN, INCH
December 4, 2013 11:53 AM

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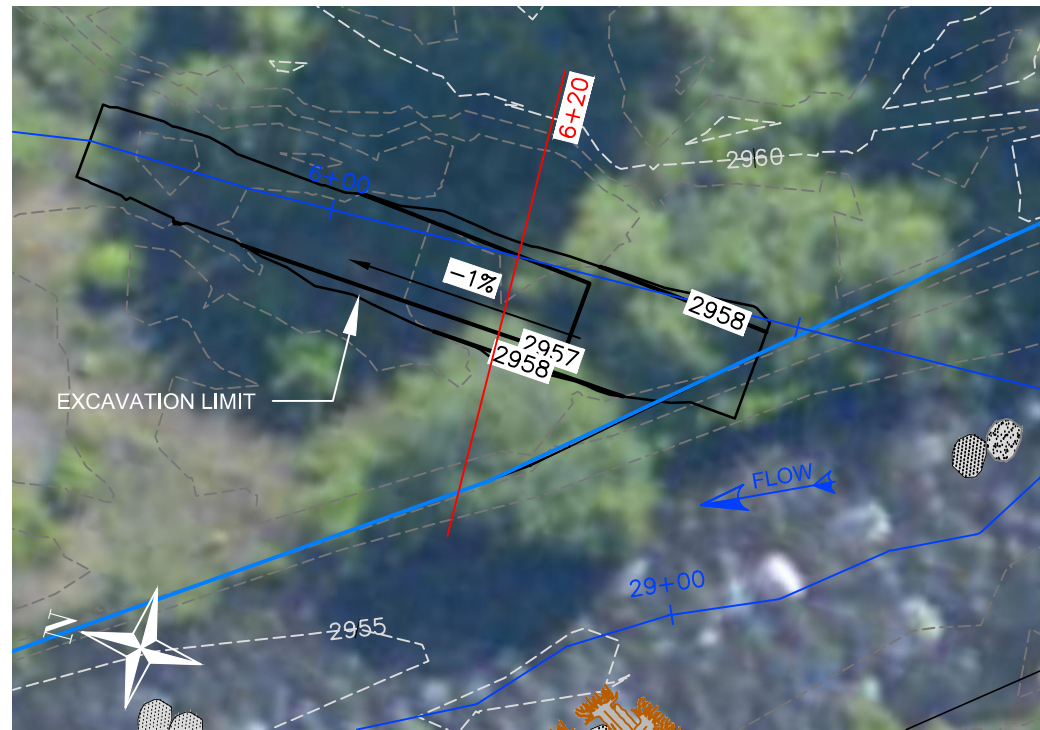
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REV.	DATE	REVISION DESCRIPTION				
-	12/04/13	NJV	NJV	ATS	GMS	ATS
-	08/16/13	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
PROPOSED DESIGN

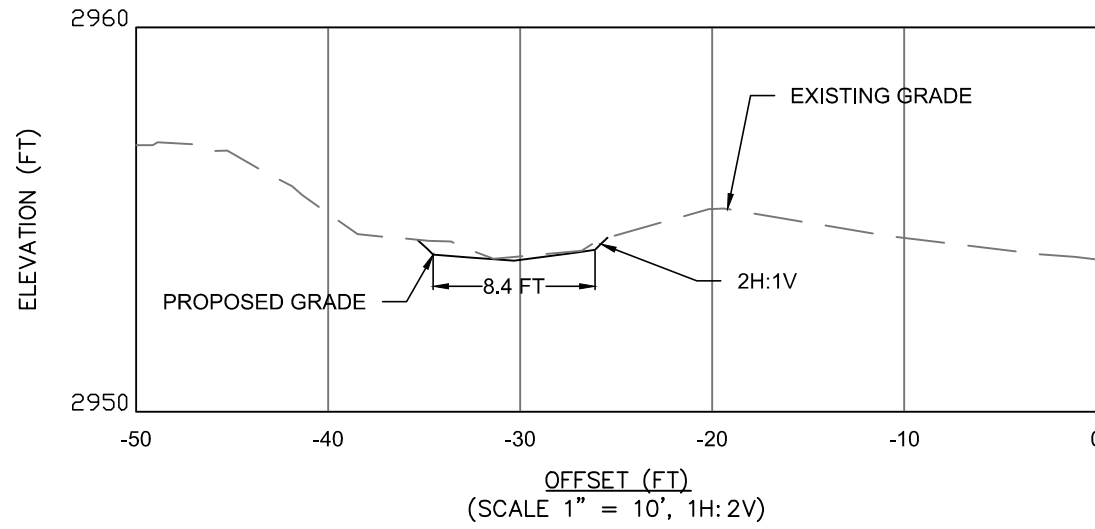
DWG. NO.: C-10	
CREATED: 08/16/2013	SHEET: 11 OF 25 SCALE: 1" = 20'



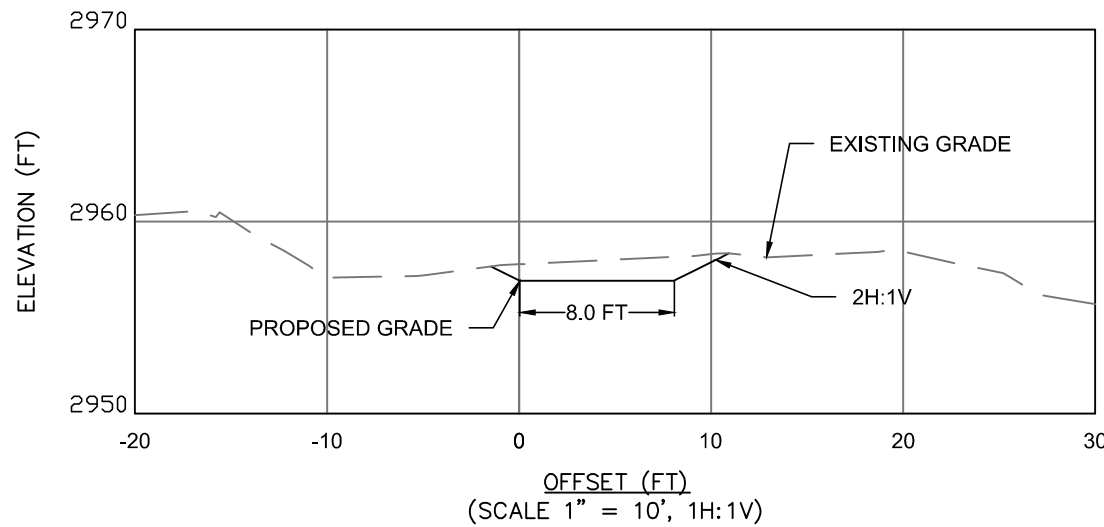
A SIDE CHANNEL EXCAVATION 27+40
SCALE: 1" = 20



C SIDE CHANNEL EXCAVATION 29+20
SCALE: 1" = 20



B SIDE CHANNEL EXCAVATION 27+40
CROSS SECTION 4+20



D SIDE CHANNEL EXCAVATION 29+20
CROSS SECTION 6+20

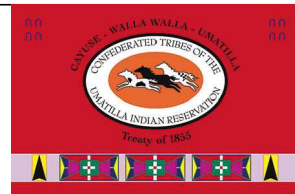
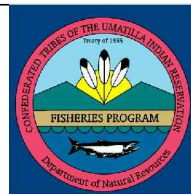
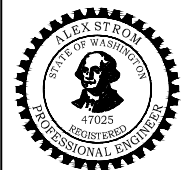
LEGEND:

- PROPERTY BOUNDARY
- SHEET BOUNDARY
- BANKFULL
- PROPOSED LWD
- EXISTING LWD
- PROPOSED FISH ROCK
- EXISTING FISH ROCK
- CONTROL POINTS
- PROPOSED CONTOUR MAJOR - 5FT
- EXISTING CONTOUR MAJOR - 5FT
- PROPOSED CONTOUR MINOR - 1FT
- EXISTING CONTOUR MINOR - 1FT

NOTES:

1. SIDE CHANNEL EXCAVATION (A/C11) TO REMOVED EXISTING HIGH POINT.
2. SIDE CHANNEL INLET (C/C11) EXCAVATED TO 1 FOOT ABOVE THALWEG,
3. EXCAVATIONS END AT EXISTING SIDE CHANNEL LOW POINTS.
4. ALL EXCAVATIONS SLOPED TO A CONSISTENT PROFILE AND CONSISTENT SIDE SLOPES.

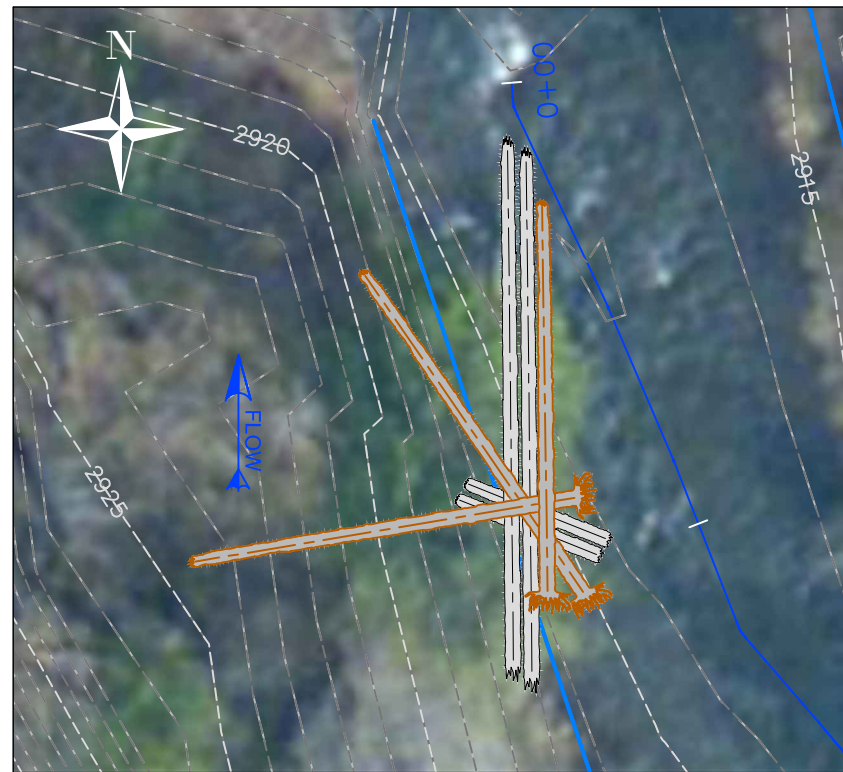
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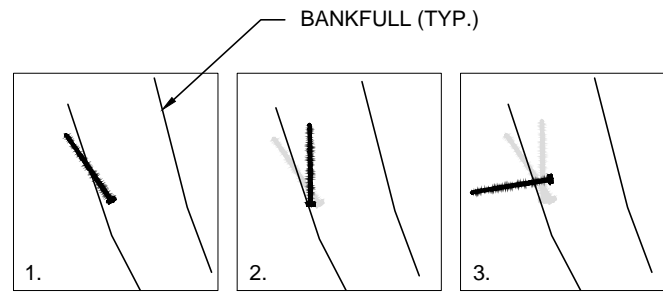
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
PROPOSED DESIGN

DWG. NO.: C-11	
CREATED: 08/16/2013	SHEET: 12 OF 25 SCALE: 1" = 20'



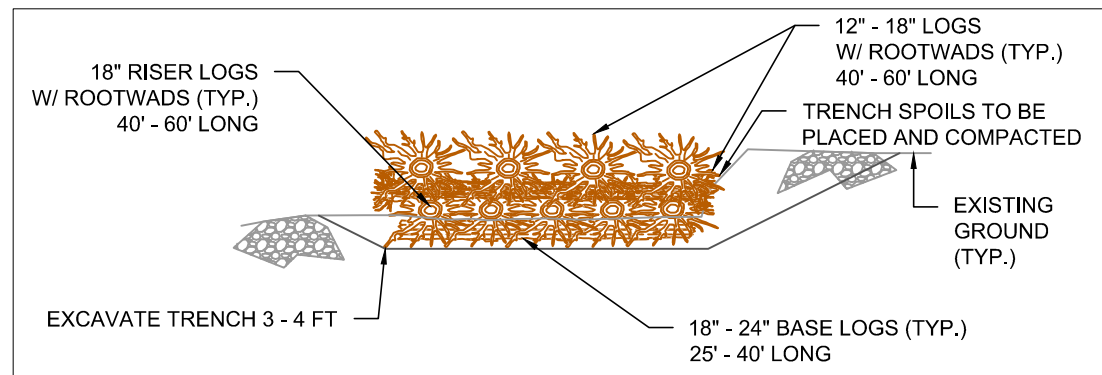
LWD 1 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')



LWD 1 - LOG PLACEMENT SEQUENCING

NOTES:

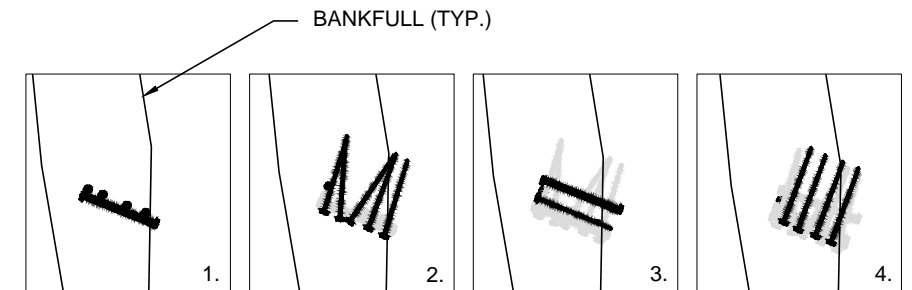
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 2 - SECTION DETAIL - FRONT VIEW



LWD 2 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')

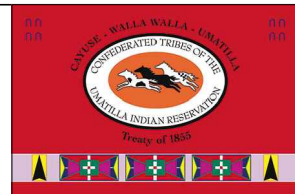
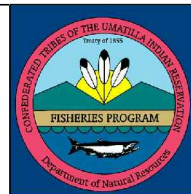
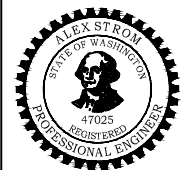


LWD 2 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS PA1.DWG
December 4, 2013 9:52 AM
PLOT DETAILS: VANBUCKEN, INCH



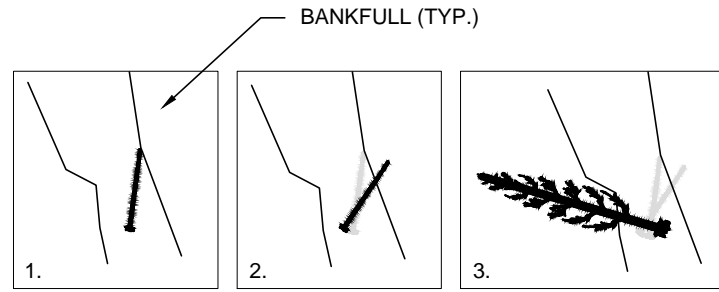
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REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-12	
CREATED: 08/16/2013	SHEET: 13 OF 25 SCALE: NTS



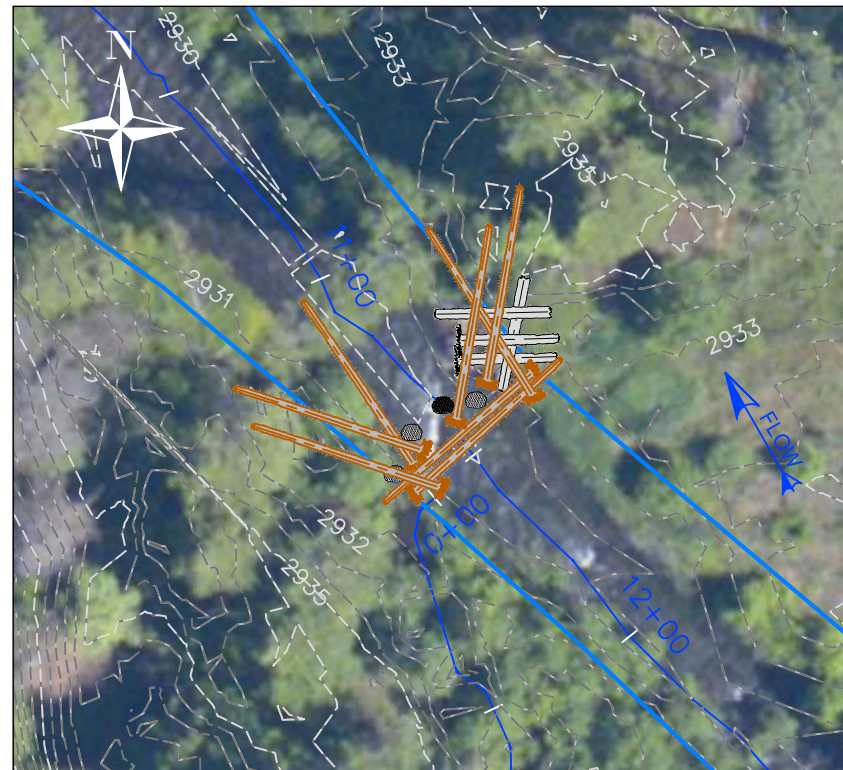
LWD 3 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 50')



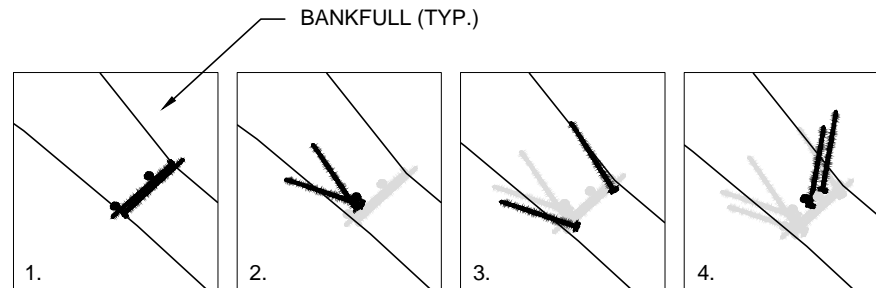
LWD 3 - LOG PLACEMENT SEQUENCING

NOTES:

1. ROCK SHALL BE MOVED FROM BANK INTO CHANNEL LOCATION AS SHOWN ON DRAWING.
2. LOG ON HILLSLOPE SHALL BE MOVED INTO CHANNEL ON UPSTREAM SIDE OF PLACED ROCK.
3. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
4. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
5. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
6. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
7. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 4 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')

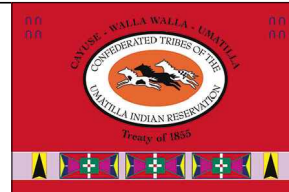
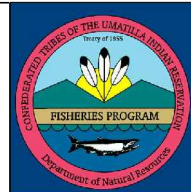
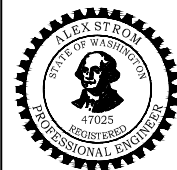


LWD 4 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

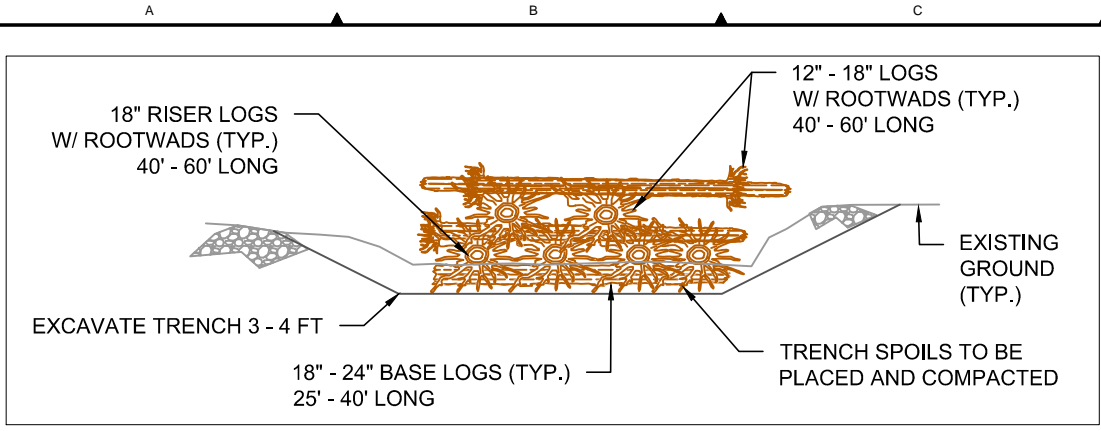
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December 4, 2013 9:55 AM
PLOT DETAILS: VANBUCKEN, INCH



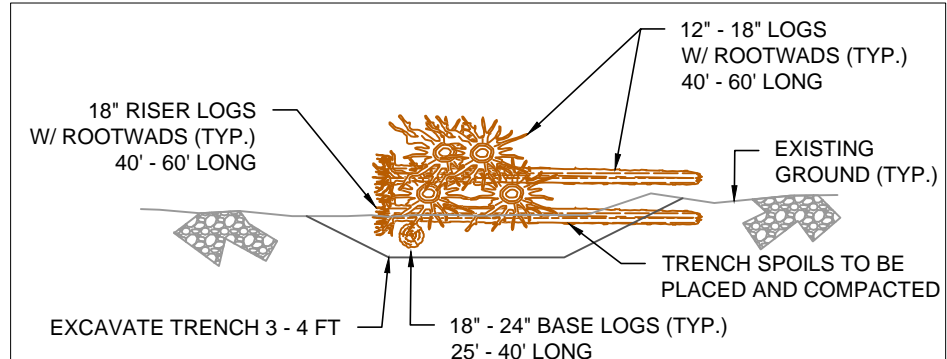
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

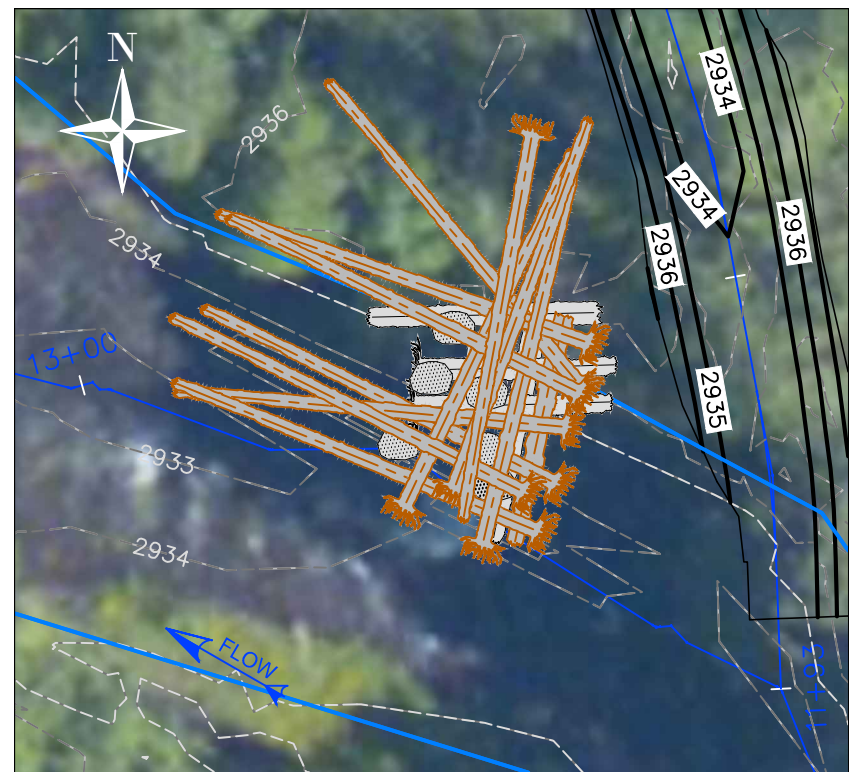
DWG. NO.: C-13	
CREATED: 08/16/2013	SHEET: 14 OF 25 SCALE: NTS



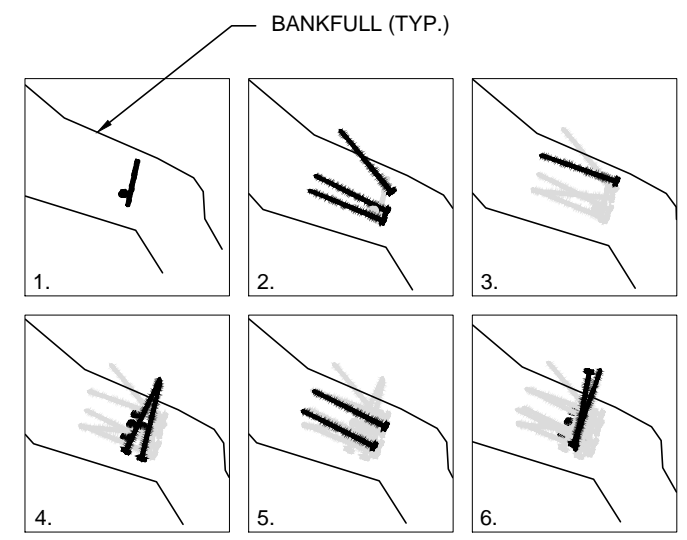
LWD 5 - SECTION DETAIL - FRONT VIEW



LWD 5 - SECTION DETAIL - SIDE VIEW



LWD 5 - SECTION DETAIL - PLAN VIEW (SCALE 1" = 20')

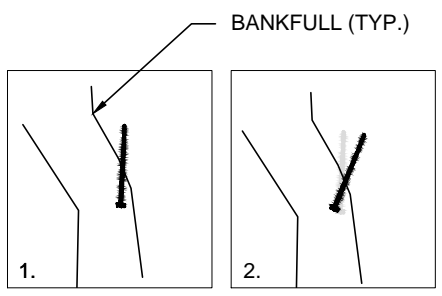


LWD 5 - LOG PLACEMENT SEQUENCING

- NOTES:**
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
 2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
 3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
 4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
 5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 6 - SECTION DETAIL - PLAN VIEW (SCALE 1" = 40')



LWD 6 - LOG PLACEMENT SEQUENCING

- NOTES:**
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
 2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
 3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
 4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
 5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS PA1.DWG
 12/04/2013 9:56 AM
 PLOT DETAILS: VANBUCKEN, INCH

TETRA TECH
 www.tetrattech.com
 19803 North Creek Parkway
 Bothell, Washington 98011
 Phone: 425-482-7600 Fax: 425-482-7652

ALEX STROM
 STATE OF WASHINGTON
 47025
 REGISTERED
 PROFESSIONAL ENGINEER

FISHERIES PROGRAM
 Department of Natural Resources

UMATILLA INDIAN RESERVATION
 CONFEDERATED TRIBES OF THE
 UMATILLA INDIAN RESERVATION
 Treaty of 1855

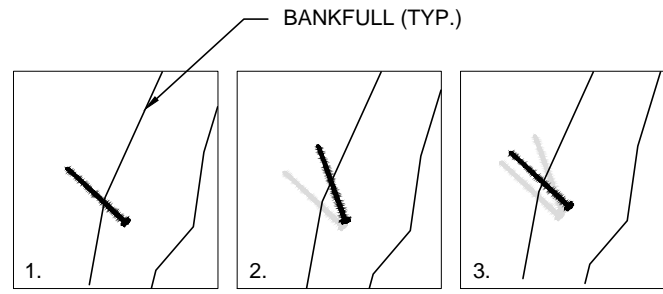
PLAN SET SIZE ANSI B (11x17)							
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 FLOODPLAIN RECONNECTION
 PROJECT AREA 1
 DETAILS

DWG. NO.: C-14	
CREATED: 08/16/2013	SHEET: 15 OF 25 SCALE: NTS



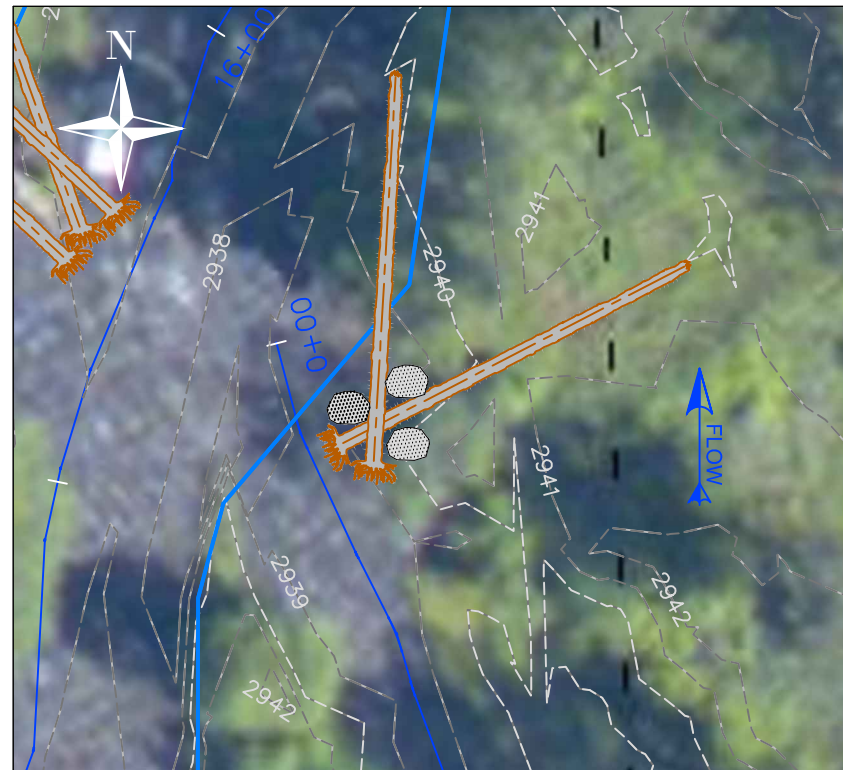
LWD 7A - SECTION DETAIL - PLAN VIEW



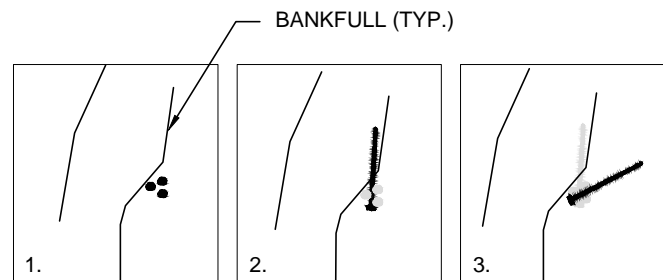
LWD 7A - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 7B - SECTION DETAIL - PLAN VIEW

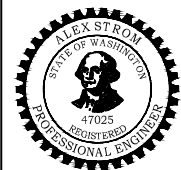


LWD 7B - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS PA1.DWG
 PLOT DETAILS: VANBUCKEN, INCH
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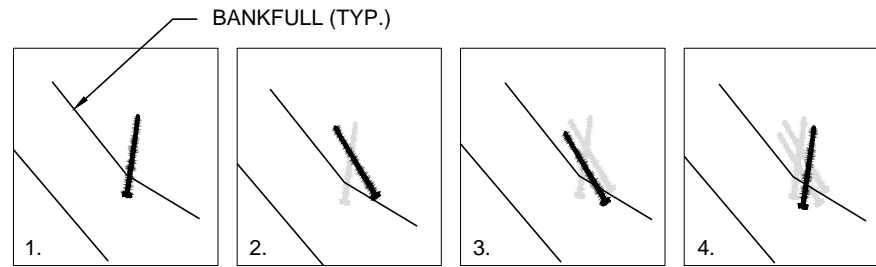
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REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 FLOODPLAIN RECONNECTION
 PROJECT AREA 1
 DETAILS

DWG. NO.: C-15	
CREATED: 08/16/2013	SHEET: 16 OF 25 SCALE: NTS



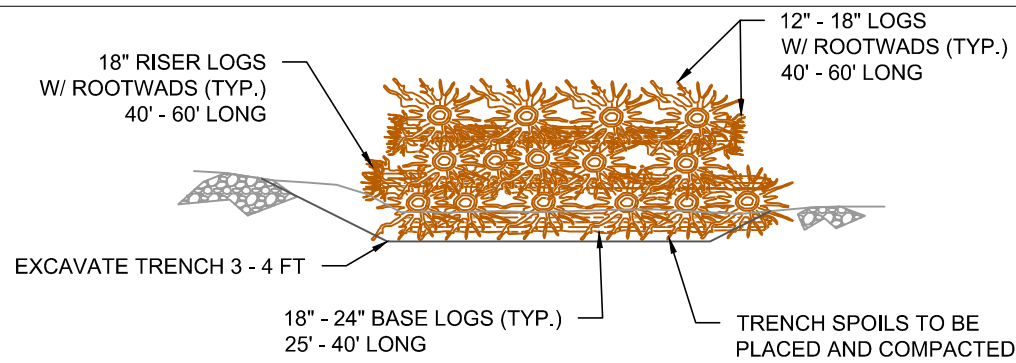
LWD 8 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')



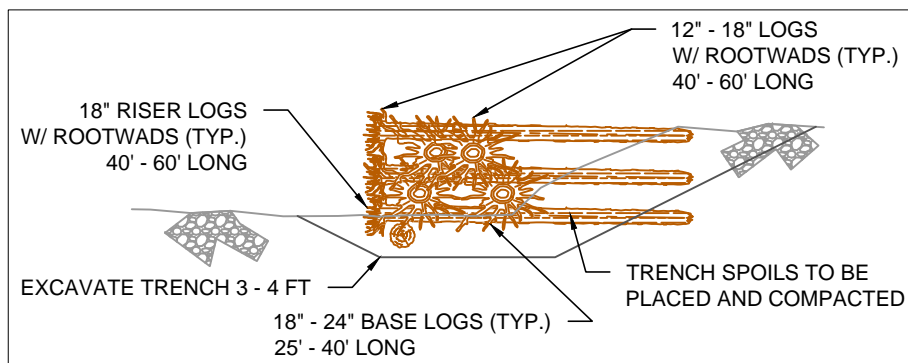
LWD 8 - LOG PLACEMENT SEQUENCING

NOTES:

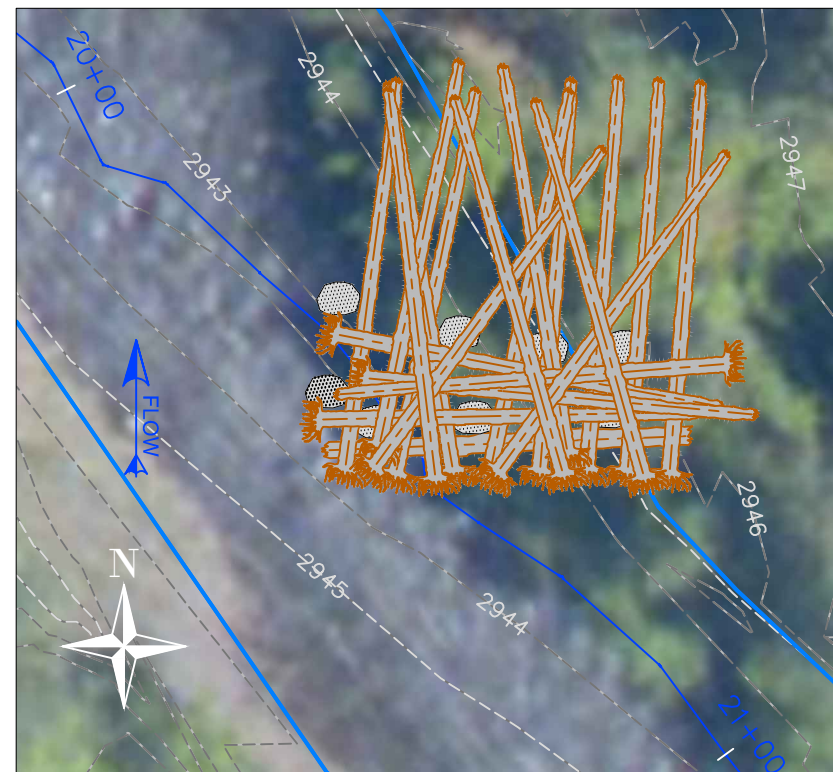
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



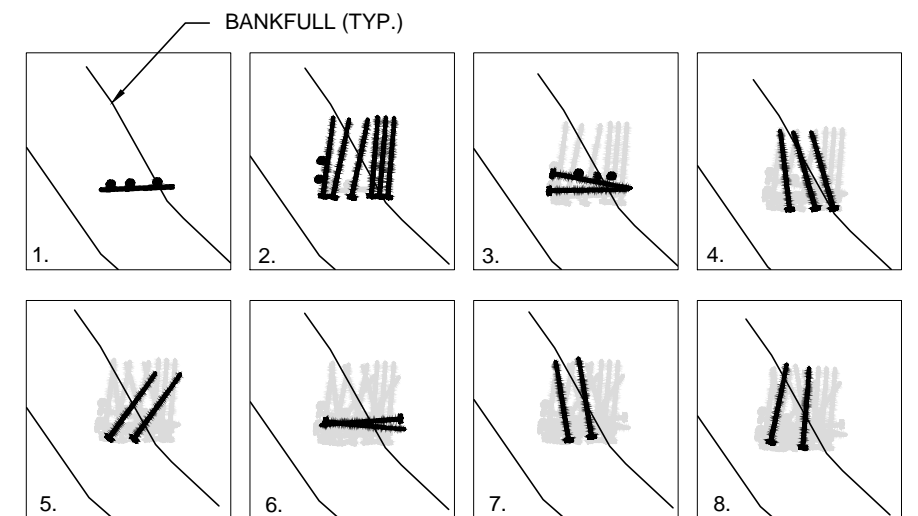
LWD 9 - SECTION DETAIL - FRONT VIEW



LWD 9 - SECTION DETAIL - SIDE VIEW



LWD 9 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')

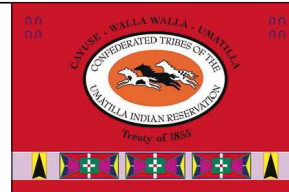
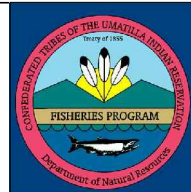


LWD 9 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

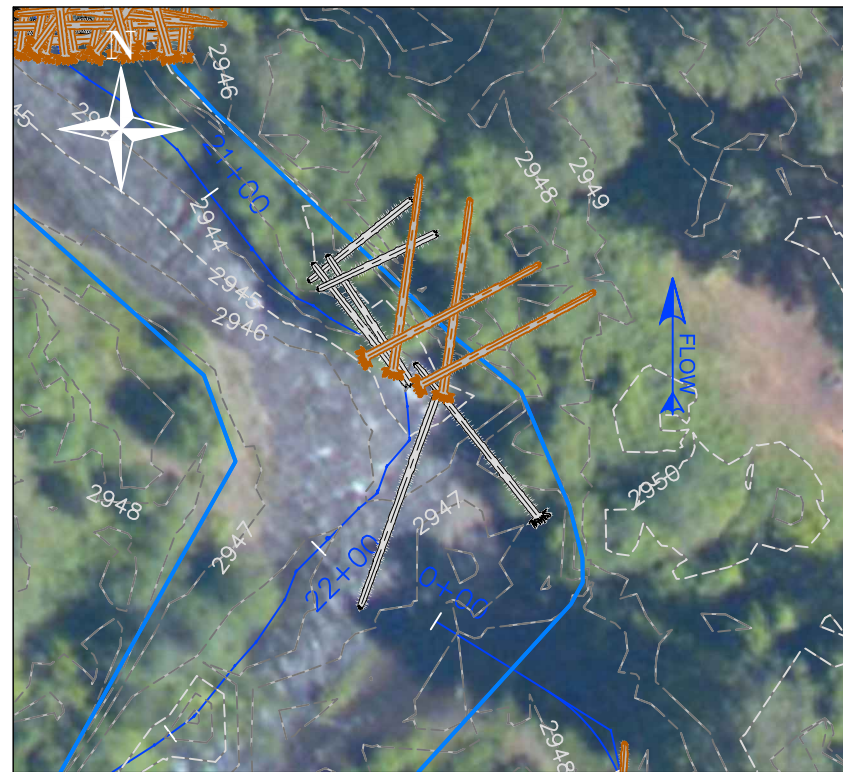
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2/10/2013 9:58 AM



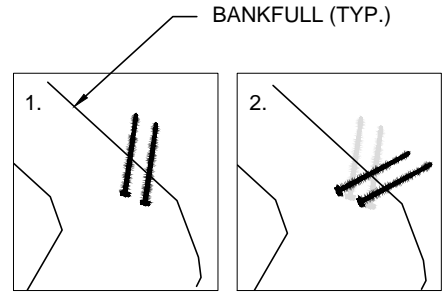
PLAN SET SIZE ANSI B (11x17)		DRW	DSG	ENG	CHK	APP
REV.	DATE	REVISION DESCRIPTION				
-	12/04/13	NJV	NJV	ATS	GMS	ATS
-	08/16/13	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-16	
CREATED: 08/16/2013	SHEET: 17 OF 25 SCALE: NTS



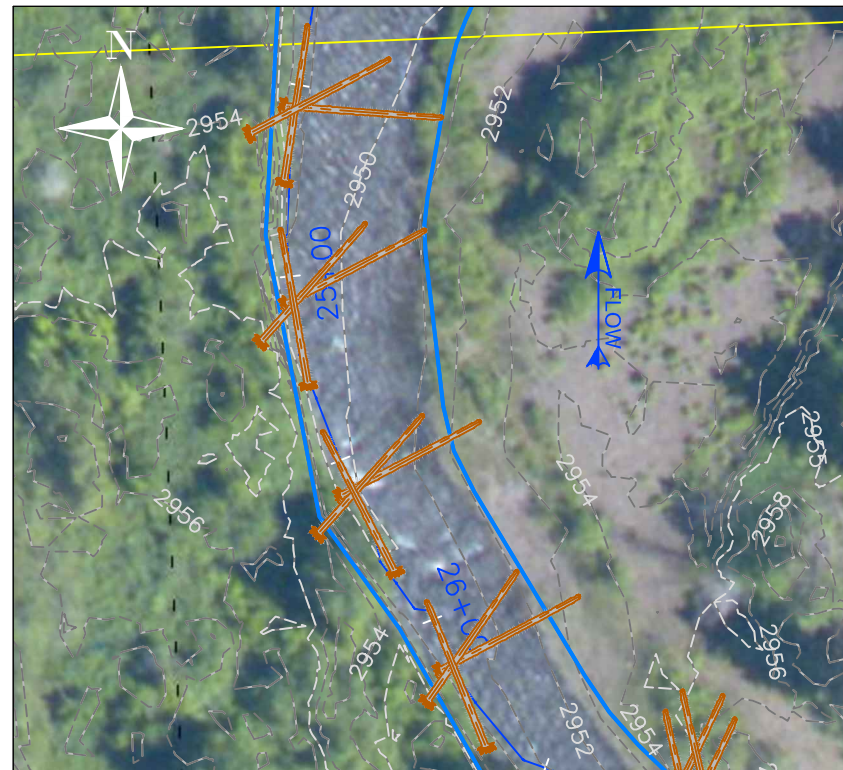
LWD 10 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



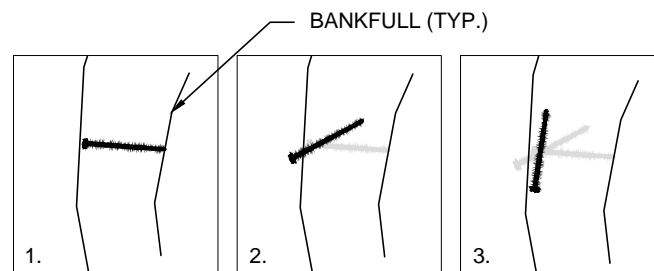
LWD 10 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 11 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 50')

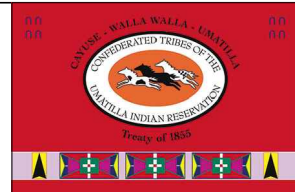
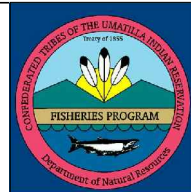
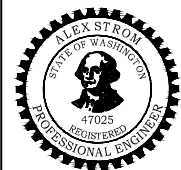


LWD 11 - LOG PLACEMENT SEQUENCING (TYP.)

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

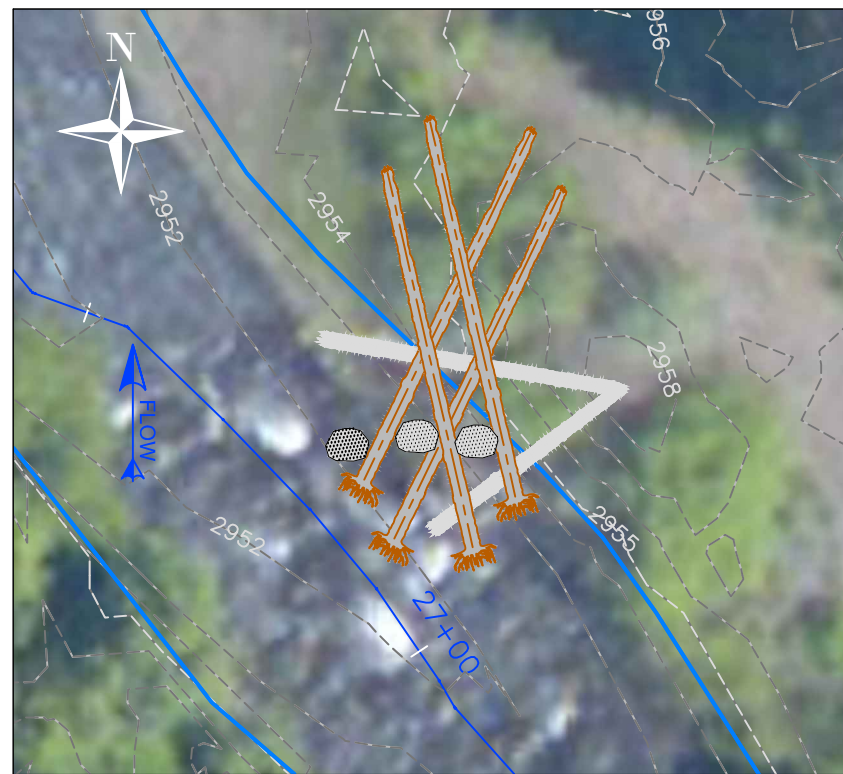
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December 4, 2013 9:58 AM
PLOT DETAILS: VANBUCKEN, INCH



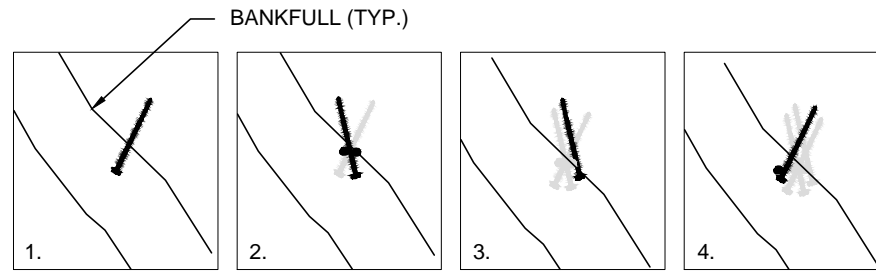
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-17	
CREATED: 08/16/2013	SHEET: 18 OF 25 SCALE: NTS



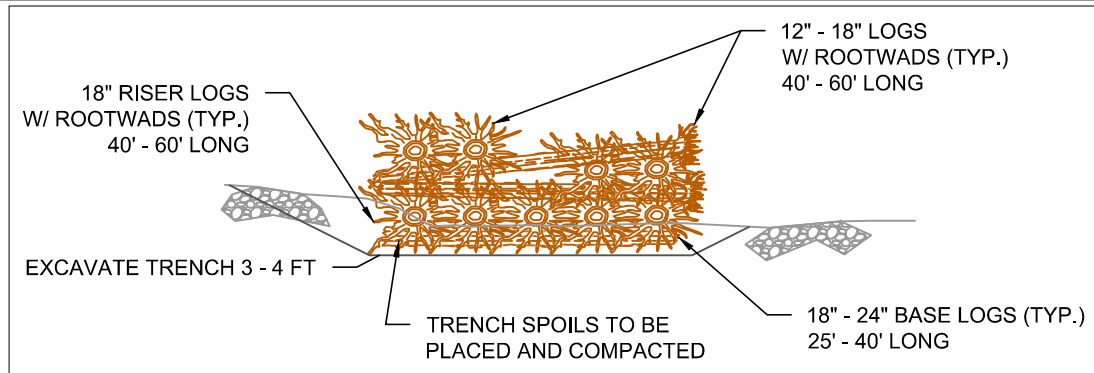
LWD 12 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')



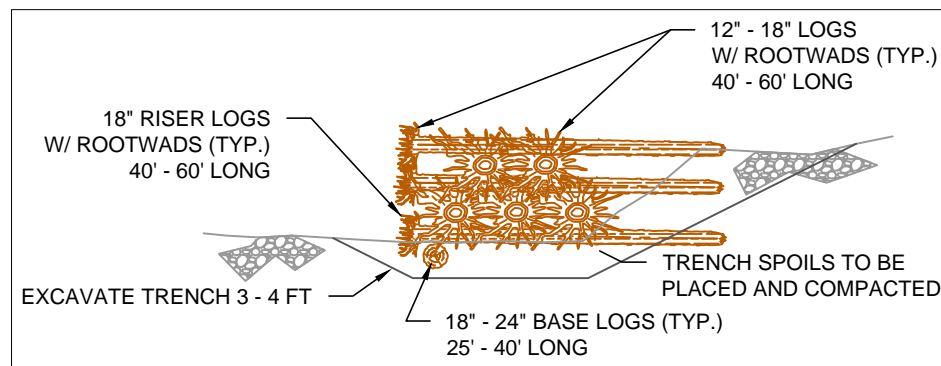
LWD 12 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



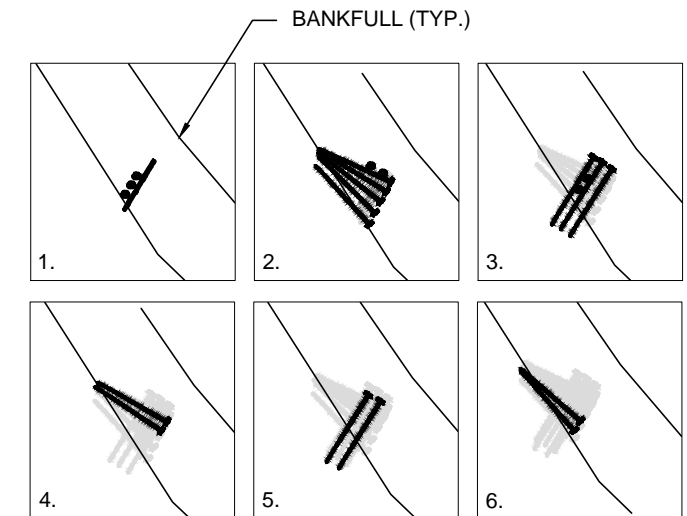
LWD 13 - SECTION DETAIL - FRONT VIEW



LWD 13 - SECTION DETAIL - SIDE VIEW



LWD 13 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 20')

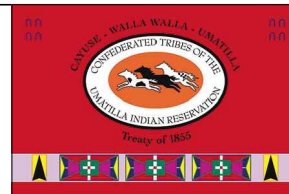
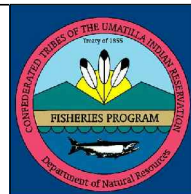


LWD 13 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

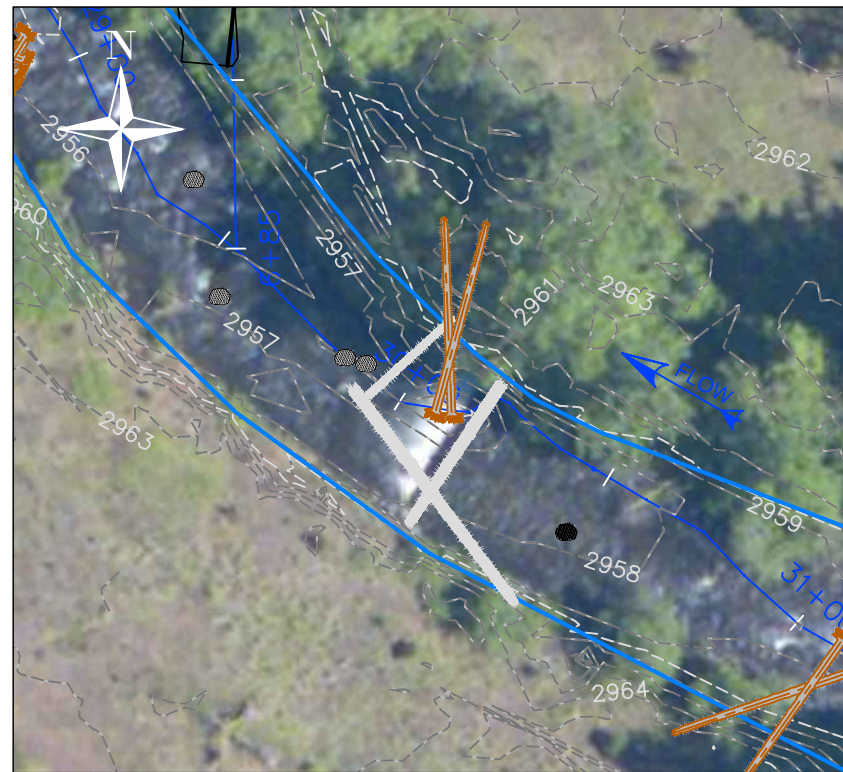
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PLOT DETAILS: VANHECKEN, INCH
December 4, 2013 9:59 AM



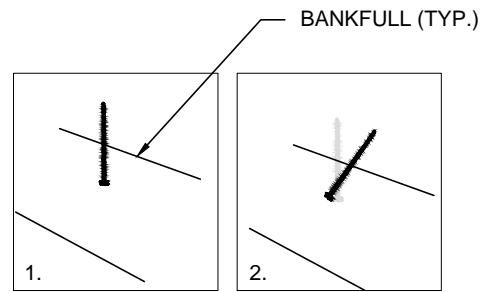
PLAN SET SIZE ANSI B (11x17)		DRW	DSG	ENG	CHK	APP
REV.	DATE	REVISION DESCRIPTION				
-	12/04/13	NJV	NJV	ATS	GMS	ATS
-	08/16/13	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-18	
CREATED: 08/16/2013	SHEET: 19 OF 25 SCALE: NTS



LWD 14A - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



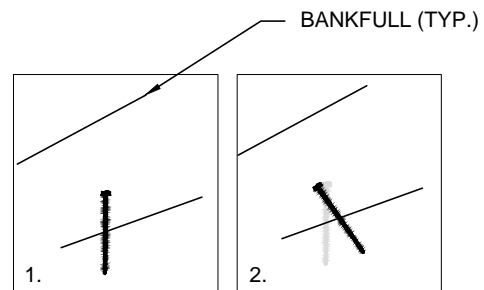
LWD 14A - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 14B - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')

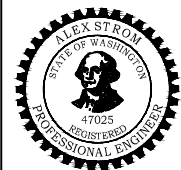


LWD 14B - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

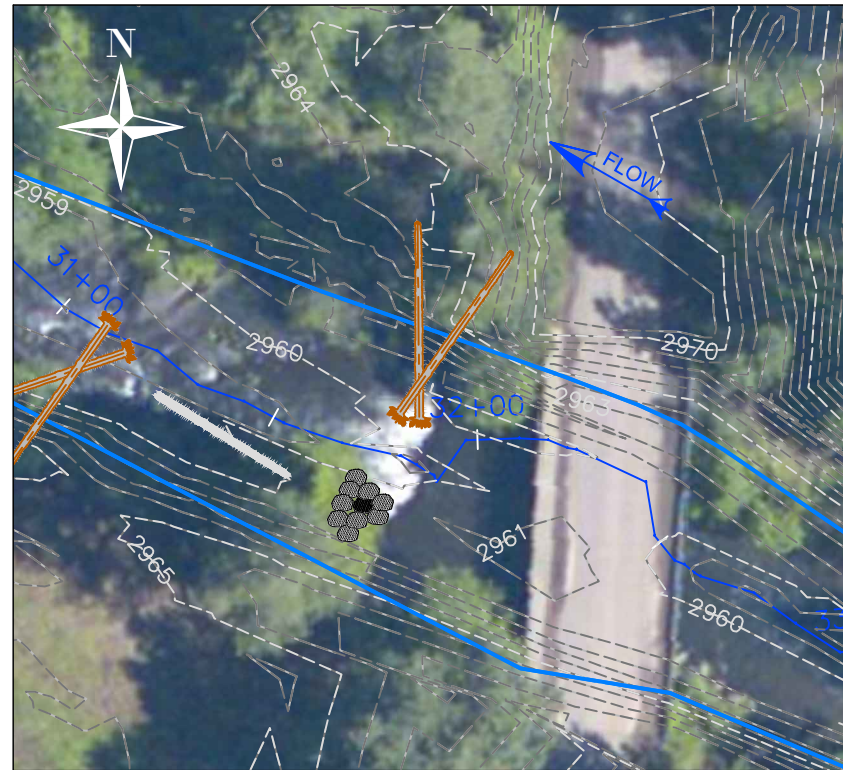
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS\PA1.DWG
PLOT DETAILS: VANBUCKEN, INCH
December 4, 2013 10:00 AM



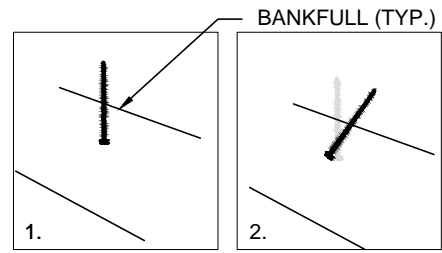
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-19	
CREATED: 08/16/2013	SHEET: 20 OF 25 SCALE: NTS



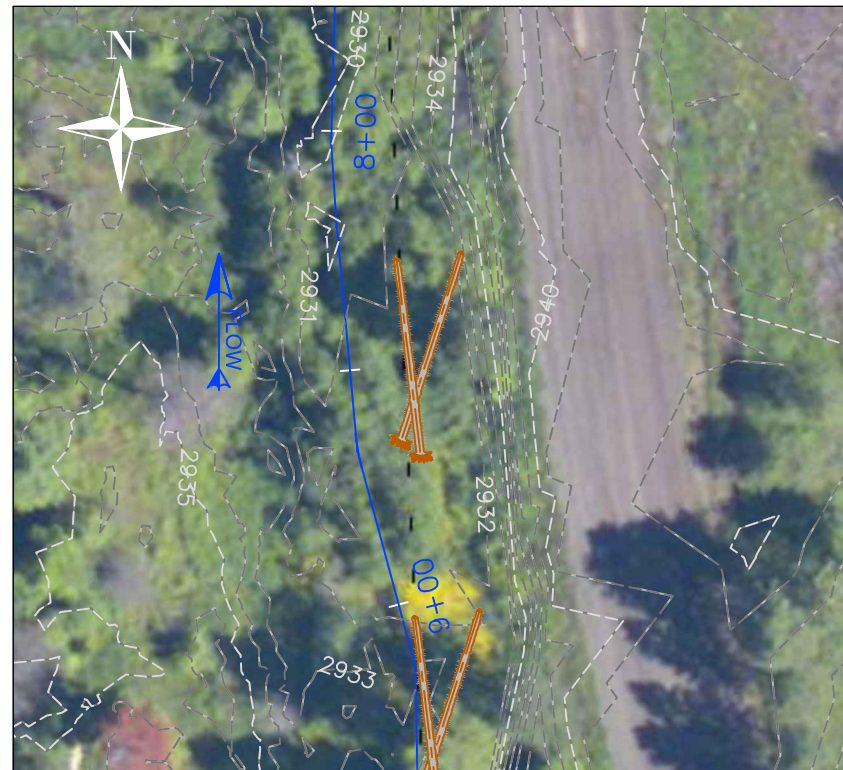
LWD 14C - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



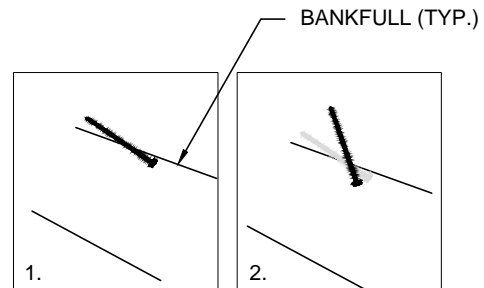
LWD 14C - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 15 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')

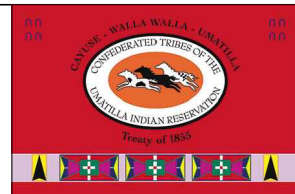
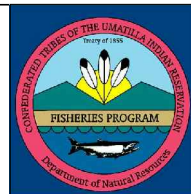


LWD 15 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

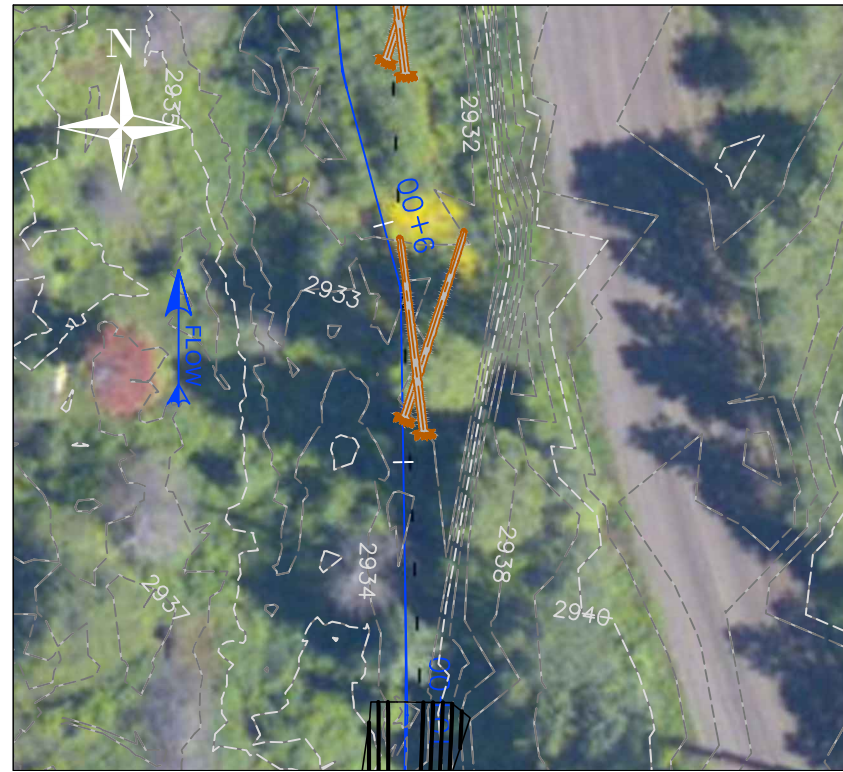
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21/12/2013 10:01 AM
21/12/2013 10:01 AM



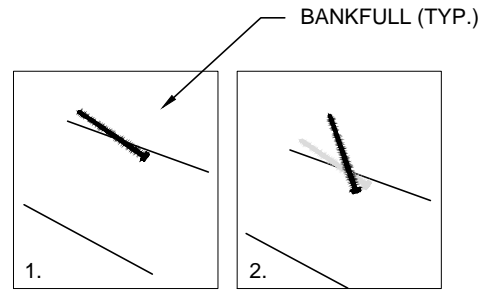
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-20	
CREATED: 08/16/2013	SHEET: 21 OF 25 SCALE: NTS



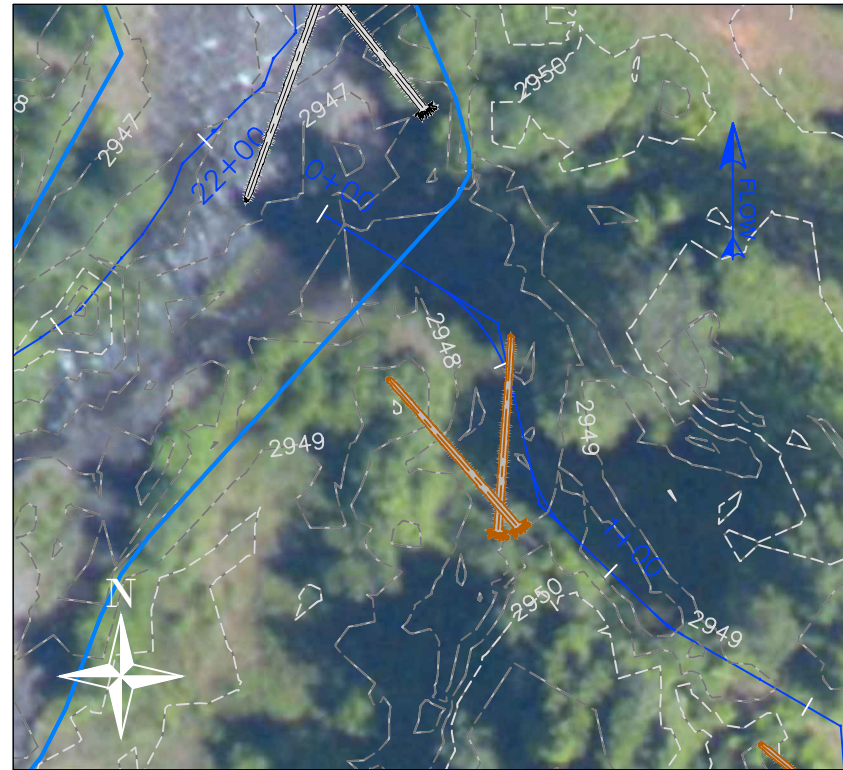
LWD 16 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



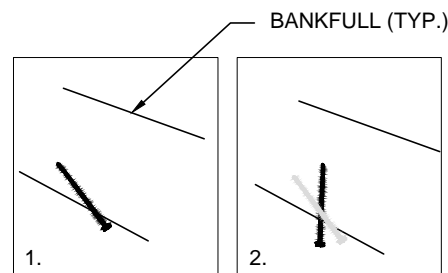
LWD 16 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 17 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')

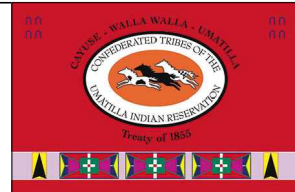
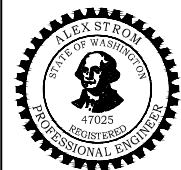


LWD 17 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

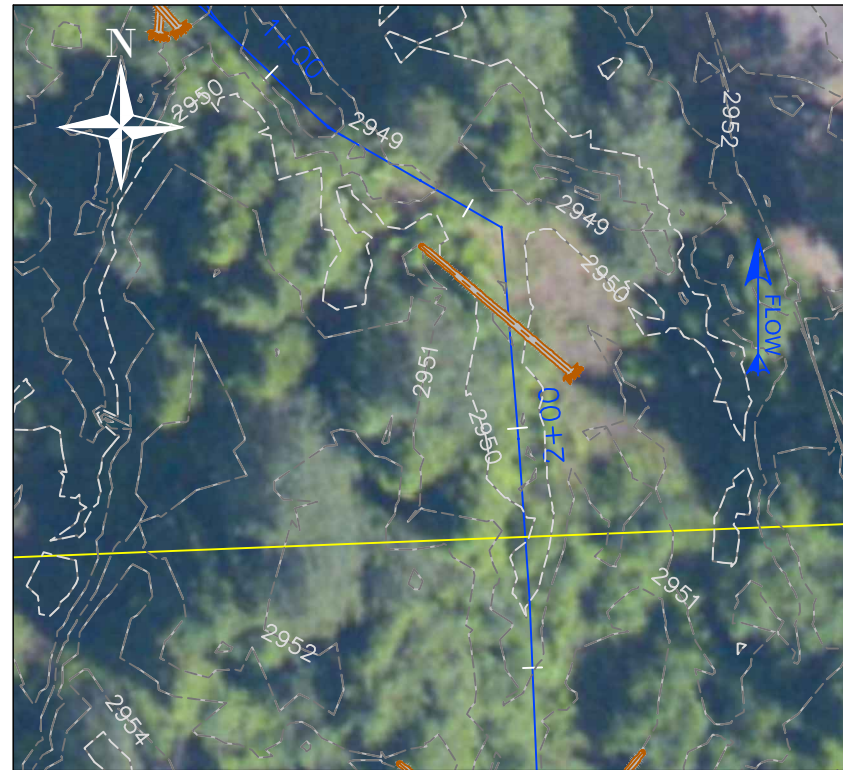
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December 4, 2013 10:01 AM
PLOT DETAILS: VANHECKEN, INCH



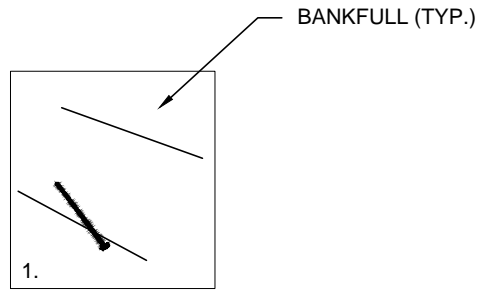
PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-21	
CREATED: 08/16/2013	SHEET: 22 OF 25 SCALE: NTS



LWD 18 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



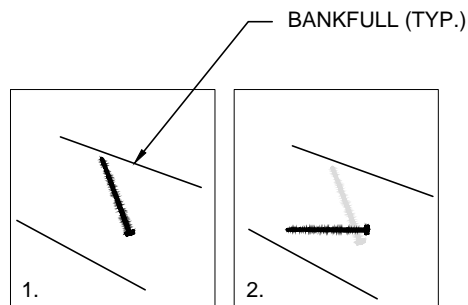
LWD 18 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.



LWD 19 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')

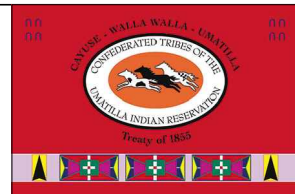
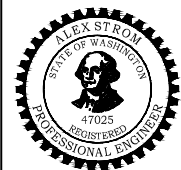


LWD 19 - LOG PLACEMENT SEQUENCING

NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

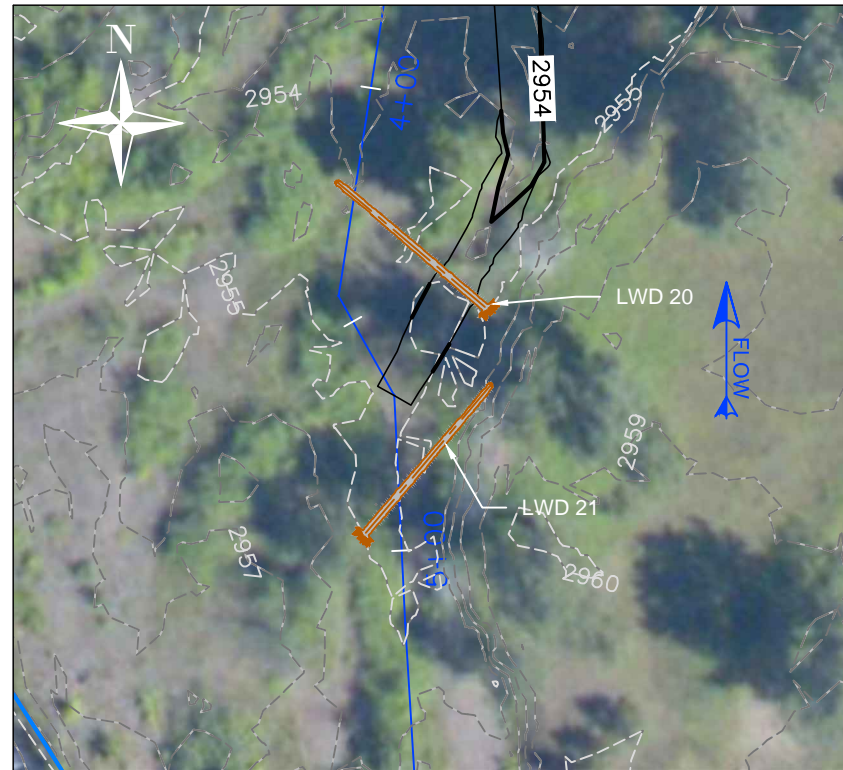
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS PA1.DWG
December 4, 2013 10:02 AM
PLOT DETAILS: VANHECKEN, INCH



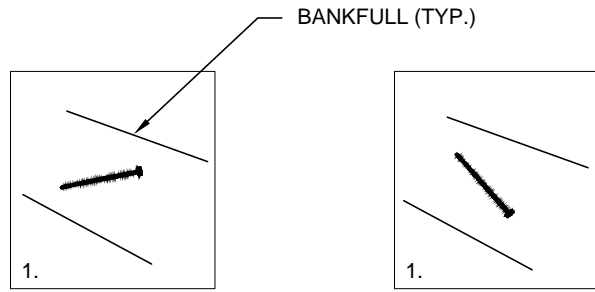
PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

DWG. NO.: C-22	
CREATED: 08/16/2013	SHEET: 23 OF 25 SCALE: NTS



LWD 20 & 21 - SECTION DETAIL - PLAN VIEW
(SCALE 1" = 40')



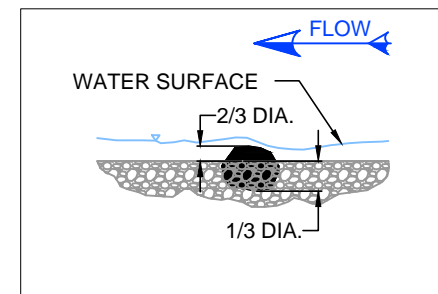
LWD 20 & 21 - LOG PLACEMENT SEQUENCING

NOTES:

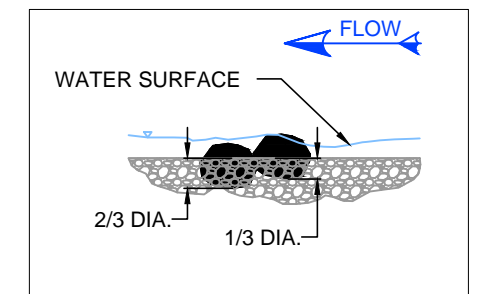
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL SHEET C-24.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.

NOTES:

1. SINGLE/DOUBLE INSTREAM BOULDERS SHALL BE SIZED 18IN TO 28IN.
2. SINGLE BOULDERS SHALL BE BURIED AT 2/3 DIAMETER DEEP, SUCH THAT 1/3 DIAMETER IS EXPOSED. DOUBLE BOULDERS SHALL HAVE THE DOWNSTREAM BOULDER INSTALLED AS PER SINGLE BOULDERS, WHILE THE UPSTREAM BOULDER SHALL BE BURIED 1/3 DIAMETER WITH 2/3 DIAMETER EXPOSED.
3. SPOILS WILL BE USED TO BACKFILL AROUND PLACED BOULDERS.

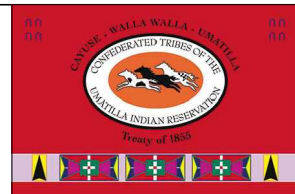
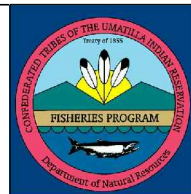
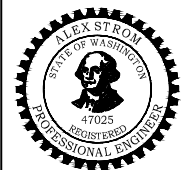


SINGLE BOULDER SECTION DETAIL



DOUBLE BOULDER SECTION DETAIL

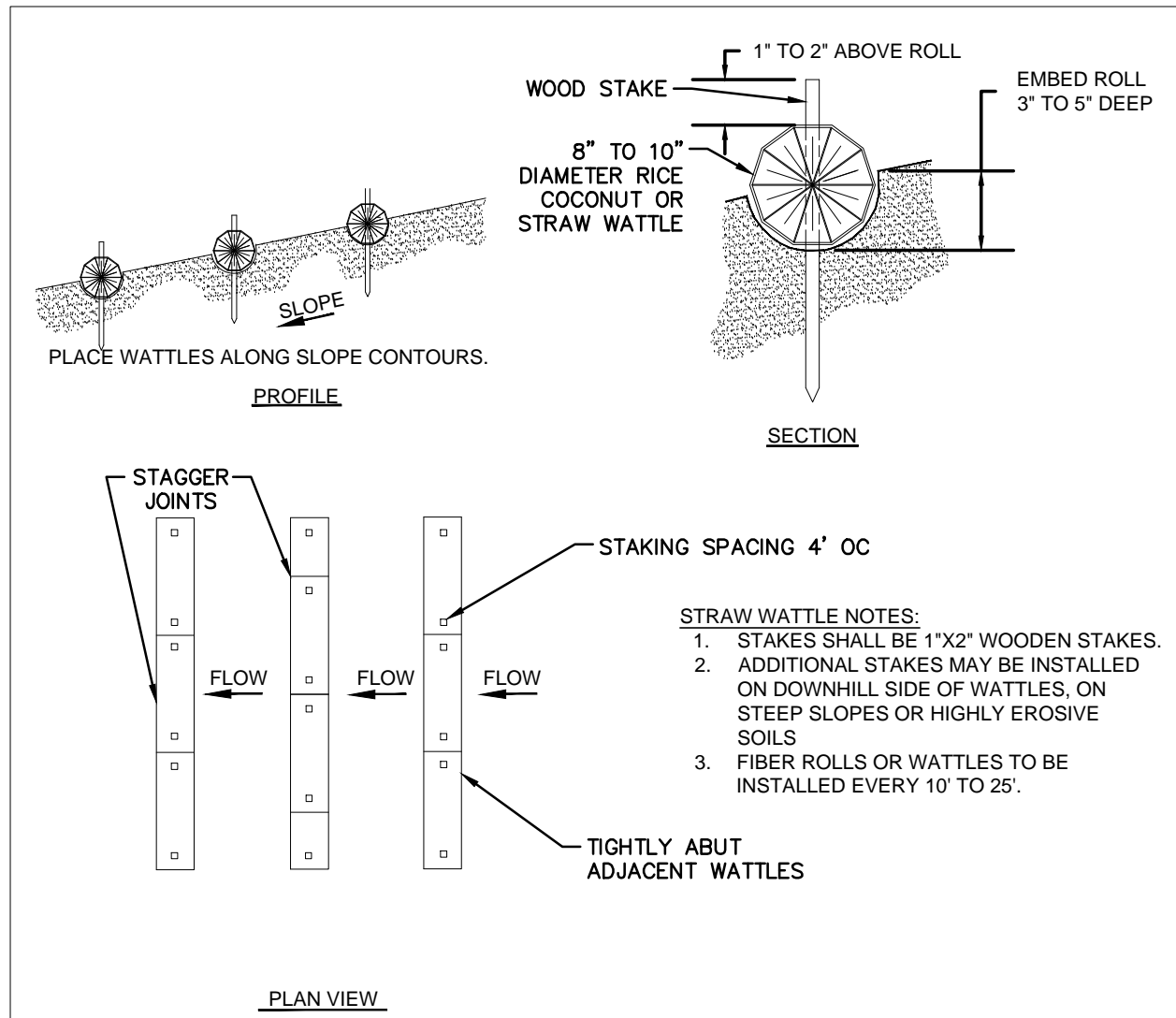
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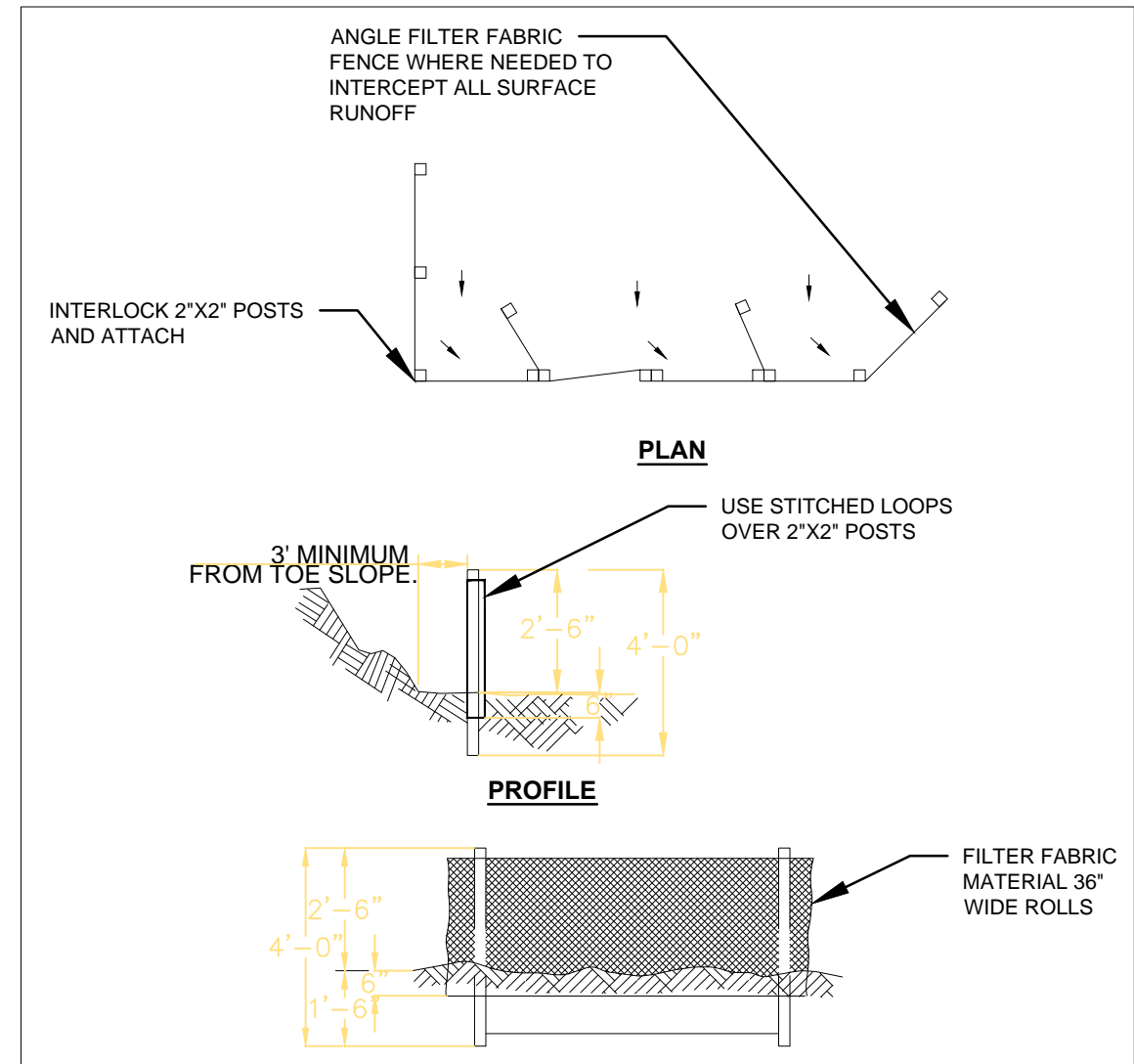
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

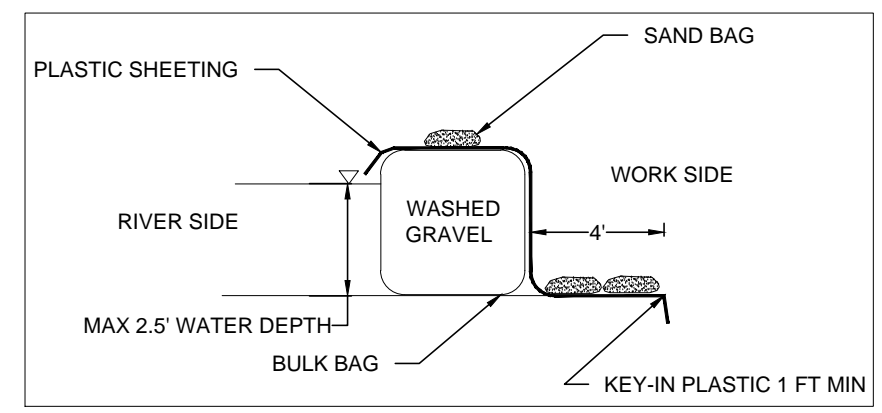
DWG. NO.: C-23	
CREATED: 08/16/2013	SHEET: 24 OF 25 SCALE: NTS



TEMPORARY STRAW WATTLES TYPICAL DETAIL



TEMPORARY SILT FENCE TYPICAL DETAIL



TEMPORARY COFFERDAM SECTION TYPICAL DETAIL

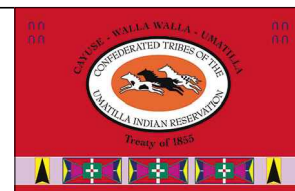
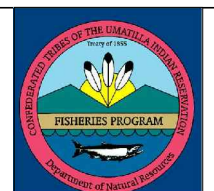
COFFERDAM NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL IN SHEET.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.
6. EXCAVATION DEPTHS RELATIVE TO BANKFULL HEIGHT.

SEDIMENT FENCE NOTES:

1. SEDIMENT FENCE SHALL BE INSTALLED ON A LINE OF EQUAL ELEVATION.
2. BOTTOM EDGE OF SEDIMENT FENCE SHALL BE BURIED MIN 6"
3. POSTS MAY BE 2"X2" FIR, PINE OR STEEL.
4. POSTS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.
5. COMPACT BOTH SIDES OF FILTER FABRIC TRENCH.
6. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATION REACHES 1/3 OF THE MEASURE HEIGHT. SEDIMENT SHALL BE DISPOSED OF TO AN AREA THAT CAN BE PERMANENTLY STABILIZED.

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\DETAILS PA1.DWG December 4, 2013 10:03 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
FLOODPLAIN RECONNECTION
PROJECT AREA 1
DETAILS

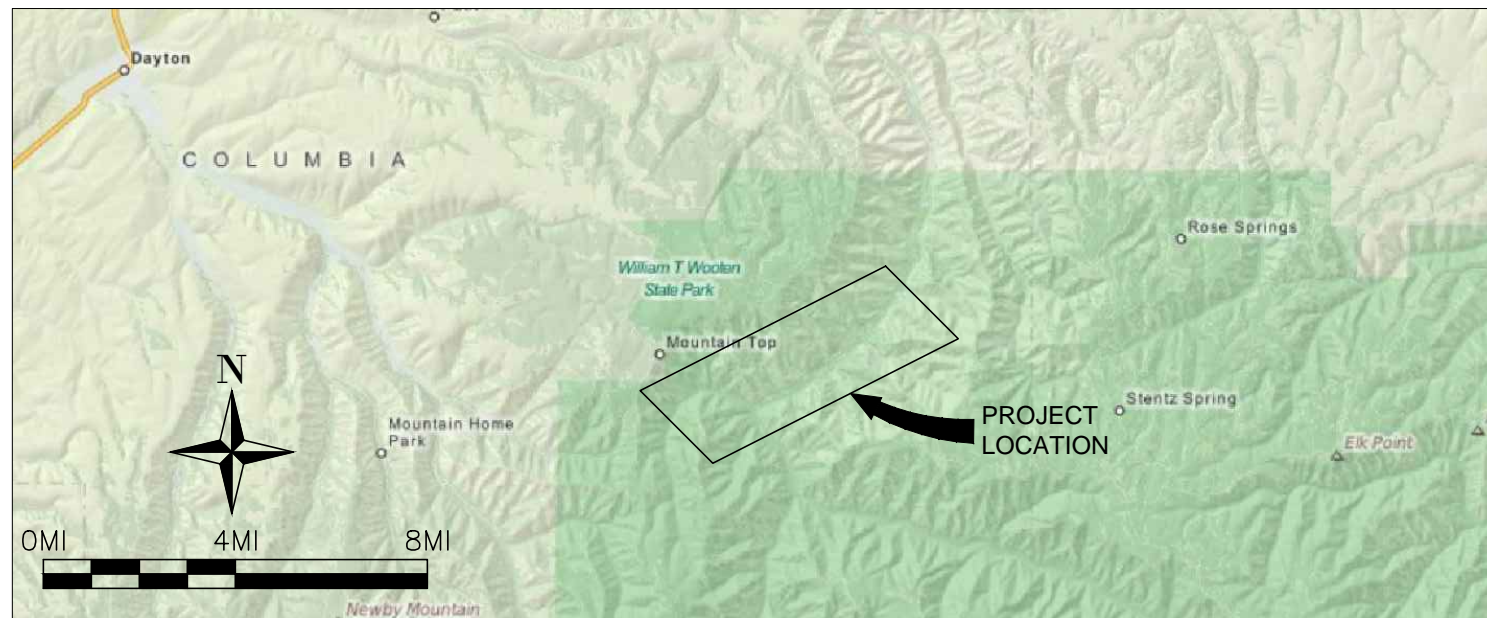
DWG. NO.:
C-24
CREATED: 08/16/2013
SHEET: 25 OF 25
SCALE: NTS

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION LARGE WOODY DEBRIS ENHANCEMENT PROJECT AREA 3 - RIVER MILE 46.75 TO 48.10



VICINITY MAP

ABBREVIATIONS			
CL	CLEARING LIMITS	RD	ROAD
CP	CONTROL POINT	RT	RIGHT
CTUIR	CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION	SPEC	SPECIFICATIONS
CONST	CONSTRUCTION	STA	STATION
D/S	DOWNSTREAM	TEMP	TEMPORARY
DIA	DIAMETER	TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
DWG	DRAWING	TYP	TYPICAL
EA	EACH	USFS	UNITED STATES FOREST SERVICE
EL	ELEVATION	USFW	UNITED STATES FISH AND WILDLIFE SERVICE
EXST	EXISTING	U/S	UPSTREAM
FG	FINISHED GRADE		
FT OR'	FOOT		
LT	LEFT		
LWD	LARGE WOODY DEBRIS		
MAX	MAXIMUM		
MIN	MINIMUM		
NO OR #	NUMBER		
NTS	NOT TO SCALE		
PL	PROPERTY LINE		
PT	POINT		



LOCATION MAP

DRAWING INDEX	
<u>GENERAL</u>	
G1	COVER SHEET
<u>CIVIL</u>	
C1 - C5	EXISTING CONDITIONS
C6	MATERIAL SITE MAP OVERVIEW
C7	TESC & ACCESS
C8	DESIGN OVERVIEW
C9 - C16	PROPOSED DESIGN
C17 - C18	DETAILS

60% DRAFT DESIGN - NOT FOR CONSTRUCTION

DATUM:
HORIZONTAL DATUM: HARN (HPGN) Washington State Planes, South Zone, US Foot
VERTICAL DATUM: North American Vertical Datum (NAVD) 88

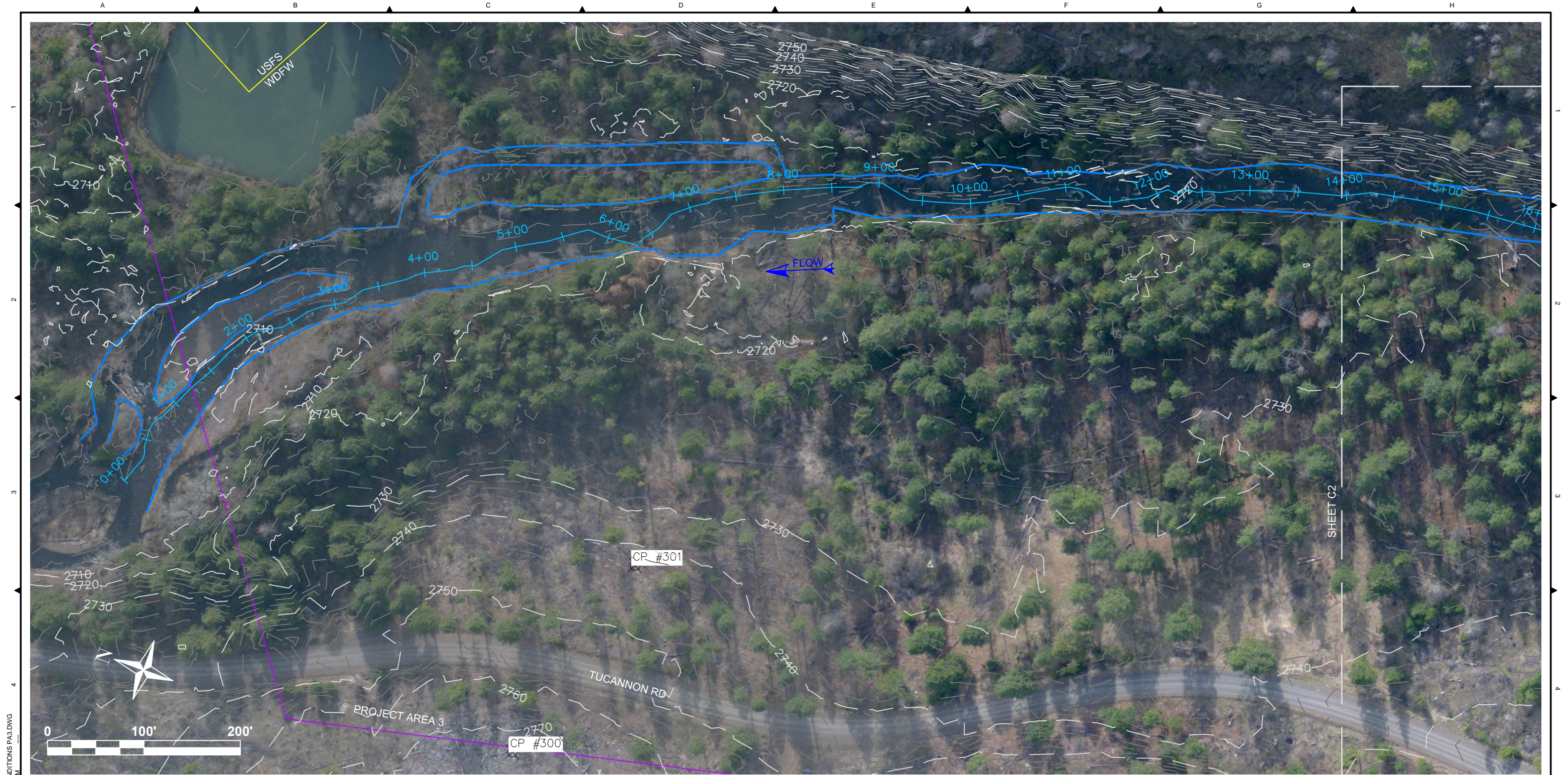
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PLOT DETAILS: JOSEPHINE, AMANDA
December 4, 2013 9:43 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
COVER SHEET

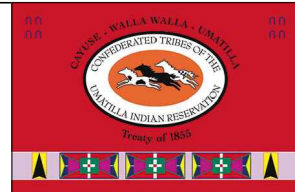
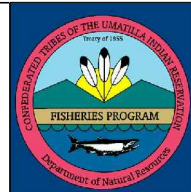
DWG. NO.: G-1	
CREATED: 08/16/2013	SHEET: 1 OF 19 SCALE: NTS



NOTES:
 1. PRESERVE ALL CONTROL POINTS TO THE EXTENT PRACTICAL.

LEGEND:
 - PROPERTY BOUNDARY
 - PROJECT AREA
 - BANKFULL CHANNEL
 ⊗ CONTROL POINTS
 - EXISTING CONTOUR MAJOR - 10FT
 - EXISTING CONTOUR MINOR - 2FT

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\PROJECT AREA 3\EXISTING CONDITIONS PA3.DWG
 PLOT DETAILS: JOSEPHINE_AWANDA
 December 4, 2013 9:44 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
 EXISTING CONDITIONS

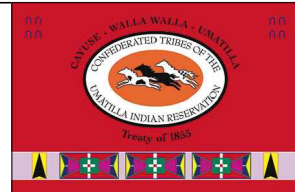
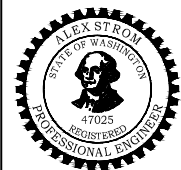
DWG. NO.:	C-1
CREATED:	08/16/2013
SHEET:	2 OF 19
SCALE:	1"=100'



NOTES:
 1. PRESERVE ALL CONTROL POINTS TO THE EXTENT PRACTICAL.

LEGEND:
 — PROPERTY BOUNDARY
 — PROJECT AREA
 — BANKFULL CHANNEL
 ⊗ CONTROL POINTS

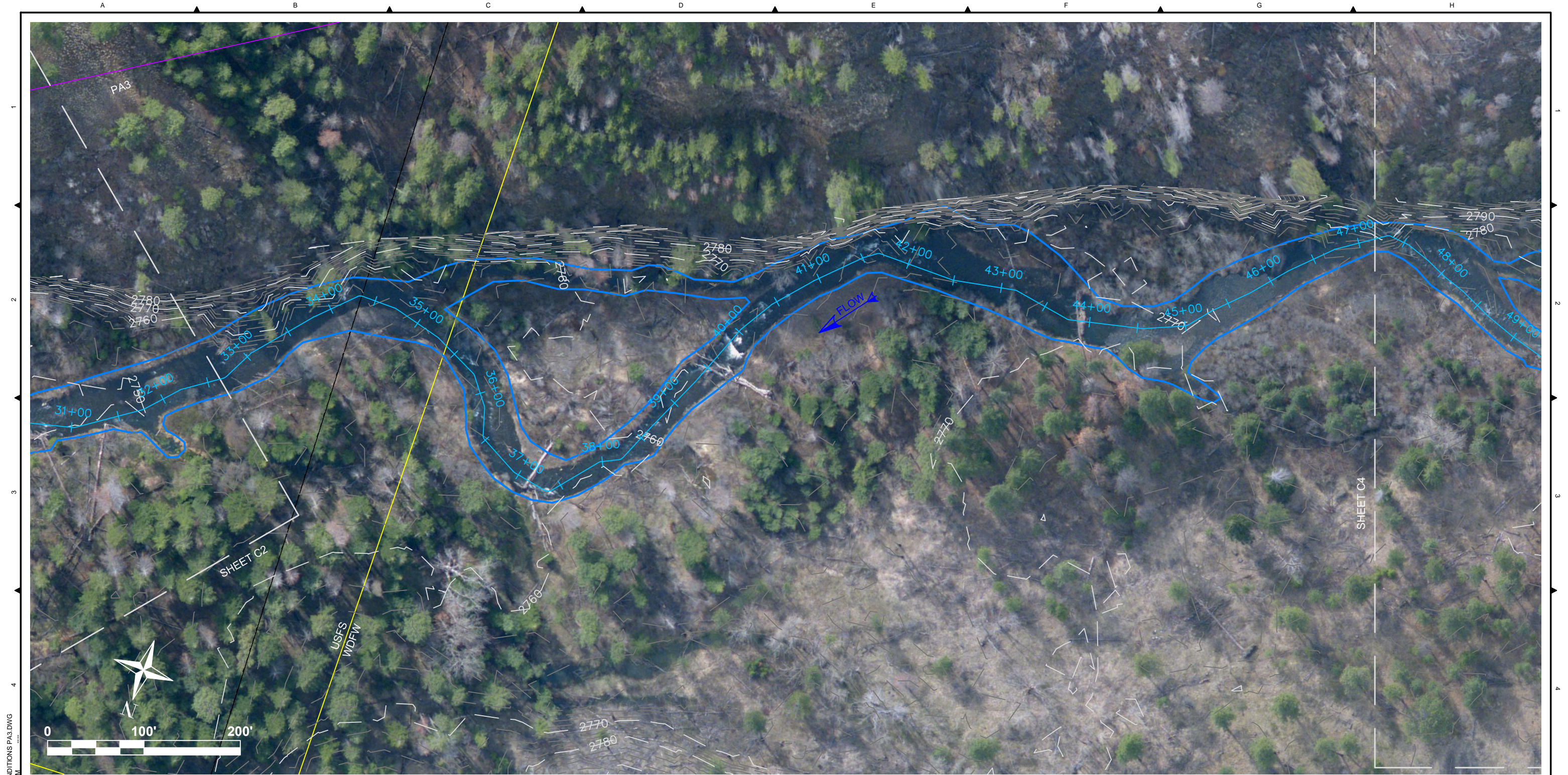
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\PROJECT SHEET FILES\EXISTING CONDITIONS PA3.DWG
 PLOT DETAILS: JOSEPH W. AMANDA
 December 3, 2013 9:44 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
 EXISTING CONDITIONS

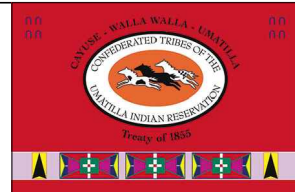
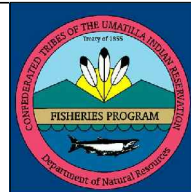
DWG. NO.:	C-2
CREATED:	08/16/2013
SHEET:	3 OF 19
SCALE:	1"=100'



NOTES:
 1. PRESERVE ALL CONTROL POINTS TO THE EXTENT PRACTICAL.

LEGEND:
 — PROPERTY BOUNDARY
 — PROJECT AREA
 — BANKFULL CHANNEL
 ⊗ CONTROL POINTS

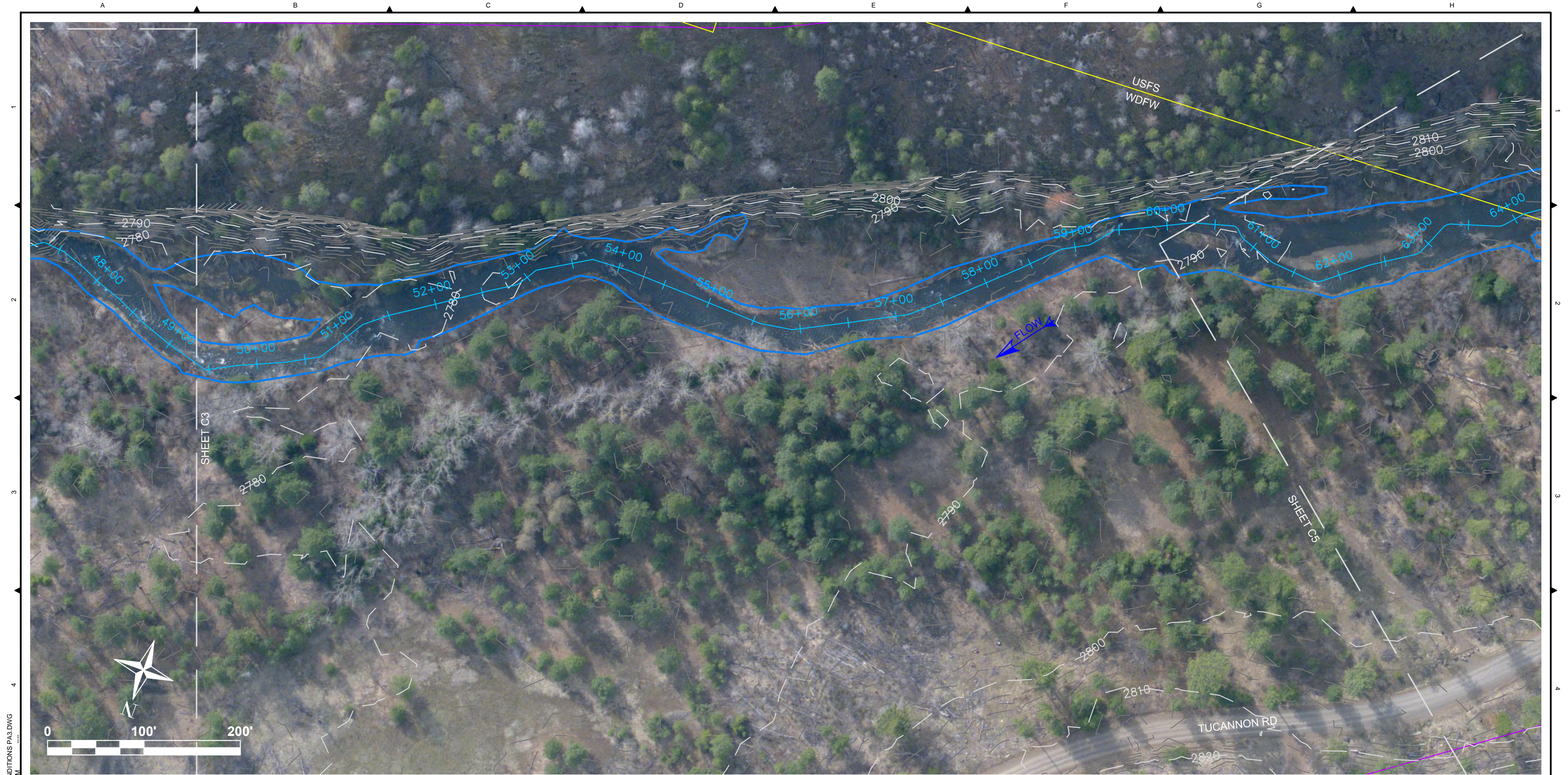
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 PLOT DETAILS: JOSEPH WANDA
 December 4, 2013 9:44 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
 PROJECT AREA 3
 EXISTING CONDITIONS

DWG. NO.:
C-3
 CREATED: 08/16/2013
 SHEET: 4 OF 19
 SCALE: 1"=100'



NOTES:
 1. PRESERVE ALL CONTROL POINTS TO THE EXTENT PRACTICAL.

LEGEND:
 — PROPERTY BOUNDARY
 — PROJECT AREA
 — BANKFULL CHANNEL
 ⊗ CONTROL POINTS

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 PLOT DETAILS: JOSEPH WANDA
 December 4, 2013 9:44 AM

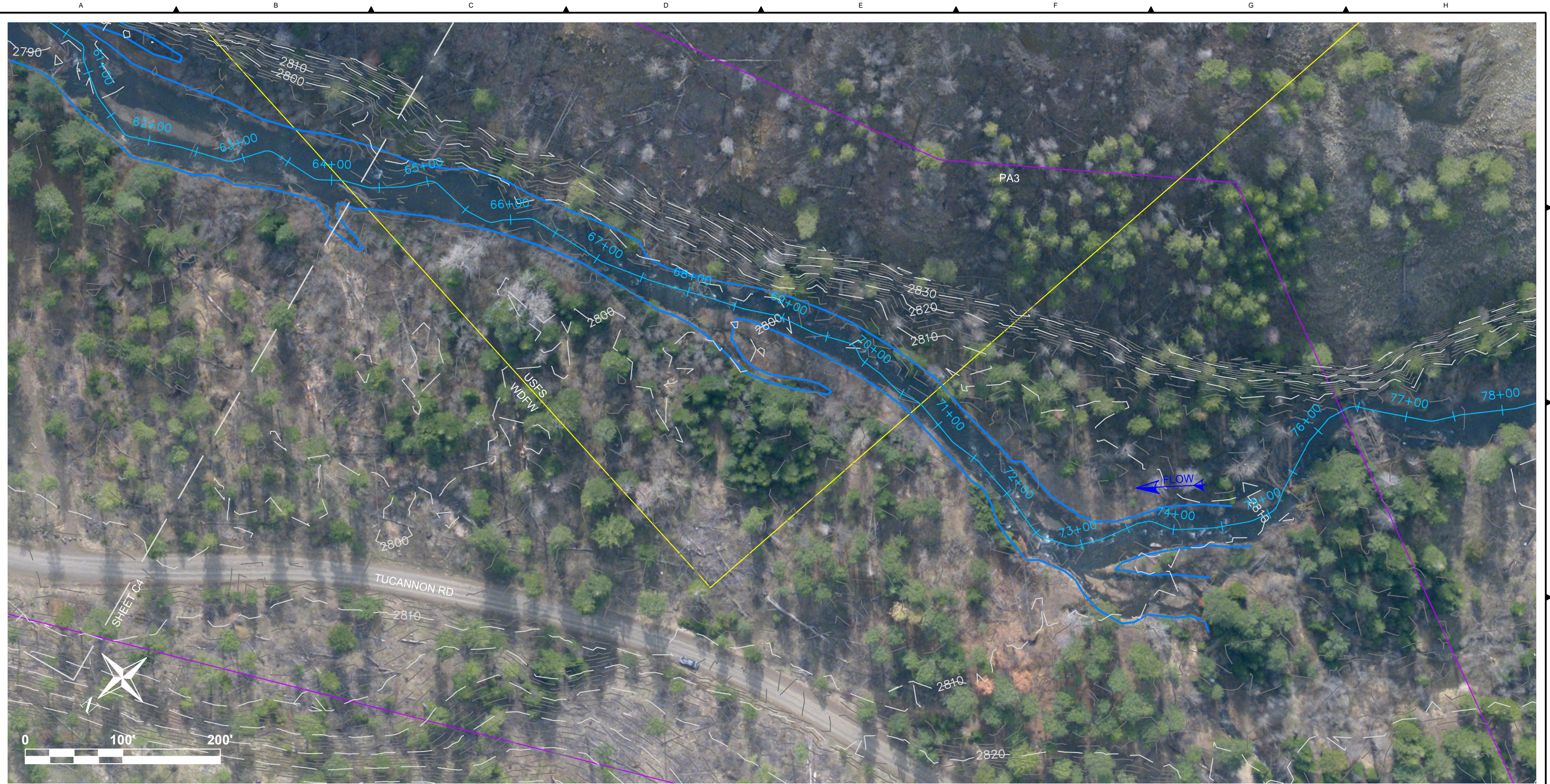
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 Bothell, Washington 98011
 Phone: 425-482-7600 Fax: 425-482-7652



PLAN SET SIZE ANSI B (11x17)							
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
EXISTING CONDITIONS

DWG. NO.: C-4	
CREATED: 08/16/2013	SHEET: 5 OF 19 SCALE: 1"=100'

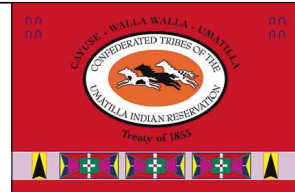


NOTES:
 1. PRESERVE ALL CONTROL POINTS TO THE EXTENT PRACTICAL.

LEGEND:
 — PROPERTY BOUNDARY
 — PROJECT AREA
 — BANKFULL CHANNEL
 ⊗ CONTROL POINTS

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\PROJECT SHEET FILES\EXISTING CONDITIONS PA3.DWG
 PLOT DETAILS: JOSEPH W. AMANDA
 December 3, 2013 9:44 AM

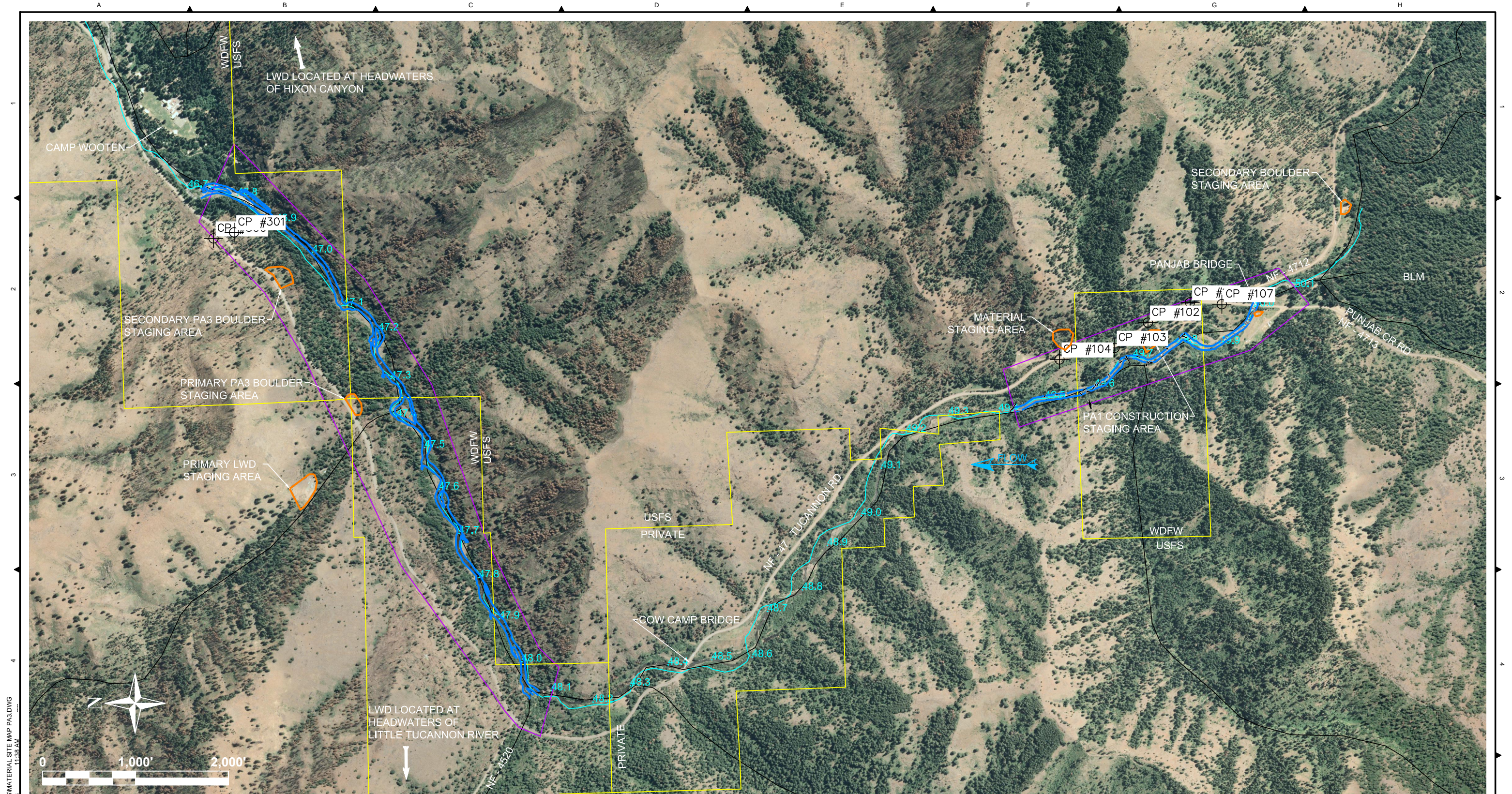
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REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

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 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
EXISTING CONDITIONS

DWG. NO.:	C-5
CREATED:	08/16/2013
SHEET:	6 OF 19
SCALE:	1"=100'



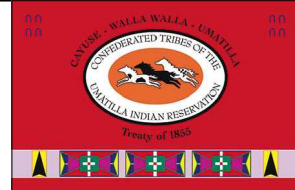
NOTES:

1. LWD TO BE FLOWN OR TRANSPORTED BY HAUL TRUCK FROM THE HEADWATERS OF HIXON CANYON AND OF THE LITTLE TUCANNON RIVER, OR THE PRIMARY LWD STAGING AREA.

LEGEND:

- PROPERTY BOUNDARY
- STAGING AREA
- ⊗ 49.4 RIVER MILE
- PROJECT AREA

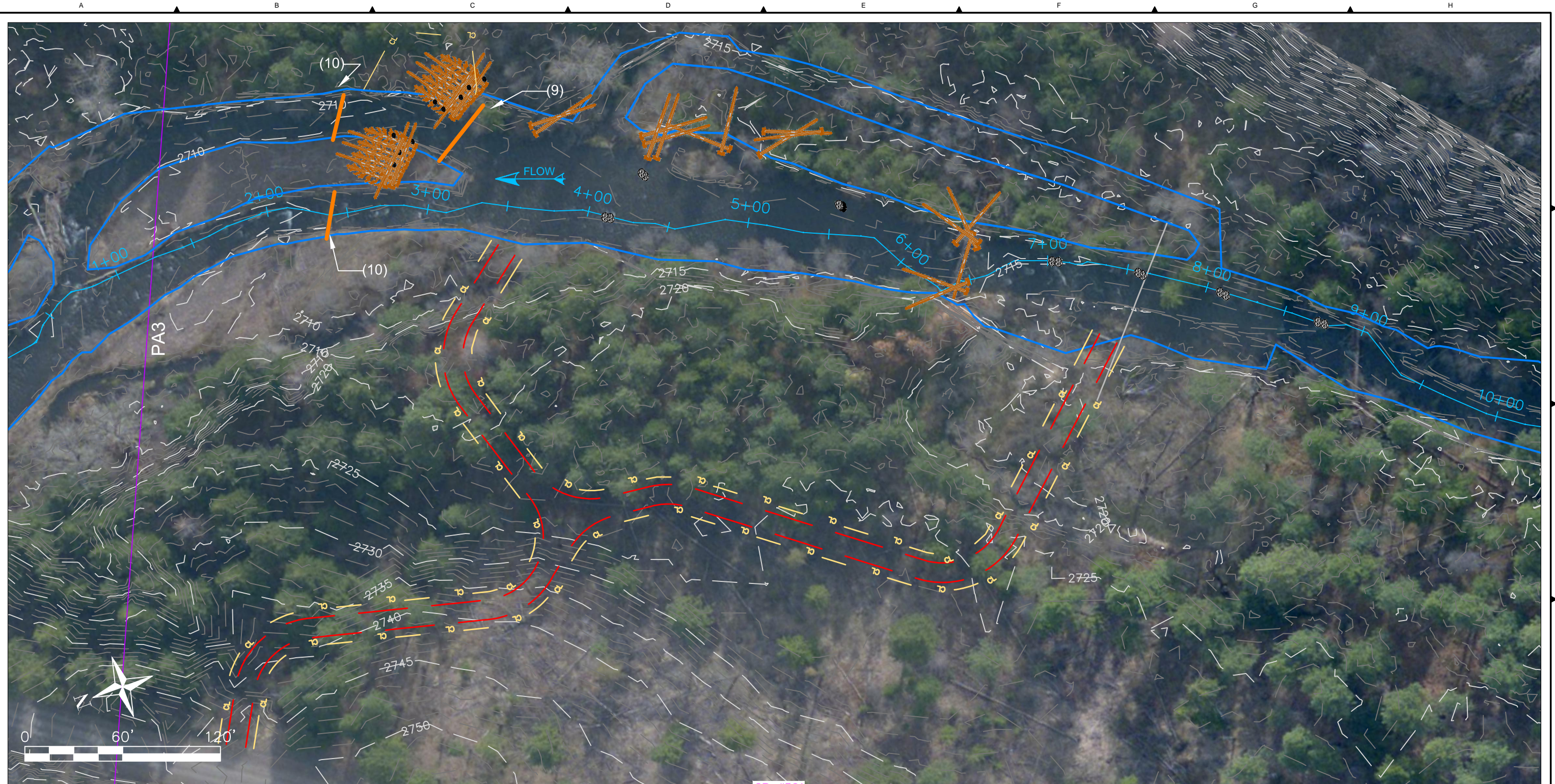
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\MATERIAL SITE MAP PA3.DWG
December 4, 2013 11:38 AM



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

**CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
MATERIAL SITE MAP
OVERVIEW**

DWG. NO.:	C-6
CREATED:	SHEET: 7 OF 19
08/16/2013	SCALE: 1" = 1,000'



NOTES:

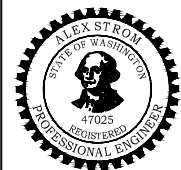
1. ALL IN-WATER WORK SHALL ONLY OCCUR BETWEEN JULY 16 AND AUGUST 15.
2. ALL IN-WATER WORK SHALL INSTALL A COFFERDAM TO ISOLATE WORK AREA.
3. ISOLATED WORK AREAS REQUIRE FISH SALVAGE PRIOR TO INITIATION OF CONSTRUCTION.
4. FISH SALVAGE OPERATIONS TO BE CONDUCTED BY QUALIFIED FISH BIOLOGIST.
5. ALL ACCESS ROADS SHALL BE SUBSOILED/SCARIFIED DURING CLOSEOUT.
6. ALL AREAS WITHIN THE CLEARING LIMITS AND STAGING AREAS SHALL BE SCARIFIED AND HYDRO-SEEDED UPON COMPLETION OF ALL WORK ACTIVITIES.
7. FOR DETAILS OF COFFER DAMS SEE SHEET C17.
8. ALL STRUCTURES AND ROCKS TO BE PLACED BY HELICOPTER UPSTREAM OF THE ACCESS ROADS ON THIS SHEET.

9. PLACE COFFERDAM DURING CONSTRUCTION. SEE SHEET 18.
10. PLACE FIBER ROLL, SILT FENCE OR EQUIV. DURING CONSTRUCTION. SEE SHEET 18.

LEGEND:

- PROPERTY BOUNDARY
- SHEET BOUNDARY
- BANKFULL CHANNEL
- TEMPORARY EROSION CONTROL
- CONSTRUCTION ACCESS ROAD EDGE
- CLEARING LIMITS
- PROPOSED LWD
- PROPOSED FISH ROCK

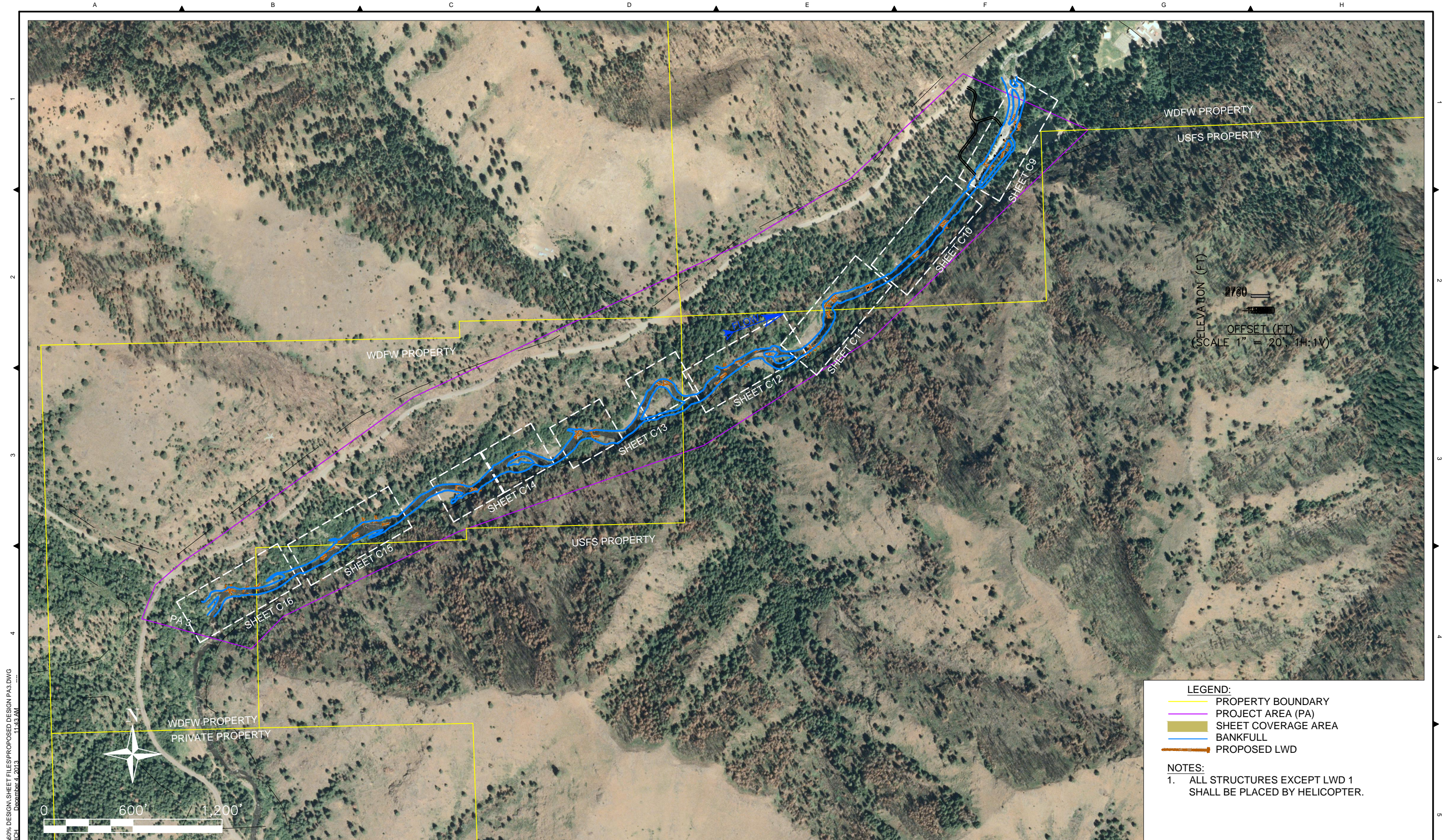
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\TESC PA3.DWG 9:46 AM December 4, 2013



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
TESC & ACCESS

DWG. NO.:	C-7
CREATED:	SHEET: 7 OF 19
08/16/2013	SCALE: 1" = 60'



ELEVATION (FT)
 2700
 2650
 OFFSET (FT)
 (SCALE 1" = 20', 1H:1V)

LEGEND:
 - PROPERTY BOUNDARY
 - PROJECT AREA (PA)
 - SHEET COVERAGE AREA
 - BANKFULL
 - PROPOSED LWD

NOTES:
 1. ALL STRUCTURES EXCEPT LWD 1 SHALL BE PLACED BY HELICOPTER.

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN SHEET FILES\PROPOSED DESIGN PA3.DWG
 PLOT DETAILS: VANBUCKLEN, INCH
 December 4, 2013 11:43 AM

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ALEX STROM
 STATE OF WASHINGTON
 47025
 REGISTERED
 PROFESSIONAL ENGINEER

CONSERVED TRIBES OF THE UMATILLA INDIAN RESERVATION
 FISHERIES PROGRAM
 Department of Natural Resources

CAWEE - WAJIA WAJIA - UMATILLA
 CONFEDERATED TRIBES OF THE
 UMATILLA INDIAN RESERVATION
 Treaty of 1855

REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

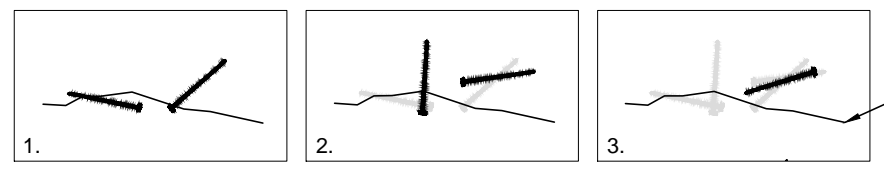
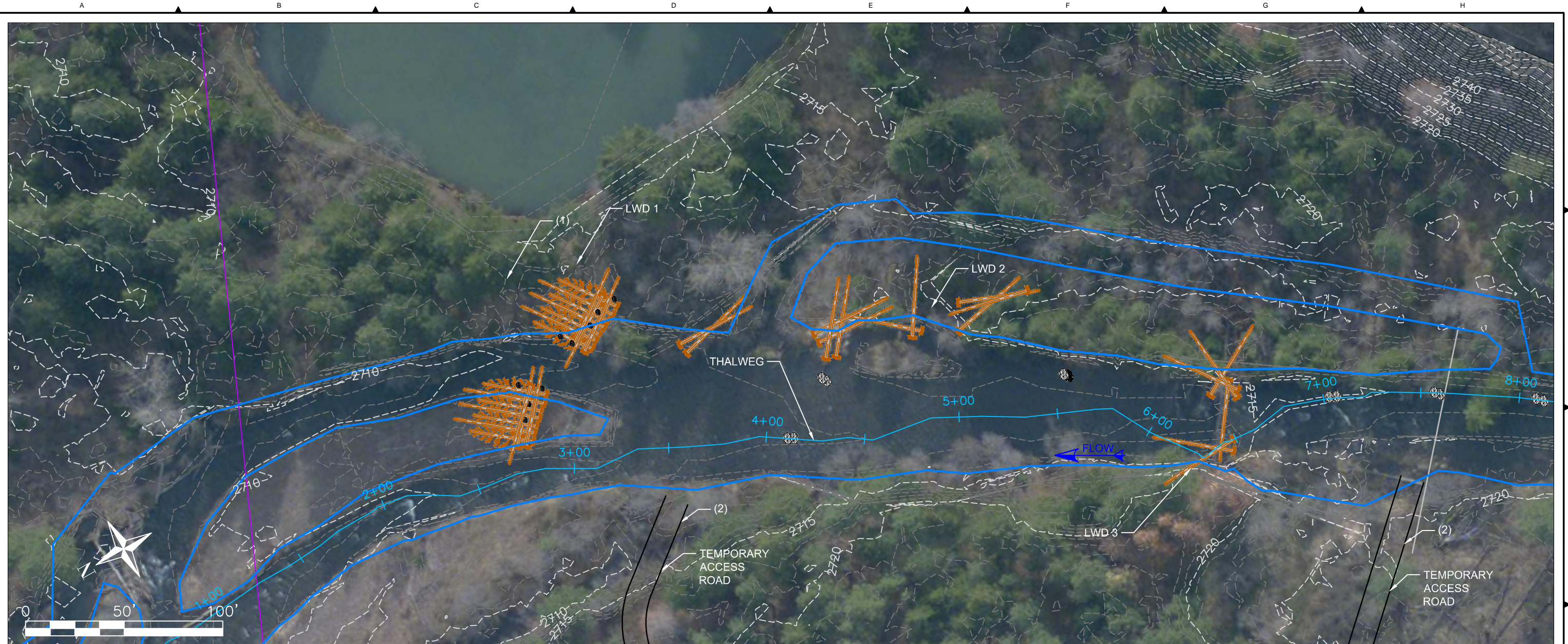
PLAN SET SIZE ANSI B (11x17)

REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

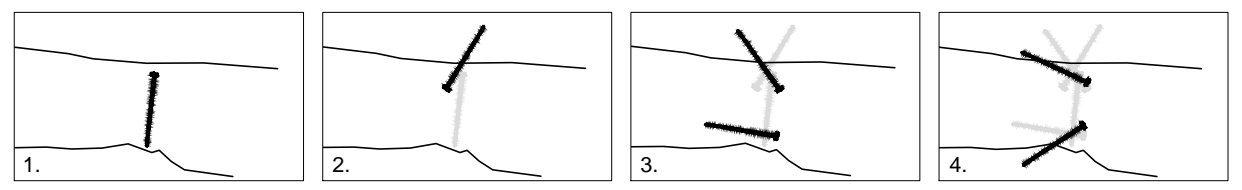
CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
 DESIGN OVERVIEW

DWG. NO.:
C-8

CREATED: 08/16/2013
 SHEET: 9 OF 19
 SCALE: 1" = 600'



LWD 2 - LOG PLACEMENT SEQUENCING



LWD 3 - LOG PLACEMENT SEQUENCING

NOTES:
 1. FOR LWD 1 DETAILS AND LOG PLACEMENT SEQUENCING SEE SHEET C-17.
 2. FOR TEMPORARY ACCESS ROAD PLAN, SEE SHEET C-6.

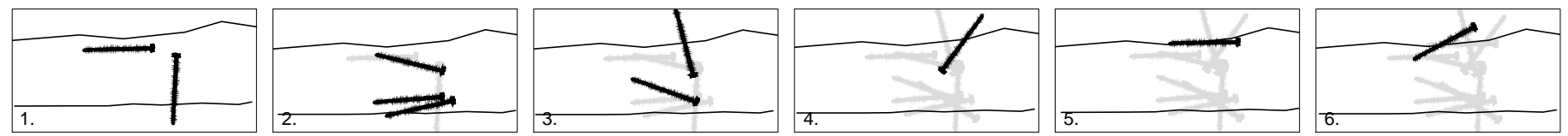
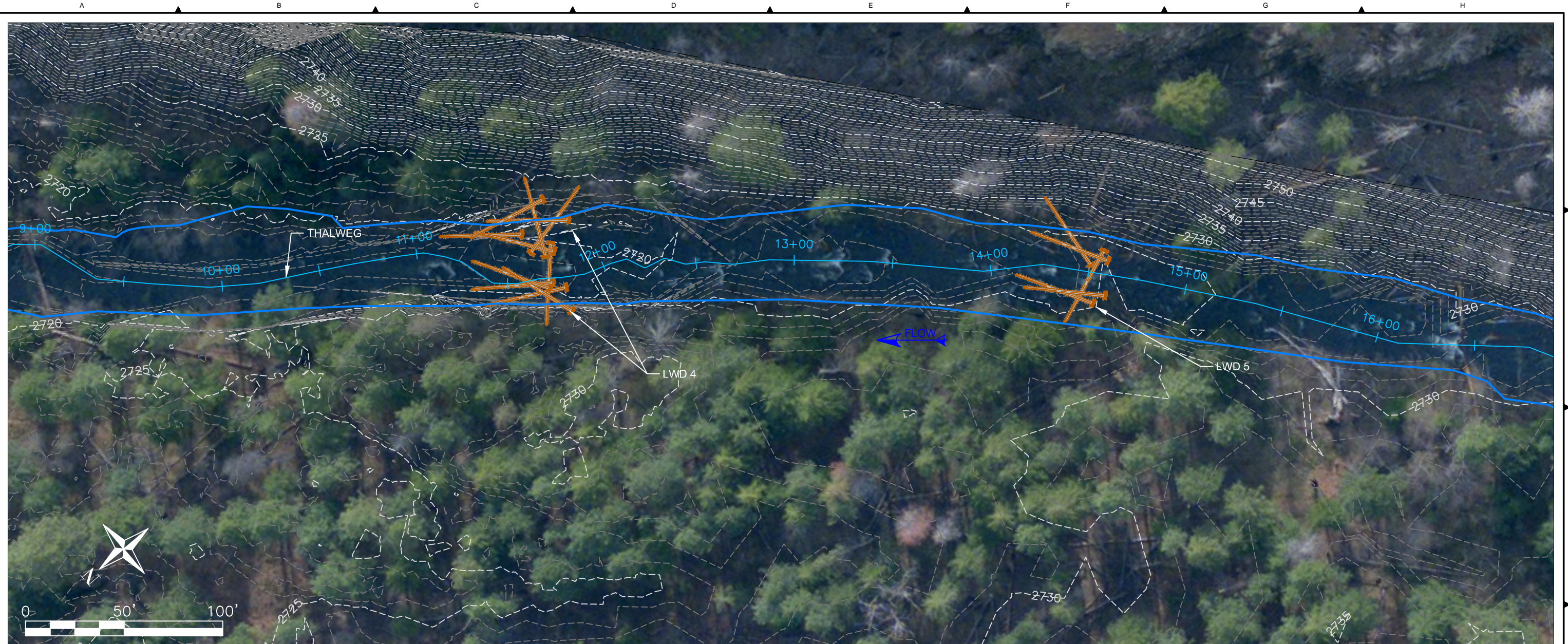
LEGEND:
 - PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\DESIGN SHEET FILES\PROPOSED DESIGN\PA3.DWG December 3, 2013 9:49 AM

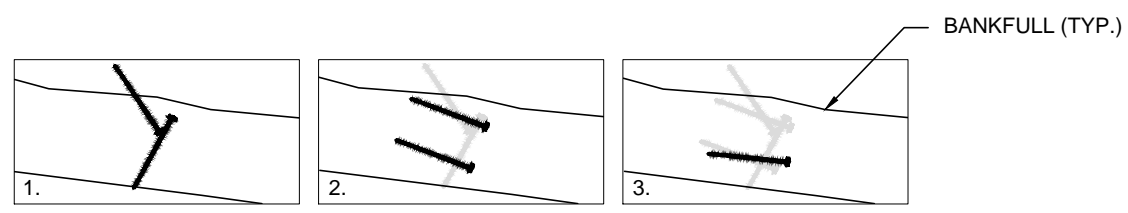
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
 TUCANNON RIVER
 LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

DWG. NO.:	C-9
CREATED:	08/16/2013
SHEET:	10 OF 19
SCALE:	1" = 50'



LWD 4 - LOG PLACEMENT SEQUENCING



LWD 5 - LOG PLACEMENT SEQUENCING

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

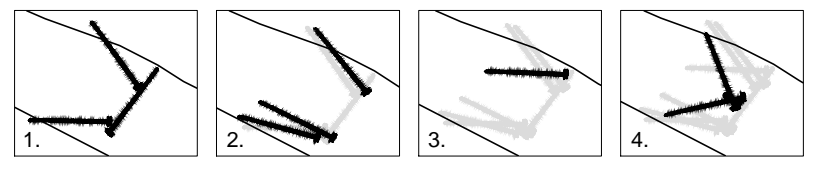
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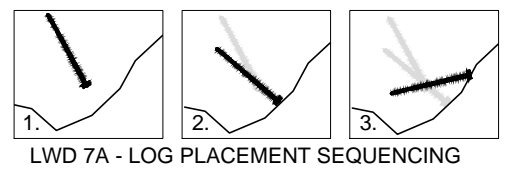
REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

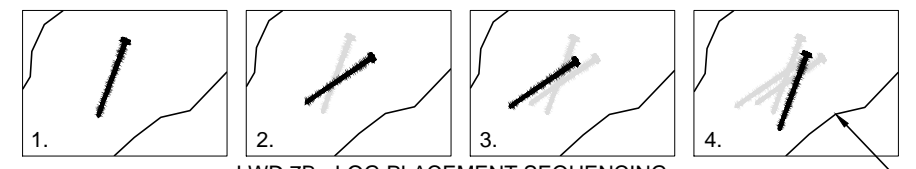
DWG. NO.: C-10	
CREATED: 08/16/2013	SHEET: 11 OF 19 SCALE: 1" = 50'



LWD 6 - LOG PLACEMENT SEQUENCING

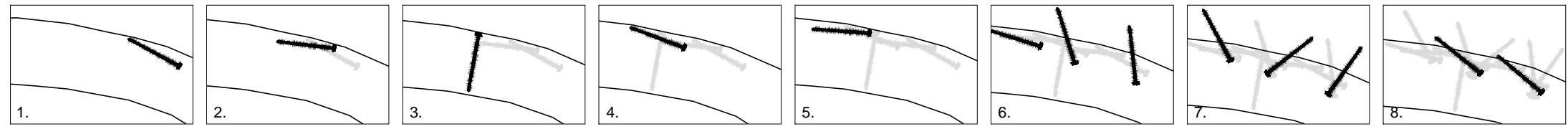


LWD 7A - LOG PLACEMENT SEQUENCING



LWD 7B - LOG PLACEMENT SEQUENCING

BANKFULL (TYP.)



LWD 8 - LOG PLACEMENT SEQUENCING

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFUL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

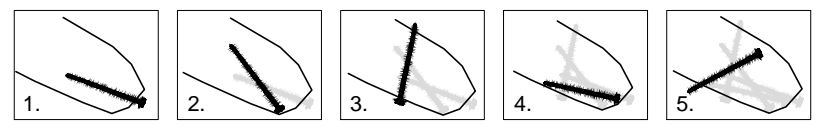
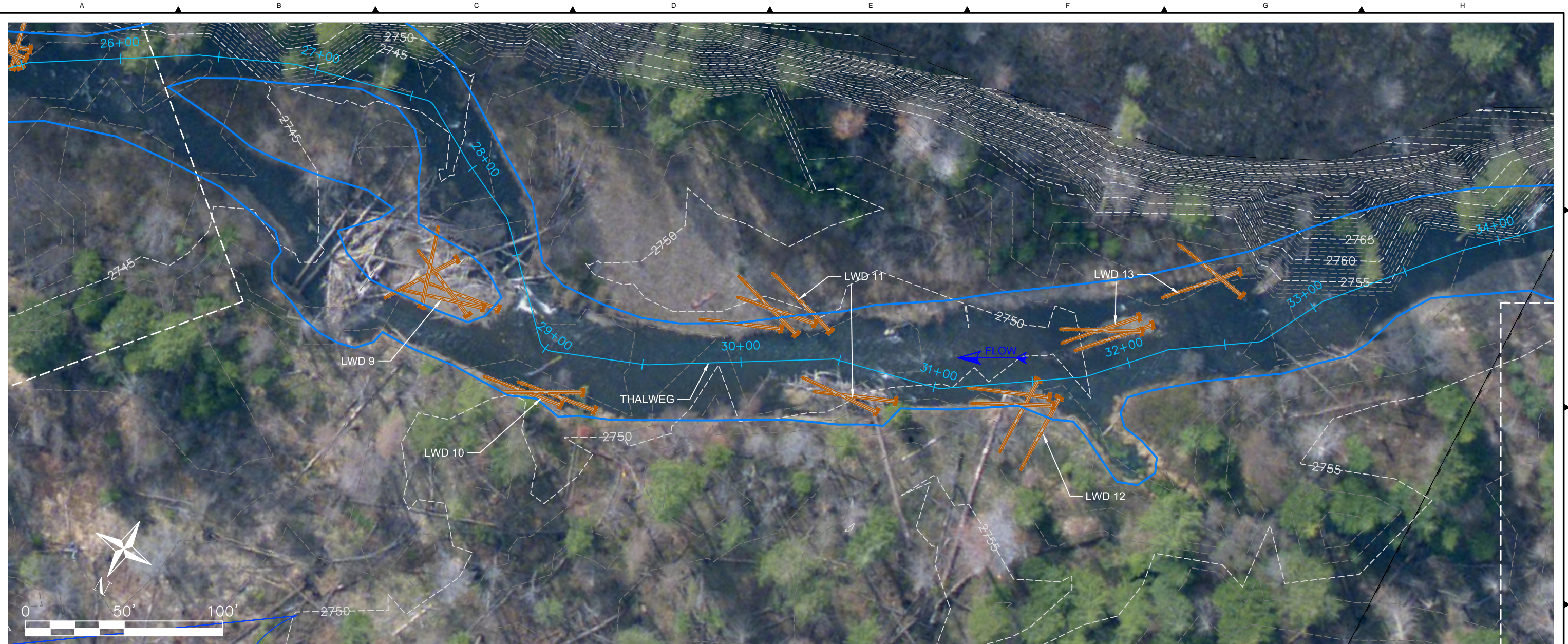
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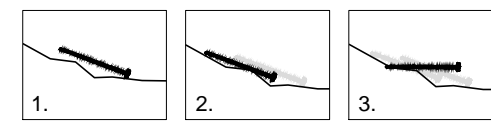
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

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TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

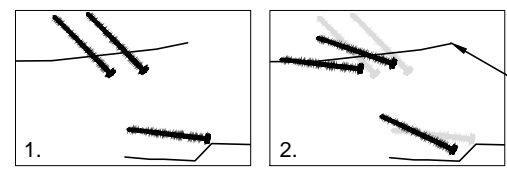
DWG. NO.: C-11	
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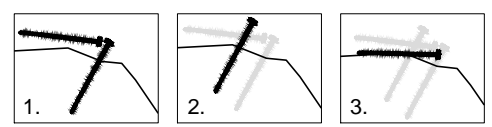
LWD 9 - LOG PLACEMENT SEQUENCING



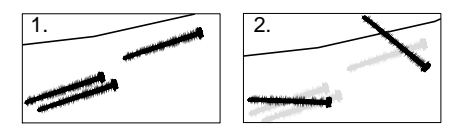
LWD 10 - LOG PLACEMENT SEQUENCING



LWD 11 - LOG PLACEMENT SEQUENCING



LWD 12 - LOG PLACEMENT SEQUENCING



LWD 13 - LOG PLACEMENT SEQUENCING

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFUL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

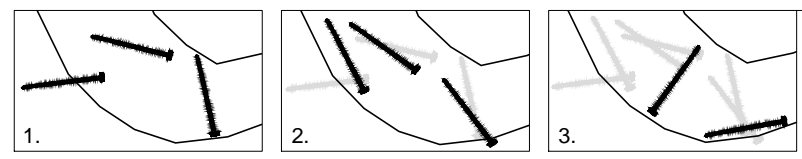
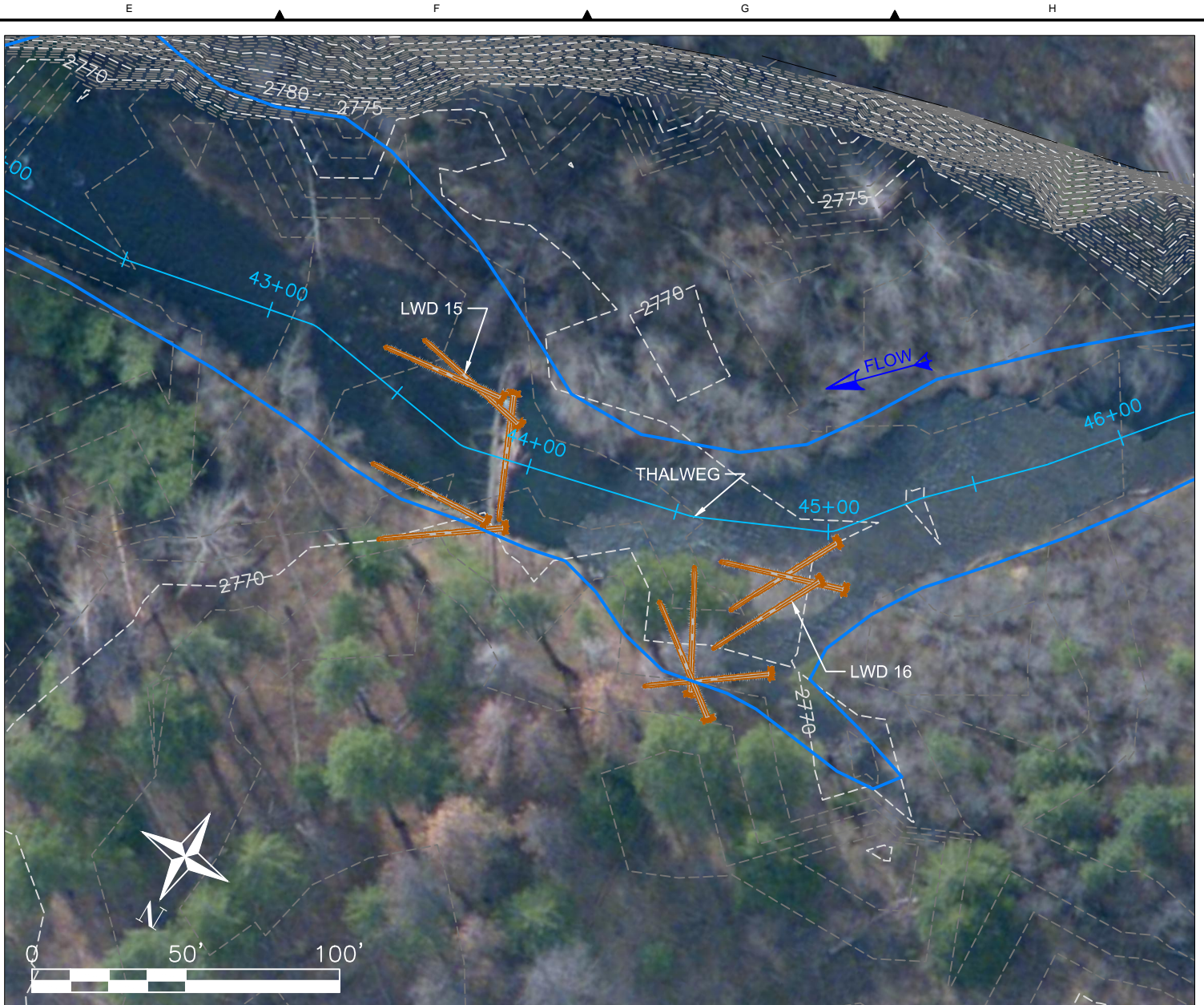
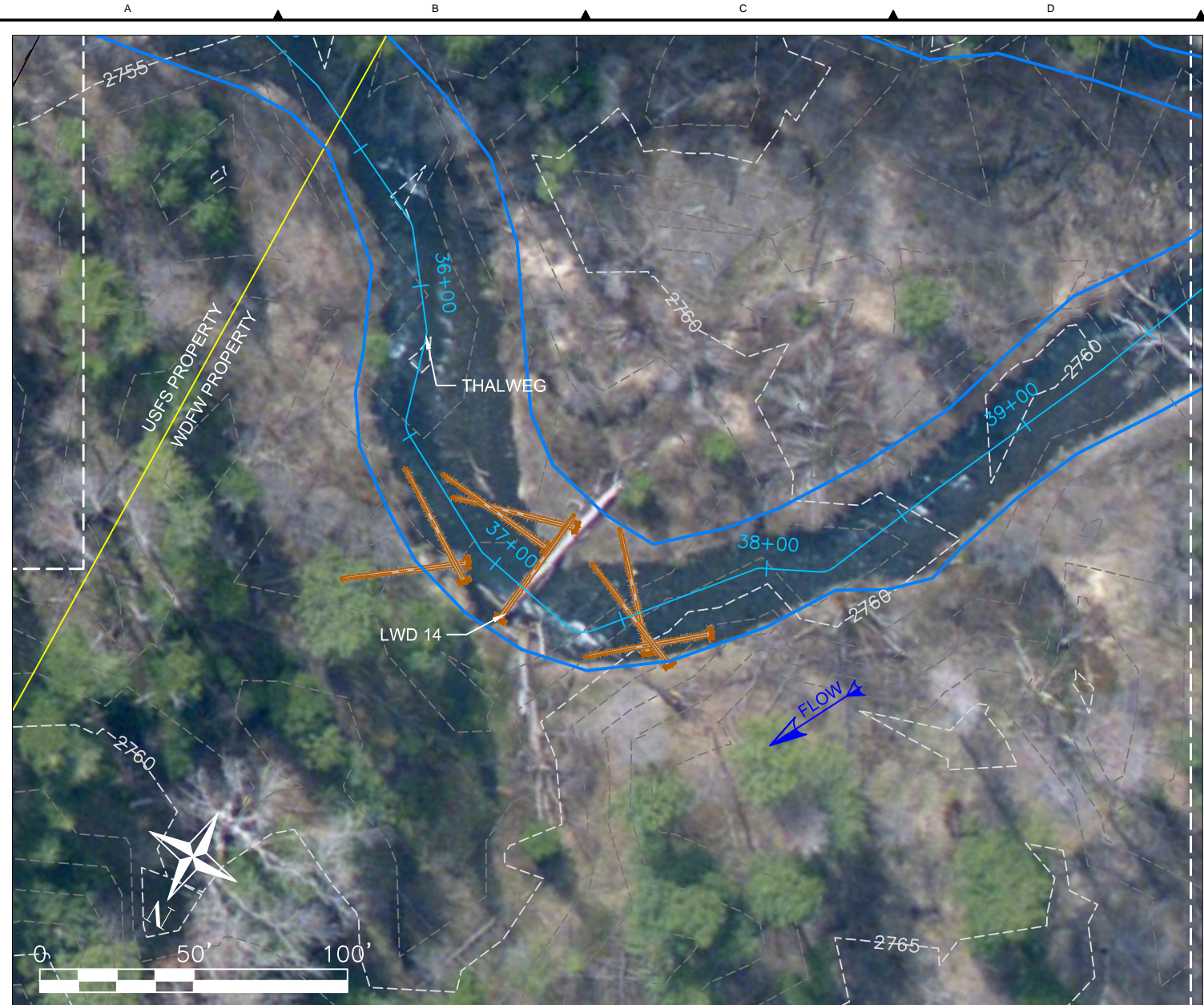
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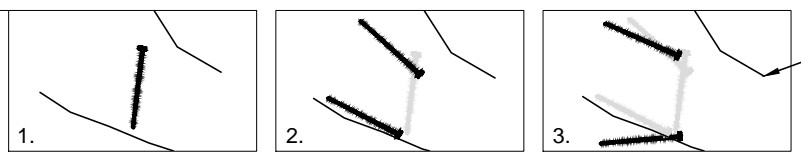
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

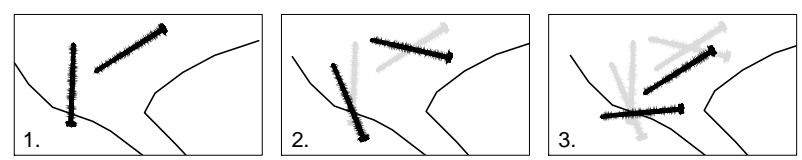
DWG. NO.: C-12	
CREATED: 08/16/2013	SHEET: 13 OF 19 SCALE: 1" = 50'



LWD 14 - LOG PLACEMENT SEQUENCING



LWD 15 - LOG PLACEMENT SEQUENCING



LWD 16 - LOG PLACEMENT SEQUENCING

BANKFULL (TYP.)

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

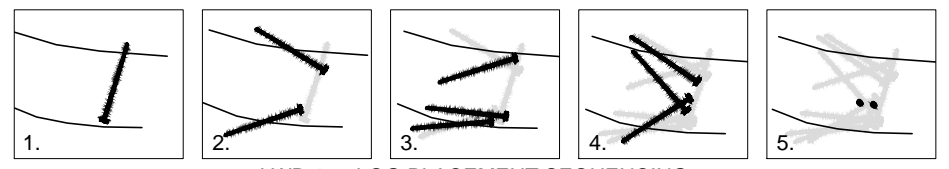
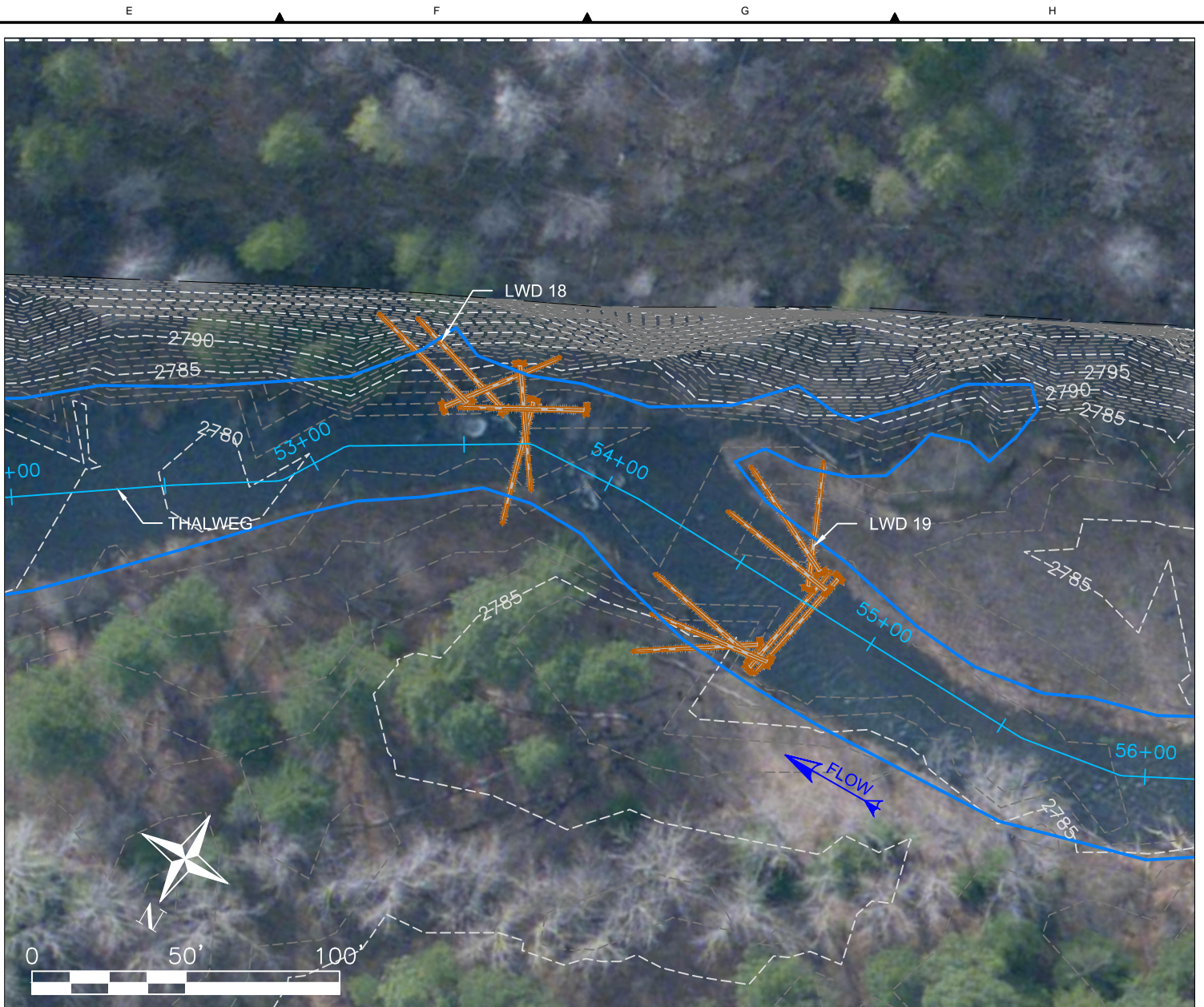
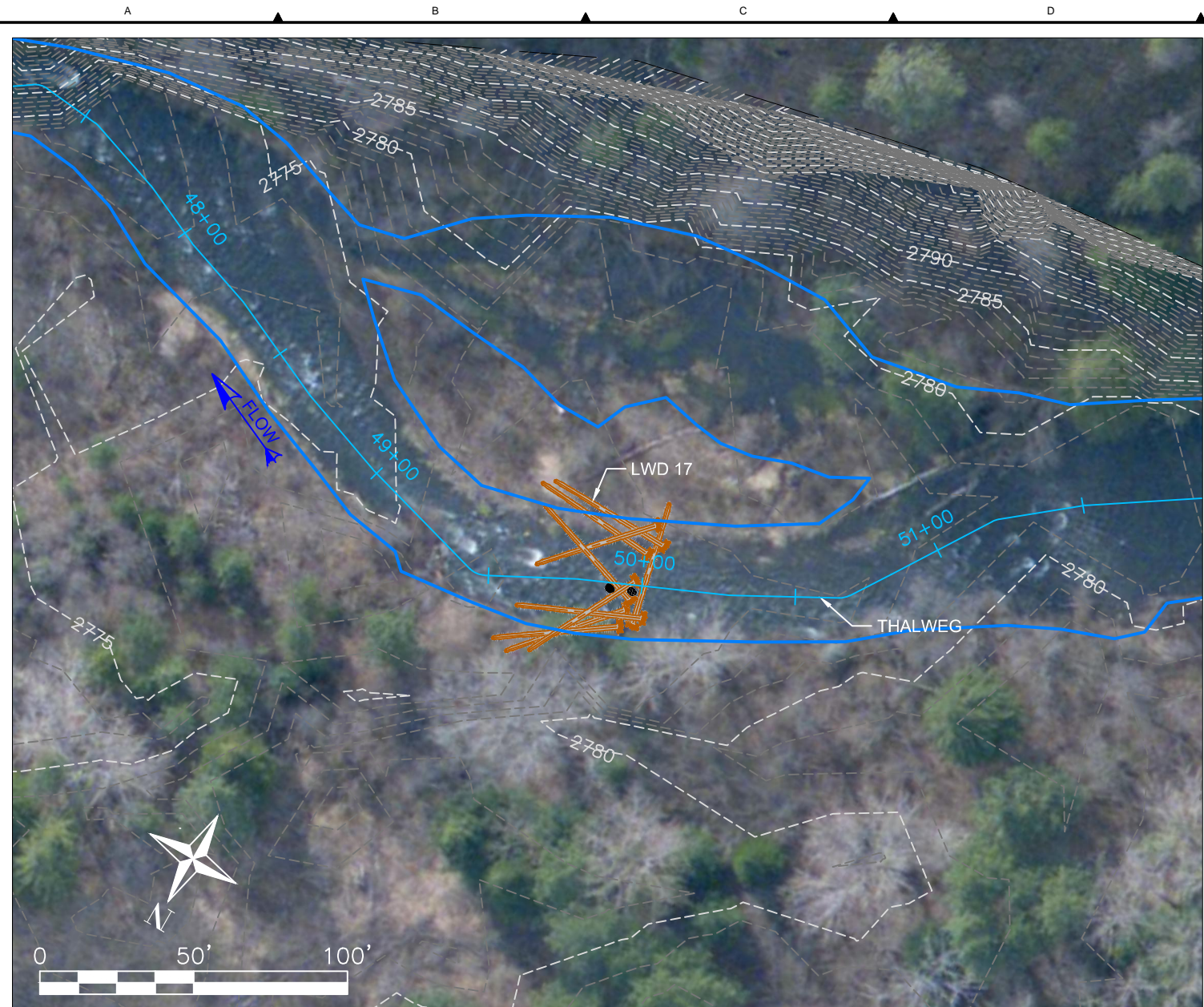
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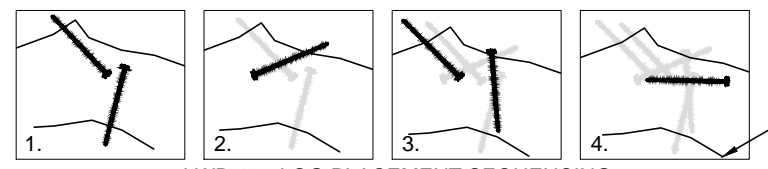
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-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

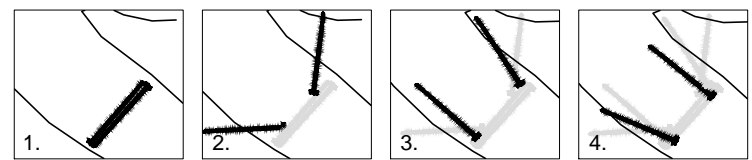
DWG. NO.: C-13	
CREATED: 08/16/2013	SHEET: 14 OF 19 SCALE: 1" = 50'



LWD 17 - LOG PLACEMENT SEQUENCING



LWD 18 - LOG PLACEMENT SEQUENCING



LWD 19 - LOG PLACEMENT SEQUENCING

BANKFULL (TYP.)

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFUL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

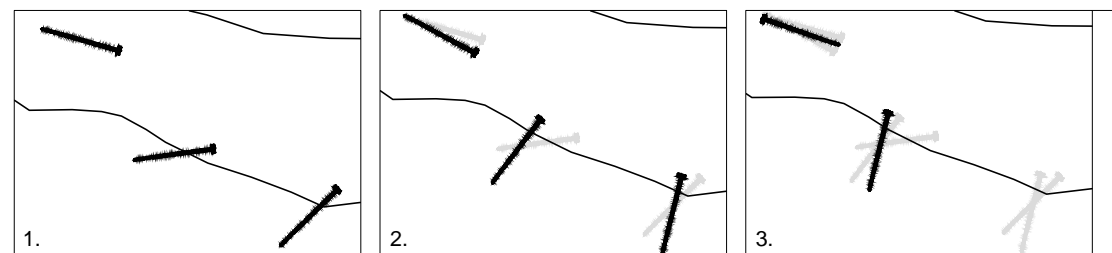
Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\SHEET FILES\PROPOSED DESIGN PA3.DWG December 3, 2013 9:55 AM

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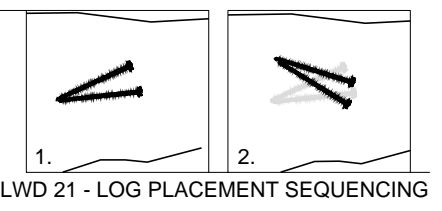
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-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

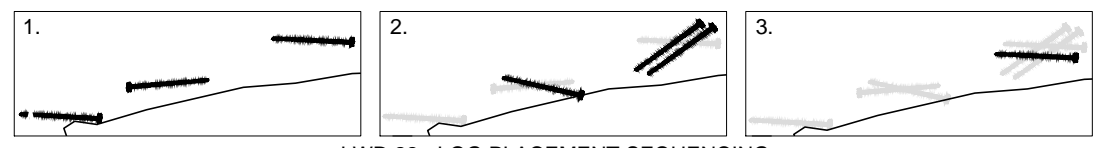
DWG. NO.: C-14	
CREATED: 08/16/2013	SHEET: 15 OF 19 SCALE: 1" = 50'



LWD 20 - LOG PLACEMENT SEQUENCING



LWD 21 - LOG PLACEMENT SEQUENCING



LWD 22 - LOG PLACEMENT SEQUENCING

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

Z:\PROJECTS\TUCANNON RIVER\60% DESIGN\DESIGN SHEET FILES\PROPOSED DESIGN P3.DWG December 4, 2013 9:55 AM

TETRA TECH
www.tetrattech.com
19803 North Creek Parkway
Bothell, Washington 98011
Phone: 425-482-7600 Fax: 425-482-7652

ALEX STROM
STATE OF WASHINGTON
47025
REGISTERED PROFESSIONAL ENGINEER

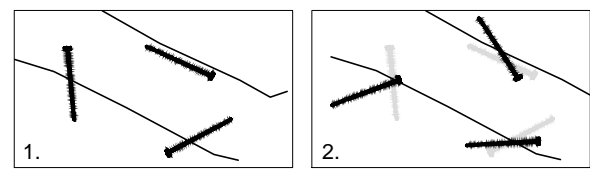
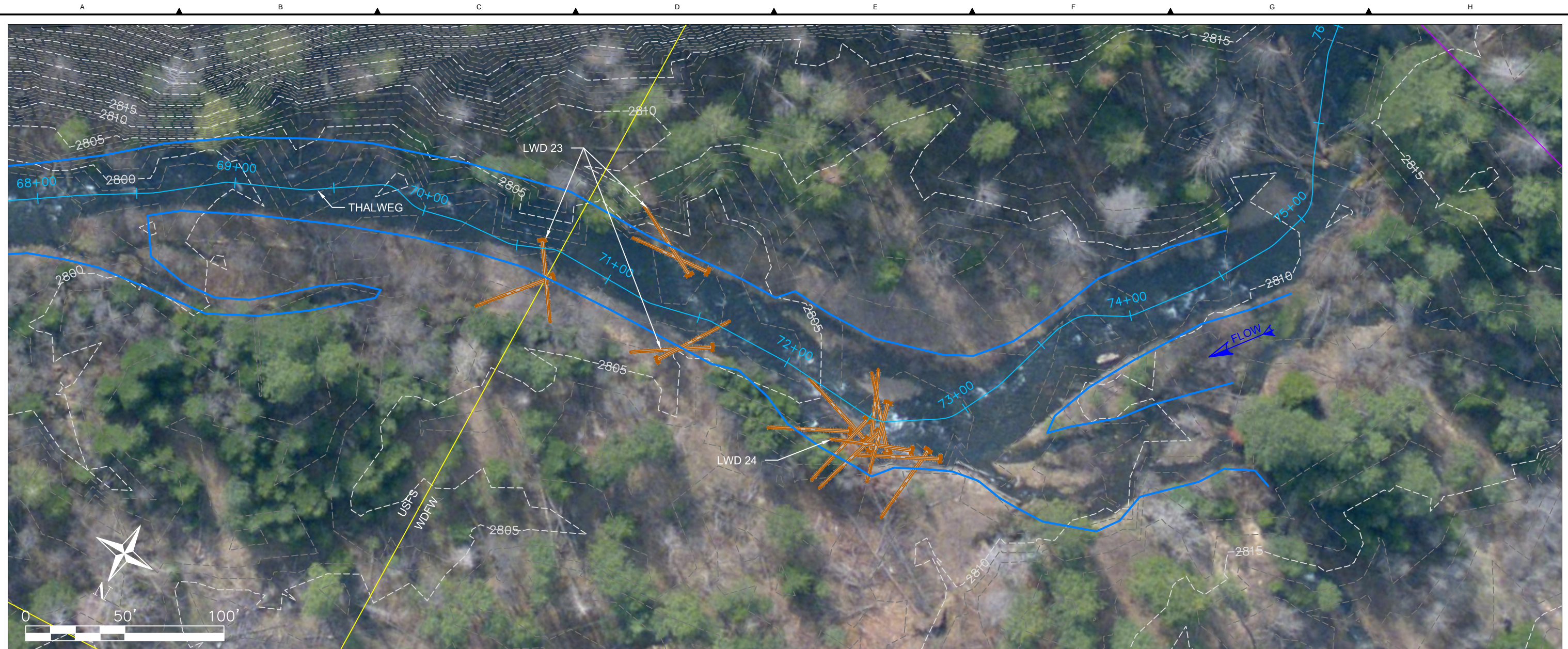
FISHERIES PROGRAM
Department of Natural Resources

UMATILLA INDIAN RESERVATION
Treaty of 1855

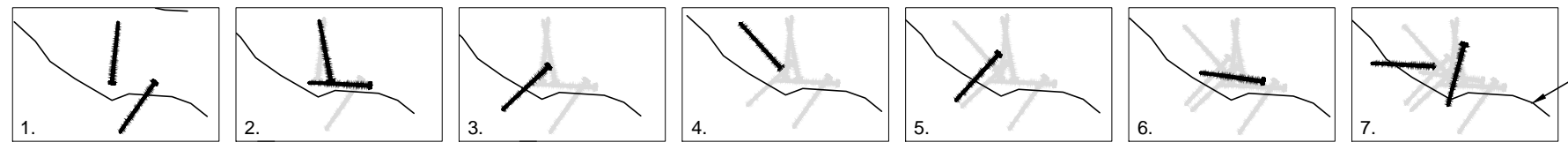
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

DWG. NO.: C-15	
CREATED: 08/16/2013	SHEET: 16 OF 19 SCALE: 1" = 50'



LWD 23 - LOG PLACEMENT SEQUENCING



LWD 24 - LOG PLACEMENT SEQUENCING

- LEGEND:**
- PROPERTY BOUNDARY
 - SHEET BOUNDARY
 - BANKFULL
 - PROPOSED WOOD
 - PROPOSED FISH ROCK

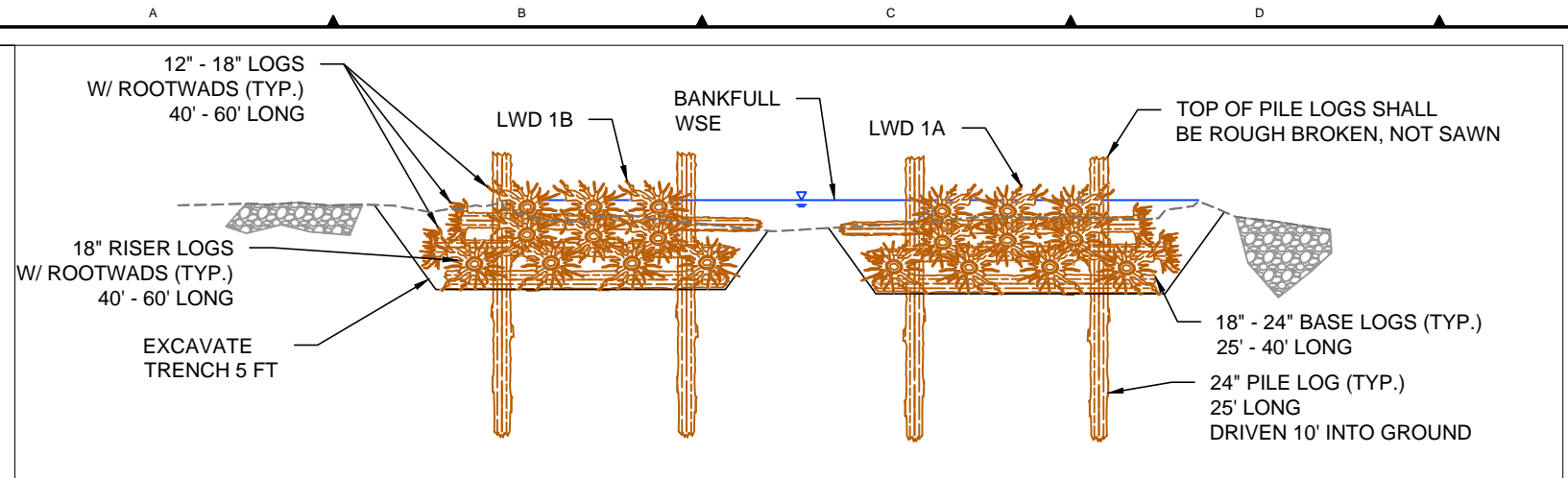
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TETRA TECH
www.tetrattech.com
19803 North Creek Parkway
Bothell, Washington 98011
Phone: 425-482-7600 Fax: 425-482-7652

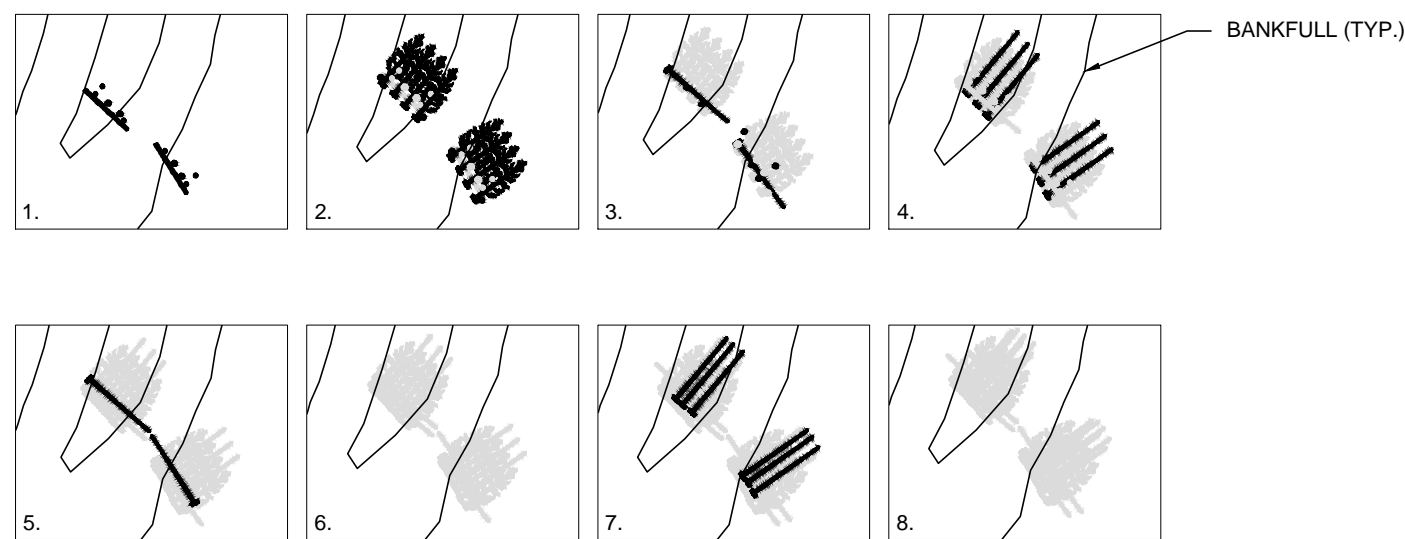
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
PROPOSED DESIGN

DWG. NO.: C-16	
CREATED: 08/16/2013	SHEET: 17 OF 19 SCALE: 1" = 50'



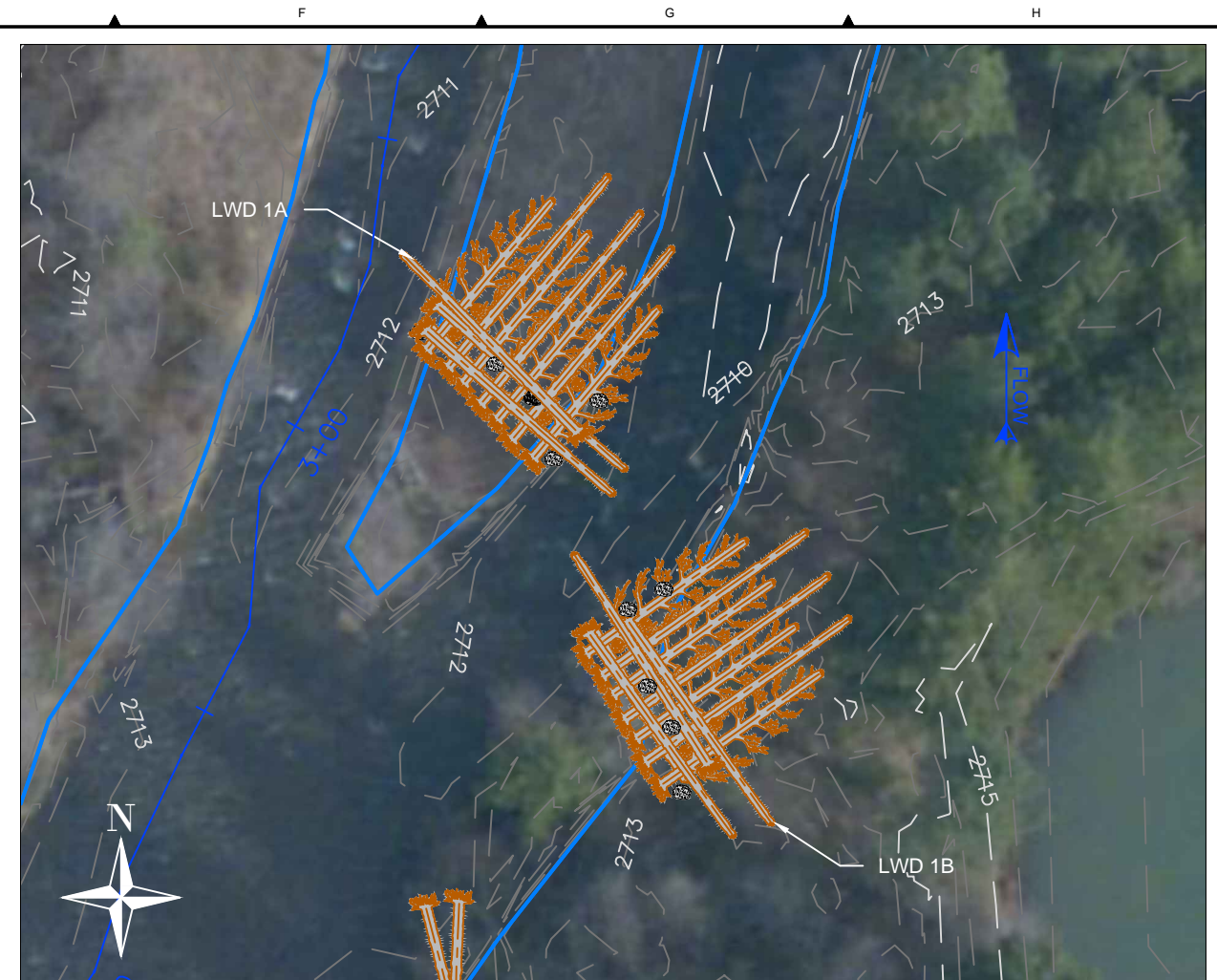
LWD 1A & 1B - SECTION DETAIL - FRONT VIEW



LWD 1A & 1B - LOG PLACEMENT SEQUENCING

LWD NOTES:

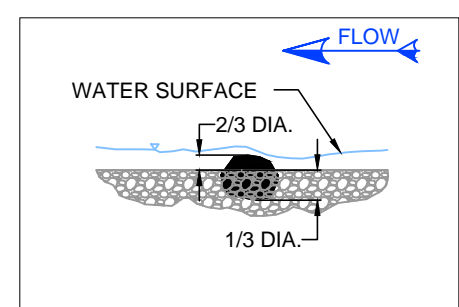
1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL ON THIS SHEET.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.
6. EXCAVATION DEPTHS RELATIVE TO BANKFULL HEIGHT.



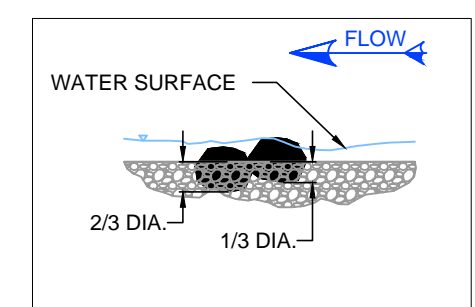
LWD 1A & 1B - PLAN VIEW
(SCALE 1" = 30')

BOULDER NOTES:

1. SINGLE/DOUBLE INSTREAM BOULDERS SHALL BE SIZED 18IN TO 28IN.
2. SINGLE BOULDERS SHALL BE BURIED AT 2/3 DIAMETER DEEP, SUCH THAT 1/3 DIAMETER IS EXPOSED. DOUBLE BOULDERS SHALL HAVE THE DOWNSTREAM BOULDER INSTALLED AS PER SINGLE BOULDERS, WHILE THE UPSTREAM BOULDER SHALL BE BURIED 1/3 DIAMETER WITH 2/3 DIAMETER EXPOSED.
3. SPOILS WILL BE USED TO BACKFILL AROUND PLACED BOULDERS.



SINGLE BOULDER SECTION DETAIL



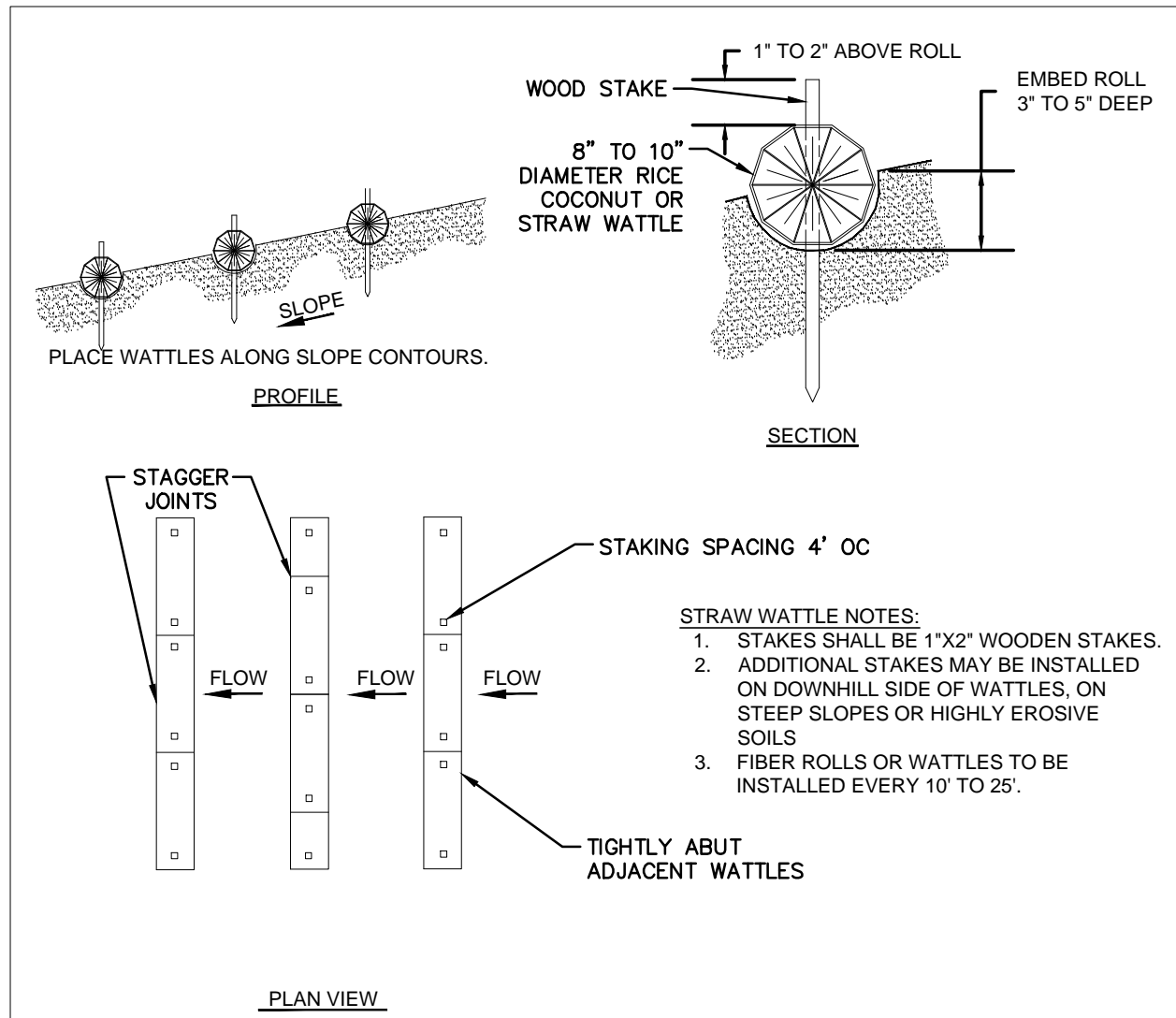
DOUBLE BOULDER SECTION DETAIL

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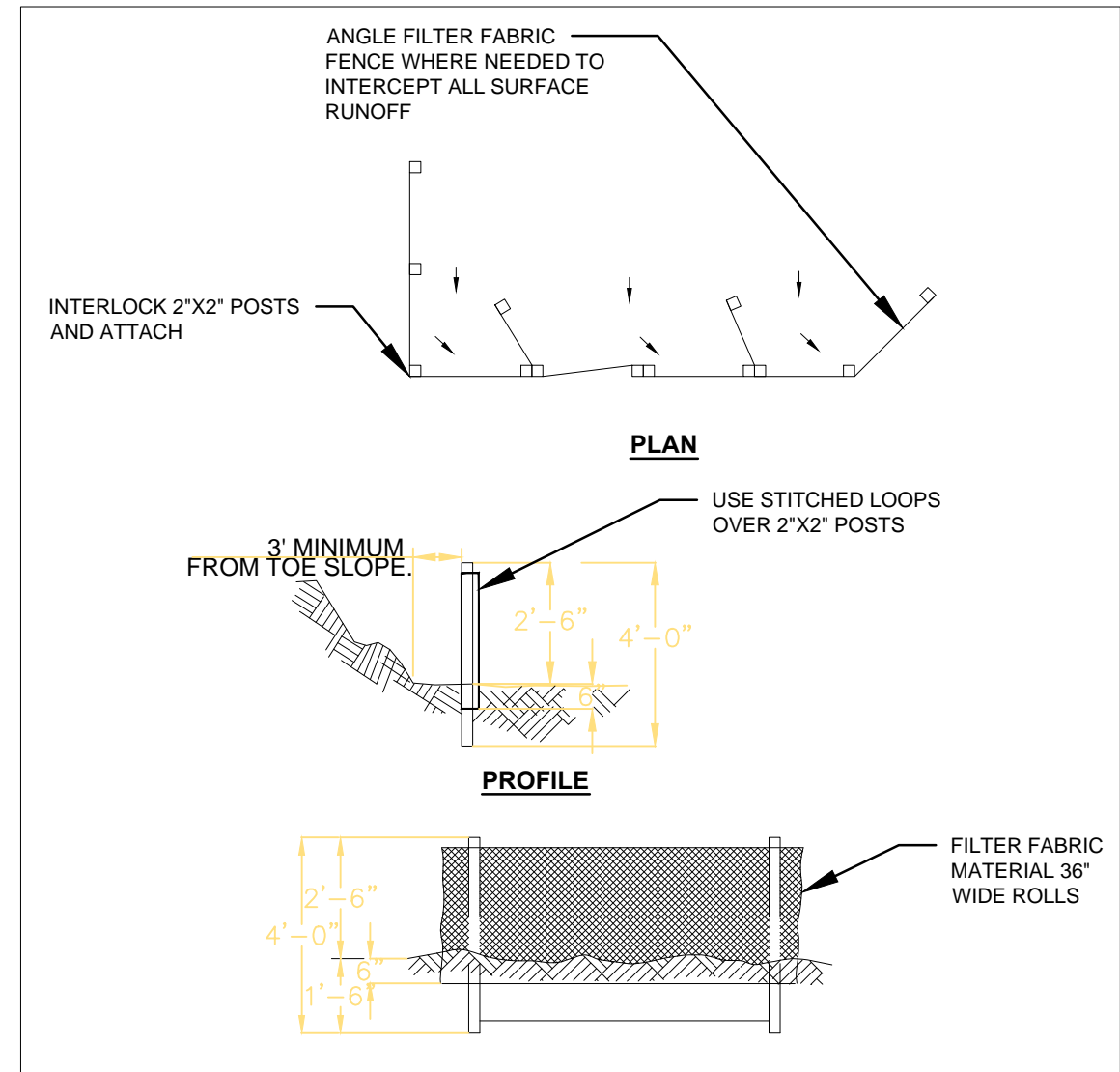
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		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
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-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
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LWD ENHANCEMENT
PROJECT AREA 3
DETAILS

DWG. NO.: C-17	
CREATED: 08/16/2013	SHEET: 18 OF 19 SCALE: NTS



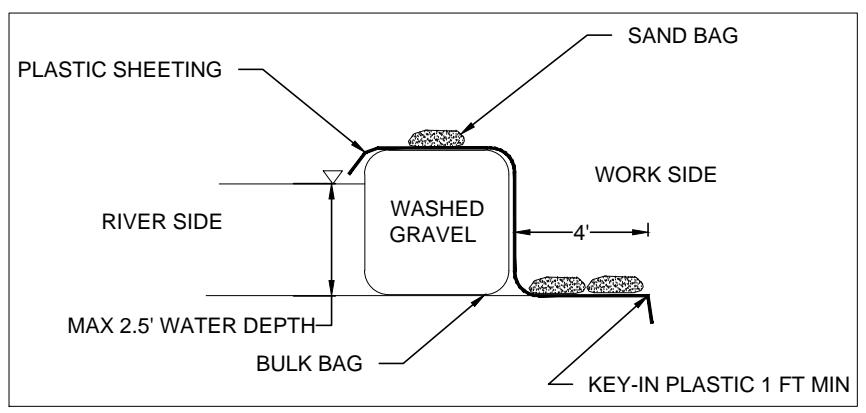
TEMPORARY STRAW WATTLES TYPICAL DETAIL



TEMPORARY SILT FENCE TYPICAL DETAIL

SEDIMENT FENCE NOTES:

1. SEDIMENT FENCE SHALL BE INSTALLED ON A LINE OF EQUAL ELEVATION.
2. BOTTOM EDGE OF SEDIMENT FENCE SHALL BE BURIED MIN 6"
3. POSTS MAY BE 2"X2" FIR, PINE OR STEEL.
4. POSTS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.
5. COMPACT BOTH SIDES OF FILTER FABRIC TRENCH.
6. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATION REACHES 1/3 OF THE MEASURE HEIGHT. SEDIMENT SHALL BE DISPOSED OF TO AN AREA THAT CAN BE PERMANENTLY STABILIZED.

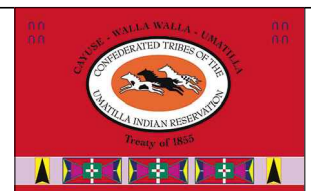
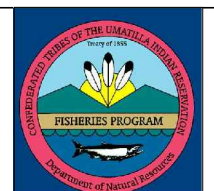


TEMPORARY COFFERDAM SECTION TYPICAL DETAIL

COFFERDAM NOTES:

1. ALL WORK IN CHANNEL SHALL BE LIMITED TO WDFW FISH WINDOW.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS, SEE DETAIL IN SHEET.
3. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
4. PLACEMENT OF BALLAST ROCK NOT SHOWN IN SECTION DETAILS FOR CLARITY, REFER TO LOG PLACEMENT SEQUENCING DETAIL FOR BALLAST ROCK PLACEMENT.
5. LOGS SHOWN WITHOUT LIMBS FOR CLARITY.
6. EXCAVATION DEPTHS RELATIVE TO BANKFULL HEIGHT.

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PLOT DETAILS: JOSEPH W. AMANDA



REV.	DATE	REVISION DESCRIPTION	DRW	DSG	ENG	CHK	APP
		PLAN SET SIZE ANSI B (11x17)					
		REVISION DESCRIPTION					
-	12/04/13	PRELIMINARY DESIGN (60%)	NJV	NJV	ATS	GMS	ATS
-	08/16/13	30% DESIGN DRAFT	NJV	NJV	ATS	GMS	ATS

CTUIR
TUCANNON RIVER
LWD ENHANCEMENT
PROJECT AREA 3
DETAILS

DWG. NO.: C-18	
CREATED: 08/16/2013	SHEET: 19 OF 19 SCALE: NTS

**ATTACHMENT B – DRAFT PRELIMINARY (60%) DESIGN
SPECIFICATIONS**

SPECIAL PROVISIONS

INTRODUCTION

The following special provisions shall be used in conjunction with the Standard Specifications for Road, Bridge and Municipal Construction, 2014 edition, as issued by the Washington State Department of Transportation, hereinafter referred to as the “Standard Specifications”.

The Standard Specifications, except as they may be modified or superseded by these provisions, shall govern all phases of work under this contract, and they are by reference made an integral part of these Specifications and contract as herein fully set forth. Measurement and payment will be only for those items listed in the proposal. All other work shall be considered as incidental with no separate measurement or payment.

Also incorporated into these Specifications by reference are the:

Manual on Uniform Traffic Control Devices for Streets and Highways, current edition.

Standard Plans for Road, Bridge and Municipal Construction, as prepared by the Washington State Department of Transportation and the American Public Works Association, current edition.

NOTE: Strict adherence to the Standard Specifications will be required along with the following amendments and clarifications:

DIVISION 1

GENERAL REQUIREMENTS

1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

1-07.15 Temporary Water Pollution /Erosion Control

Supplement this Section with the following:

TESC plans shall comply with all requirements specified in the permits acquired for the project.

DIVISION 8

MISCELLANEOUS CONSTRUCTION

8-02 ROADSIDE RESTORATION

Roadside restoration also applies to temporary access roads. Supplement this Section with the following:

Plant material sizes shall be as shown on the Plans.

8-02.2 Materials

Supplement this Section with the following:

Seed	9-14.2
Mulch and Amendments	9-14.4

8-02.3 Construction Requirements

Supplement this Section with the following:

Seed shall be placed in accordance with Section 8-01.3(2) of the Standard Specifications.

8-02.4 Measurement

Supplement this Section with the following:

Measurement for Vegetation Restoration will be acre of area planted with willows and seed mix.

8-02.5 Payment

Supplement this section with the following:

Payment will be made in accordance with Section 1-04.1, for the following listed Bid Item:

1. “Vegetation Restoration”, per square acre.

The Bid item price for “Vegetation Restoration” shall include all costs for the work required to furnish and install the willows, seed mix, soils, mulch, and disposal of excess material, and any other material necessary to install the willows.

8-30 STREAM RESTORATION (NEW SECTION)

8-30.1 Description

This work consists of the installation of large woody debris, fish rocks and reconnection of floodplain to channels at the locations shown in the Plans or where designated by the Engineer in accordance with these Specifications.

Other than the Owner-supplied large wood to designated storage sites, the Contractor is responsible for furnishing all materials, equipment and labor necessary for protection and maintenance, guarantee and replacement of the stream channel restoration items listed below, including all related items required to complete the work as shown on the Plans and specified herein.

Payment for quantities will be measured based on satisfactory installation in accordance with the Plans and Specifications and acceptance by the Engineer.

8-30.2 Materials

8-30.2(1) Large Wood

The Contractor shall locate, at the Owner-designated storage sites, and then deliver large wood logs of the type and dimensions shown in the Plans. The Owner will supply all Large Wood needed to the designated storage sites on the Plans. The selected large wood for placement shall be ponderosa pine or fir logs of recent vintage and free from insects, rot, and decay. Logs may be barked or un-barked. All used timber and associated materials shall be free of any preservative such as creosote. The large wood material installed shall not be encrusted with silts and fines. Root wads may have to be cleaned prior to placement.

To cut/break down logs, first score the log at the desired length, and then, using a backhoe, snap the log at the scored location to create a natural look to the break. Crunch broken ends to disguise saw cuts. Cut ends of wood features shall have no blunt ends.

The Contractor will be required to locate, at the Owner designated storage sites, and deliver to the stream sites the material required for the complete installation of the large wood according to the following material requirements:

Minimum diameter: 18 inch

Maximum diameter: 24 inch

Rootwad 2 to 4 times the bole diameter

8-30.2(2) Fish Rocks

Fish rocks shall be hard, sound, and durable. They shall be free from segregation, seams, cracks, and other defects tending to impede resistance to weather. Fish rocks shall conform to Section 9-03.11(3) and 9-03.11(4) depending on rock size selected by the Engineer. All fish rocks shall consist of material free from adherent coatings. The materials shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances.

Fish rocks shall be from an alluvial (river) source(s) and shall be rounded and washed. Gradation of materials shall be as shown on the Plans.

8-30.3 Construction Requirements

The Contractor is required to execute the work in conformance with the Hydraulic Project Approval. Except as noted below, all in-stream structures, devices, materials, and appurtenances shall be installed in a dry condition.

The Contractor shall notify the Engineer two working days prior to beginning installation and construction of large woody debris structures. All large wood material structures shall be constructed as shown on the Plans at the locations indicated on the Plans or as directed by the Engineer. Large wood material structures will be subject to field fit conditions. The Contractor will be required to work in conjunction with the Engineer and may be required to reposition or adjust the installation as directed to fit field conditions. Disturbance of adjacent work shall be repaired by the Contractor at no additional cost to the Owner.

8-30.3(1) Large Wood

The Contractor shall install the large wood at the locations shown in the Plans. The Engineer may revise the actual location or installation details to accommodate field conditions.

Large wood material logs shall consist of either a straight timber bole or a straight timber bole with rootwad attached to the dimensions as specified in the Plan Drawings. Nominal rootwad diameter shall be a minimum of 2 times the timber bole diameter and a maximum of 4 times the timber bole diameter. Anchor all large woody as described in the Plan Drawings or as directed by the Owner's Representative or Engineer. The logs shall be placed so there are no voids beneath its entire length. Minor hand excavation is permitted to accommodate localized high spots on the ground or log.

8-30.3(2) Fish Rocks

Fish Rocks shall be placed at the locations and the dimensions indicated on the Plans. Even though the Plans show the location of these items, the Engineer will provide field direction for placement. Fish Rocks sizes shall be as shown on the Plans.

8-30.3(3) Temporary in Channel Cofferdams and Dewatering

The Contractor shall provide, install and maintain the temporary in-channel cofferdams around each flowing channel area where large wood would be installed, as indicated on the Plans. The cofferdam system shall include installation of gravel berm and plastic sheet, providing a mostly water tight seal as shown in the Plans. Fish removal would occur in the improvement area. Sediment must not be conveyed downstream during construction period. Once the cofferdam is in place and fish removed, the area would be dewatered with silt laden water discharged to an upland settlement basin to avoid sediment entering the stream. The coffer dam and any dewatering measures required will remain operating properly for the duration of the large woody debris installation.

The Contractor shall size the water pumping system to convey flow out of the large wood installation area during the fish window period. The Contractor shall remove the temporary coffer dam, backfill the area with native material including compaction of backfill, and restore the areas to the finish grades indicated in the Plans when the temporary cofferdam is no longer needed.

8-30.3(4) Fish Removal

Collection of fish shall comply with the requirements of the Hydraulic Project Approval. The Contractor shall provide services of a fish biologist to coordinate and supervise the fish bypass activities. The fish biologist shall have a Master of Science degree in fish biology and at least 5 years of field experience in fish habitat restoration and managing relocation of fish from restoration or culvert replacement projects. Contractor shall use one of the following methods to capture fish:

- A. Manual: Collect fish by manual collection such as herding or dip netting as the area is slowly dewatered.
- B. Seining: Use seine with mesh of such a size to ensure entrapment of the residing fish.
- C. Minnow traps: Traps will be left in place overnight and in conjunction with seining.
- D. Electrofishing: All fish capture and release must follow National Marine Fisheries (NMFS) electrofishing guidelines (Available from NMFS Northwest Region Protected Resources Division, <http://www.nwr.noaa.gov/Regional-Office/Protected-Resources/index.cfm>)

If capture, removal, and relocation of ESA-listed fish are required, contractor shall comply with the following fish handling and transfer protocols steps:

- A. Isolate work area.
- B. If block nets are used leave in a secured position to exclude fish from entering the project area if needed.
- C. Leave nets secured to stream channel bed and banks until fish capture and transport activities are complete.
- D. Remove block nets the same day they are installed. If block nets remain in place more than 1 day, daily net monitoring is required to ensure they are secured to the banks and free of organic accumulation.

8-30.4 Measurement

All large wood will be measured per each piece installed on site. There will be separate measurements for large wood placed by helicopter and large wood structures with boulders. No separate measurement will be made for excavation, backfill, anchoring, or compaction of the native material during log installation. The costs for this item shall be included in the installation of large wood material.

All Fish Rocks will be measured per each rock installed on site. No separate measurement will be made for haul, excavation or backfill required for Fish Rock installation.

Cofferdam and dewatering will be measured as Lump Sum. A separate measurement will be made for Fish Removal.

8-30.5 Payment

Payment will be made in accordance with Section 1-04.1 for the following bid items:

“Log by helicopter” per hour.

“Logs with boulders” lump sum.

“Logs by excavator” per each.

“Fish Rocks” per each.

“Cofferdams and Dewatering System” per lump sum.

“Fish Removal” per lump sum.

The contract price shall be full compensation for all labor, materials, tools and equipment necessary to install the large wood structures, furnish and install fish rocks and floodplain reconnection as shown in the Plans. This includes all excavation, haul and disposal of surplus excavated material (if any); stockpiling of suitable excavated material for use as backfill; placing all large wood and fish rocks, installing and maintaining the cofferdam and dewatering system, adjusting the stream channel as directed by the Engineer; and field locating the structures as directed by the Engineer.

**ATTACHMENT C – PLANNING LEVEL ESTIMATE OF CONSTRUCTION
COSTS (60%)**

PROJECT NAME

JOB NO.: 194-4861
PROJ. ENG.: ATS
CHECKED BY: VM

TUCANNON RIVER - FLOODPLAIN RESTORATION AND LWD ENHANCEMENT

PLANNING LEVEL ESTIMATE OF CONSTRUCTION COSTS - PA 1
60% SUBMITTAL



ITEM	UNIT	TOTAL QUANT.	UNIT PRICE	AMOUNT \$	Notes
1. PREPARATION					
MOBILIZATION AND DEMOBILIZATION (SEE BELOW)	LS	1	SEE BELOW	SEE BELOW	
CLEARING AND GRUBBING	AC	3	\$3,500	\$8,750	Estimated clearing area
TEMPORARY CONSTRUCTION FENCES	LS	1	\$5,000	\$2,500	
PRECONSTRUCTION SURVEYING, LAYOUT	LS	1	\$18,000	\$9,000	
2. EARTHWORK					
EXCAVATION	CY	250	\$10	\$2,500	Secondary channels
3. STREAM STRUCTURES					
LARGE WOOD-PLACEMENT BY HELICOPTER	HR	4	\$20,000	\$82,000	82 trees total, 20 trees/hour for drop sites; PA 1 = Site 1, PA 3 drop sites
LARGE WOOD STRUCTURES WITH BOULDERS	LS	4	\$5,000	\$20,000	Major wood structures placed with tracked excavator with boulders for stability (PA 1 sites 2, 5, 9, 13)
LARGE WOOD MATRIX HABITAT STRUCTURES- EXCAVATED	EA	65	\$360	\$23,400	Simple LWD structures, soft placed with tracked excavator (PA 1 sites 1, 3, 4, 6-8, 10-12, 14-21)
FISH ROCKS	EA	45	\$360	\$16,200	Placement of 45 habitat boulders not associated with wood structures (PA 1 = 45)
4. EROSION CONTROL AND PLANTING					
CONSTRUCTION AREA BMPS	LS	1	\$10,000	\$5,000	Spill plans & good practices for vehicle and material storage in floodplain
MATERIAL STORAGE AREAS	LS	1	\$5,000	\$2,500	Expenses associated with transporting, stockpiling, and sorting material collected from floodplain
TEMPORARY EROSION AND SEDIMENTATION CONTROL	LS	1	\$25,000	\$12,500	Erosion control for bare soil, work area isolation, work pads
VEGETATION RESTORATION	AC	3	\$5,000	\$12,500	Mechanical seeding of access roads; 8' spacing, container plants & willow cuttings at wood sites (see note below)
5. OTHER ITEMS					
STREAM DEWATERING & COFFERDAMS	LS	1	\$18,000	\$9,000	Installation, pumping and removal, 5 sites
DE-FISHING	LS	1	\$10,000	\$5,000	Removal, care and transportation
PROJECT CLEANUP & REPAIRS	LS	1	\$3,600	\$1,800	Remove garbage, repair roads & fences, etc at end of project
AS-BUILT SURVEY	LS	1	\$18,000	\$9,000	
SUB TOTAL				\$221,650	
MOBILIZATION (10%)				\$22,200	
SUBTOTAL				\$243,850	
CONTINGENCY (30%)				\$73,200	
PA 1 Total:				\$317,000	TOTAL OPINION OF PROBABLE CONSTRUCTION COST (Rounded to the nearest thousand dollars)

COSTS ASSOCIATED WITH LAND ACQUISITIONS, PERMITS, ENGINEERING, EASEMENTS, TAX, CONSTRUCTION SERVICES, ETC. ARE NOT INCLUDED IN THIS ESTIMATE
 FLOODPLAIN REVEGETATION PLANTS SUPPLIED BY OTHERS; COSTS DO NOT INCLUDE IRRIGATION OR INSTALLATION
 ASSUME SOME TREES ON SITE CAN BE HARVESTED AND USED IN WOOD STRUCTURES
 ASSUME ALL TOPSOIL NEEDED FOR REPLANTING CAN BE HARVESTED ON SITE
 ASSUMES CHINOOK HELICOPTER, ALL HELICOPTER TREES AND HAZARD TREES AVAILABLE AT STAGING AREAS, COSTS TO STAGE TREES NOT INCLUDED

PROJECT NAME

JOB NO.: 194-4861
PROJ. ENG.: ATS
CHECKED BY: VM

TUCANNON RIVER - FLOODPLAIN RESTORATION AND LWD ENHANCEMENT

PLANNING LEVEL ESTIMATE OF CONSTRUCTION COSTS - PA 3
60% SUBMITTAL



ITEM	UNIT	TOTAL QUANT.	UNIT PRICE	AMOUNT \$	Notes
1. PREPARATION					
MOBILIZATION AND DEMOBILIZATION (SEE BELOW)	LS	1	SEE BELOW	SEE BELOW	
CLEARING AND GRUBBING	AC	3	\$3,500	\$8,750	Estimated clearing area
TEMPORARY CONSTRUCTION FENCES	LS	1	\$5,000	\$2,500	
PRECONSTRUCTION SURVEYING, LAYOUT	LS	1	\$18,000	\$9,000	
2. EARTHWORK					
EXCAVATION	CY	0	\$10	\$0	Secondary channels
3. STREAM STRUCTURES					
LARGE WOOD-PLACEMENT BY HELICOPTER	HR	40	\$20,000	\$795,000	159 trees total, 4 trees/hour for individual placements (159); PA 1 = Site 1, PA 3 sites 2-24
LARGE WOOD STRUCTURES WITH BOULDERS	LS	1	\$5,000	\$5,000	Major wood structures placed with tracked excavator with boulders for stability (PA 1 sites 2, 5, 9, 13; PA 3 site 1)
LARGE WOOD MATRIX HABITAT STRUCTURES- EXCAVATED	EA	0	\$360	\$0	Simple LWD structures, soft placed with tracked excavator (PA 1 sites 1, 3, 4, 6-8, 10-12, 14-21)
FISH ROCKS	EA	12	\$360	\$4,320	Placement of 12 habitat boulders not associated with wood structures (PA 3 = 12)
4. EROSION CONTROL AND PLANTING					
CONSTRUCTION AREA BMPs	LS	1	\$10,000	\$5,000	Spill plans & good practices for vehicle and material storage in floodplain
MATERIAL STORAGE AREAS	LS	1	\$5,000	\$2,500	Expenses associated with transporting, stockpiling, and sorting material collected from floodplain
TEMPORARY EROSION AND SEDIMENTATION CONTROL	LS	1	\$25,000	\$12,500	Erosion control for bare soil, work area isolation, work pads
VEGETATION RESTORATION	AC	3	\$5,000	\$12,500	Mechanical seeding of access roads; 8' spacing, container plants & willow cuttings at wood sites (see note below)
5. OTHER ITEMS					
STREAM DEWATERING & COFFERDAMS	LS	1	\$18,000	\$9,000	Installation, pumping and removal, 6 sites
DE-FISHING	LS	1	\$10,000	\$5,000	Removal, care and transportation
PROJECT CLEANUP & REPAIRS	LS	1	\$3,600	\$1,800	Remove garbage, repair roads & fences, etc at end of project
AS-BUILT SURVEY	LS	1	\$18,000	\$9,000	
SUB TOTAL				\$881,870	
MOBILIZATION (10%)				\$88,200	
SUBTOTAL				\$970,070	
CONTINGENCY (30%)				\$291,000	
PA 3 Total:				\$1,261,000	TOTAL OPINION OF PROBABLE CONSTRUCTION COST (Rounded to the nearest thousand dollars)

COSTS ASSOCIATED WITH LAND ACQUISITIONS, PERMITS, ENGINEERING, EASEMENTS, TAX, CONSTRUCTION SERVICES, ETC. ARE NOT INCLUDED IN THIS ESTIMATE
 FLOODPLAIN REVEGETATION PLANTS SUPPLIED BY OTHERS; COSTS DO NOT INCLUDE IRRIGATION OR INSTALLATION
 ASSUME SOME TREES ON SITE CAN BE HARVESTED AND USED IN WOOD STRUCTURES
 ASSUME ALL TOPSOIL NEEDED FOR REPLANTING CAN BE HARVESTED ON SITE
 ASSUMES CHINOOK HELICOPTER; ALL HELICOPTER TREES AND HAZARD TREES AVAILABLE AT STAGING AREAS, COSTS TO STAGE TREES NOT INCLUDED