River Enhancement Design

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

for
Confederated Tribes of the Umatilla Indian Reservation

February 26, 2010

GeoEngineers
Earth Science + Technology

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File No. 2698-006-01

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GeoEngineers

Table of Contents

APPENDICES (CONTINUED)

LIST OF FIGURES

APPENDICES

INTRODUCTION

Project Overview

GeoEngineers, Inc. (GeoEngineers) was contracted by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) to develop conceptual river and floodplain enhancement alternatives along approximately 1,400 feet of the Walla Walla River near Milton-Freewater, Oregon, known as the Lampson Reach. Subsequent to alternative development, a contract Amendment was agreed upon to complete this Engineering Design Package (Package) for the Lampson Reach based on the preferred enhancement alternative selected by the CTUIR. The Technical Services Agreement was authorized by GeoEngineers and CTUIR on March 23, 2009, and the Contract Amendment was authorized on September 24, 2009. A second Contract Amendment was issued on December 21, 2009 to extend the project schedule.

The purpose of this Package was to prepare plans (drawings), general construction specifications and construction quantities adequate to secure environmental permits and support a non-governmental/public works construction bid process. This design package is adequate for construction by an experienced, well qualified contractor with the understanding that GeoEngineers staff will be on-site to observe construction. Attached to this document are appendices including Appendix A – Report Limitations and Guidelines for Use, Appendix B – Construction Quantities and Cost Estimates, and Appendix C – River Enhancement Design Drawings. Reference is made to the "Sheets" throughout this report. These sheets are the River Enhancement Design Drawings attached as Appendix C.

As indicated on Sheet S-1, the Lampson Reach is located along the main stem Walla Walla River in Umatilla County, Oregon, at about river mile 49. It is approximately 2.5 miles southeast of Milton-Freewater, Oregon, south of Walla Walla River Road, and is situated within the Lampson property boundaries.

Project Vision and Goals

The overall vision for this project is to enhance habitat for native fish and wildlife, particularly ESA-listed steelhead (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and reintroduced spring-run Chinook (*O. tshawytscha*). To achieve this vision, the project design focuses on addressing the limiting habitat factors of the project reach and, to the extent possible, this general reach of the Walla Walla River. Specifically, the proposed design is intended to decrease flow velocity, diversify in-stream structure, add low-velocity refugia, enhance spawning habitat and increase habitat complexity. Secondary benefits anticipated by the proposed enhancements will include increased flood storage capacity, increased hyporheic connectivity, and dissipation of flood energy and channel aggradation. These goals are intended to be achieved within the hydrologic and geomorphic constraints of the river; the physical constraints of the adjacent topography; the practical constraints of the property's land use; the environmental constraints of applicable regulations permits; and the constraints of CTUIR's schedule and the availability of funds.

Project Objectives

The objectives of our work are to address some of the symptoms and causes of the degraded condition to enhance habitat for native salmonids within an ecological context. In other words; the proposed enhancement design focuses on improving habitat for all freshwater life history stages of native salmonids by restoring a self-maintaining geomorphic landscape. Since habitat for juvenile rearing, adult resting, and spawning are the most limiting factors, the design reflects measures that will increase both quantity and quality of habitats supporting these life history stages. Secondary benefits of these measures will span aquatic and terrestrial communities alike and reverberate throughout the watershed. Specific enhancement measures include:

- Levee setback to increase channel capacity, encourage bar development and sediment deposition, increase low-velocity channel margins, and increase riparian area width
- Add large woody debris (LWD) and boulders to increase complex pool and pocket-water habitat
- Create a side-channel, and a tributary (from springs and irrigation return flows), to enhance juvenile rearing
- Widen and diversify the riparian community
- Promote hydraulic, geomorphic and biologic interaction between the river, spring/irrigation return, side channels, riparian areas, and floodplains

Sheet S-3.1 graphically depicts these vision, goals and objectives. Sheet S-3.2 lists and describes the proposed enhancement treatments that will achieve the project's vision, goals and objectives.

SCOPE OF SERVICES

GeoEngineers developed this Package for the Lampson site based on the preferred enhancement alternative selected by the CTUIR under the existing agreement. The Package includes plans (drawings), general construction specifications and construction quantities adequate to secure environmental permits and support a non-governmental/public works construction bid process. This design package is adequate for construction by an experienced, well qualified contractor with the understanding that GeoEngineers staff will be on-site to observe construction. GeoEngineers' construction-related services are not included in this scope of services. Specifically the scope of services included:

Task 1: Additional Data

GeoEngineers mobilized to the site to document the geomorphic character of the Walla Walla River and surrounding site. Specifically, we assessed the channel bed, bank, floodplain composition and geometry, documented grain sizes, and assessed the overall character of the Walla Walla River in the vicinity of the project area. This visit also included the measurement of typical river bankfull widths and depths to facilitate the design. These data were then reduced back in the office and utilized throughout the design process. It should be noted that relatively high flows limited our in-stream data collection.

Task 2: Hydrology and Hydraulics

Peak stream flow measurements from nearby historic United States Geologic Survey (USGS) stream gauges were used to estimate discharges for the project site in the previous alternatives analysis phase of this project. Return intervals included 1.25-, 1.5-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year flood events. These discharges were then input into a hydraulic model to approximate the channel response throughout the range of flows and utilized in the channel design.

GeoEngineers developed a hydraulic model for the existing channel condition. Stream geometry, obtained from the topography and river cross-sections collected by the US Army Corps of Engineers (USACE) in 1999 and supplemented by additional cross-sections by CTUIR in December 2009 and several GeoEngineers' cross-section measurements were utilized for this model. This Scope of Services did not include the preparation and submittal of requests for a FEMA Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR).

Task 3: Stream Design

GeoEngineers prepared a set of stream enhancement design drawings based upon design Alternative 2 as selected by the CTUIR. These river enhancement design drawings are attached as Appendix C. The following design stages were completed to allow client review and input to the design process.

- Draft preliminary design drawings, associated construction cost estimates and specifications
- CTUIR Review of Draft Preliminary Design Drawings
- Design review meeting with CTUIR to discuss changes and revisions
- Finalize design drawings, associated construction cost estimates and construction specifications

Task 4: Reporting

Our analyses and designs are fully supported by this stream enhancement report. This report, which is signed and stamped by a registered professional engineer, includes our design approach, assumptions, design plans and supporting appendices. This Package constitutes this deliverable.

Task 5: Project Management

This task includes the time necessary to manage this project accordingly.

SITE DESCRIPTION

Site Location and Overview

The Lampson property is located on the mainstem Walla Walla River at river mile (RM) 49, approximately 2.5 miles southeast of Milton-Freewater, Oregon. The Lampson Reach of the Walla Walla River is located within the northeast quarter of Section 19 of Township 5 North, Range 36 East of the Bowlus Hill, Oregon quadrangle map. The site location is shown on Sheet S-1. An aerial photo of the existing site is presented on Sheet S-4.1. Site soils generally consist of silt loam in the riparian and agricultural areas, throughout the valley floor, which is laterally controlled by rock outcrops. Sheet S-4.2 identifies the site soils, rock outcrops and boundaries. Site topography is shown on Sheet S-4.3.

A long-term conservation easement, signed by the landowner in 1998, includes 2,000 feet of the mainstem Walla Walla River and 22 acres of adjacent riparian and upland habitat. The approximate location of this easement is shown on Sheet S-4.4. The river along this reach is confined by a near-vertical rock cliff on the south bank and a levee constructed in the 1960s on the north bank. The majority of the Lampson Reach consists of confined, moderately incised, riffles with essentially no floodplain connectivity during all but extreme flood events. Based on our field observations and conversations with the CTUIR and property owner, the levee appears to have been “field designed” and most likely does not satisfy current U.S Army Corps of Engineers design standards. Based on the Federal Emergency Management Agency’s (FEMA) Flood Insurance Rate Map (FIRM) for Community/Panel number 410204 0250 B, revised March 4, 1987, the 100-year baseflood accesses the upland areas behind the levee. Sheet S-4.5 shows the FEMA FIRM over an aerial photo of the site.

Water Rights

Two water rights are located within the Lampson property. One is a surface water right owned by the Oregon Water Resources Department (OWRD) and applies to maintaining mainstem Walla Walla River flows from the confluence of the North and South Forks of the Walla Walla River downstream to the Little Walla Walla Diversion in Milton-Freewater. The priority date associated with this right is November 1983. The other right is a groundwater right owned by Clark Lampson and is used for irrigation on his property. The priority date associated with this right is January 1957.

Riparian Area

The project reach riparian area is largely restricted to the immediate bank area due to natural confinement by a vertical rock cliff on the south (left) bank and artificial confinement by a levee on the north (right) bank. In general, the riparian vegetation on bars and the immediate banks, inside the levee, is dominated by a black cottonwood (*Populus trichocarpa*) overstory. The understory is largely comprised of Himalayan blackberry (*Rubus armeniacus*) and other woody shrubs, likely emerging from rhizomes of overstory trees. The levee itself is almost exclusively dominated by a black locust (*Robinia pseudoacacia*) overstory and herbaceous groundcover. Despite the separation created by the levee, a relatively robust riparian community is developing landward of the right-bank levee due to a successful re-vegetation effort implemented by the CTUIR in 2001. The success of this re-vegetation effort is evidence of relatively shallow groundwater and hyporheic connectivity associated with either the river, irrigation or both. As such, this design was developed under the assumption that the overall riparian community will respond with increased density and expand to accommodate natural floodplain conditions. The approximate limits of the riparian area, directly associated with the project reach, are depicted on Sheet 4.4.

ANALYSIS

Geomorphology

The Walla Walla River drains westerly from approximately 5,400 feet above Mean Sea Level (MSL), near the crest of the Blue Mountains, through rock-bound canyons to the eastern edge of the Walla Walla Valley, near Milton-Freewater, Oregon at an elevation of approximately about 1,200 feet MSL. From there the Walla Walla River drains northerly onto broad alluvial fans and then westerly on terrace lands of the Walla Walla Valley to the Columbia River. The mainstem Walla Walla River is formed by the confluence of the South Fork and North Fork of the Walla Walla River. The North Fork drains about 34 square miles. The South Fork is the principle tributary, and is actually the upstream continuation of the mainstem. The South Fork of the Walla Walla River Basin makes up about 4 percent of the land area in the entire watershed and supplies about 30 % of the water yield (U.S. Army Corps of Engineers 1997).

The portion of the basin containing the project reach is within the Blue Mountain section of the Columbia Plateaus physiographic province (Fenneman, 1931). Accordantly layered lava flows of the Columbia River Basalt are the bedrock exposed within the steep-walled canyons. The basalts were extruded during the Miocene Age (15 to 20 million years ago) and were subsequently uplifted. The Blue Mountain anticline roughly defines the drainage divide between the Walla Walla River and Grande Ronde River drainages. The basalt dips westward about 3 percent to 5 percent from the Blue Mountains. In the project area the mainstem and South Fork canyon dissecting the upland basalt surface runs parallel with the dip.

The upper Walla Walla River valley is steep-sided and narrow. The mainstem Walla Walla River valley narrows from about 1,900 feet at the confluence of the Forks to about 1,120 feet near the Couse Creek confluence over a length of about 3.5 miles. As measured from topographic contours, the longitudinal profile of the channel is evenly graded at about 1 percent average in the mainstem. Overall channel sinuosity (ratio of stream length to valley length) of the mainstem is about 1.11.

Presently, the upper Walla Walla River is confined and disconnected from its floodplain largely due to large-scale river training and land use practices. Confining elements include constructed levees and bridges that control lateral migration. Downstream of the Lampson Reach the confinement also includes the terrace (former floodplain) due to the river's vertical incision of its channel bed following channel straightening and levee construction.

We deduce that prior to settlement beginning in the 1800's the historic upper Walla Walla River might have occupied any portion of its valley. Evidence for this reasoning includes:

- The distribution and depth of alluvium within the valley floor (Newcomb 1965)
- Channel position, meander scrolls, and patterns of vegetation in undisturbed portions of the valley evident from 1947 photos
- The form of the North Fork and its occupation of its valley within a relatively undisturbed setting upstream of lands converted to agricultural use (from both recent and 1947 aerial photography); the North Fork is a smaller drainage, but in scale is similarly characteristic of the South Fork

In plan form, the South Fork and mainstem channels exhibit little change as reflected by comparison of recent and 1957 aerial photographs. Some differences in channel form are evident between the photo sets. For example, the channel belt width appears to be greater in the reach downstream of the Lampson Reach, likely due to differences in confinement by reconstruction of levees in 1965 and 1966.

Much of the land within the study reach has been altered from its natural state for agricultural purposes. Channel dredging and diking were completed in the 1950's by the U.S. Army Corps of Engineers, and levees were re-constructed and improved by the Corps below the Forks in 1965-1966 for flood control following major flooding in late 1964 and early 1965. The local flood control district maintains dike functionality by removal of in-channel Large Woody Debris (LWD) and vegetation on the dikes having stems larger than about 4 inches (B Wolcott pers. comm. 2009; Hoverson 2005). The subsequent reduction of river length, increase in channel gradient and flow velocities, vertical channel incision, and coarsening of channel substrate has resulted in a loss of in-channel habitat variability.

Geomorphic parameters of the existing Lampson Reach were classified using the Rosgen stream classification method (Rosgen, 1996). These parameters are summarized in Table 1 below. It should be noted that these parameters were averaged over the whole reach. Additionally, we classified the river as a Rosgen Type C3 channel even though the reach's sinuosity of 1.03 is less than 1.2, which is typically considered the minimum for a C3 channel. This classification was made because we believe this stream type best represents the existing (and historic) stream condition.

TABLE 1. GEOMORPHIC PARAMETERS OF EXISTING LAMPSON REACH

Parameter	Unit
Bankfull Width (ft)	62
Bankfull Depth (ft)	3.6
Width Depth Ratio (ft)	17.2
Flood Prone Width	650
Flood Prone Depth	11.5
Entrenchment Ratio (ft/ft)	10.5
Sinuosity (ft/ft)	1.03
Slope (ft/ft)	0.01
D_{15} (inches)	1.4
D_{50} (inches)	3.2
D_{95} (inches)	9.0
Median Bed Material	Cobbles
Rosgen Stream Type	C3

Topography

Generally, the topography of the project site includes steep, bedrock-dominated valley walls marking the outer edge of a relatively flat floodplain, between 800 and 1000 feet wide. Within the project area the Walla Walla River is situated along the left (southern) side of the floodplain where it has become discontinuously incised by as much as three feet.

A topographic survey of the Lampson property was performed by the USACE in 1999 along the floodplain down to the right bank toe of the channel. Seven cross sections of the river were also surveyed during this data collection effort. CTUIR supplied supplemental cross sections and survey data that were obtained in December 2009. The limited river bathymetry and USACE floodplain topography was utilized for this design.

Fish Habitat

Native fish assemblages in the Walla Walla River Basin have evolved to thrive in a system of cold and clean water, complex and dynamic lotic habitats, dense riparian communities, and ecological connectivity between the aquatic and terrestrial environment (floodplains). Among the native salmonids in the Walla Walla system, bull trout (*Salvelinus confluentus*) and steelhead (*Oncorhynchus mykiss*) are listed threatened under the Endangered Species Act (ESA). Redband trout (*O. mykiss*) are largely distributed in headwater areas with relatively cool and stable flows. Van Cleve and Ting (1960) in Hoverson and Schwartz *(2005)* and USACE (2000) reported that spring chinook (*O. tshawytscha*) had been extirpated by the 1950's. However, spring Chinook reintroduction efforts were initiated by the CTUIR in the year 2000. For the habitat purposes of this report, spring Chinook, present in the system today, are considered native even though the donor stock is from another basin.

To begin our evaluation of project area habitat conditions, GeoEngineers reviewed a habitat assessment completed by Hoverson and Schwartz (2005) for 18 miles of the mainstem Walla Walla River and South Fork Walla Walla River. The boundaries of their assessment included the Lampson reach. Generally, they found stable banks and cold, stable flows. These conditions are relatively rare in the Columbia Basin and provide a good opportunity to implement beneficial geomorphic restoration measures. They noted habitat degradation is largely attributable to channel straightening and levee construction. As a result, the channel structure and complexity have been simplified and degraded. For instance; their results suggest the channel is comprised of more than 77 percent fast water habitat with an average of 7.8 pools per mile and an average of 45 pieces of wood per channel mile. Consequently, they assert, low-velocity and off-channel juvenile rearing habitat, adult resting/holding habitat, and spawning habitat are limiting. In fact, they noted, the best juvenile rearing habitat occurred where irrigation ditches were accessible. What's more; more than 70 percent of the riparian areas are in poor condition and floodplain exchange capacity and hyporheic connectivity have been virtually eliminated and replaced with an orchard/pasture landscape. Despite all the degradations Hoverson and Schwartz (2005) suggest, primarily due to the cool and stable flow characteristics, high-quality salmonid habitat does exist intermittently.

To further examine habitat suitability, we compared existing conditions to Habitat Suitability Indices (HSI) documented in 17 references (Beak 1985, Bovee 1978, Burger et al. 1982, Crumly and Stober 1984, Hardin-Davis et al. 1990, Hosey 1986, Hunter 1973, NESCO 1984, Raleigh et al. 1984, Raleigh et al. 1986, Rittmueller 1985, Sams and Pearson 1963, See 1987, Stempel 1984, Wampler 1986, WDF 1990, WDFW 2000). These HSI data generally describe habitat suitability, for specific life history stages, based on water depth and velocity. We recognize aquatic habitat encompasses many variables beyond depth and velocity; however, most other attributes are qualitative and subject to individual interpretation. We apply published HSI data because it is quantifiable and compatible with hydraulic model analyses.

First, based on the aforementioned references, we created composite suitability curves for three life history stages (spawning, fry, and Juvenile) of steelhead and spring Chinook. The composite curves are summarized in Table 2 and illustrated in Figures 1 through 6. Overall, optimum habitat suitability is similar for both species but steelhead are generally able to tolerate a wider range of velocities. A key difference between the two species is depth at the fry life-stage. Optimum depth suitability for steelhead fry is between about 0.5 feet and 0.85 feet, while Chinook fry prefer depths between about 2.3 feet and 2.7 feet (Figure 1).

TABLE 2: STEELHEAD AND SPRING CHINOOK LIFE HISTORY STAGES AND HABITAT PARAMETERS EVALUATED FOR SUITABILITY, THROUGH THE PROJECT AREA.

Life History Stage/Habitat Parameter	Steelhead	Spring Chinook
Adult/spawning-velocity	X	X
Adult/spawning-depth	X	X
Fry/velocity	X	X
Fry/depth	X	X
Juvenile/rearing-velocity	X	X
Juvenile/rearing-depth	X	X

To describe existing conditions, relative to index conditions, we walked each project reach and noted areas suitable for steelhead and spring Chinook. Additionally, to put our habitat assessment into a geomorphic context; we measured channel length, profile, cross section, flood-prone area, channel-shape, water-velocity, and substrate size/distribution. Our results suggest that fry and juvenile rearing habitats are the most limiting, particularly for spring Chinook. These habitats are limiting mainly because habitat becomes largely unsuitable for spring Chinook fry at velocities greater than 0.7 feet per second and depths less than 1.75 feet and greater than 3 feet (Figures 1 and 2). Juvenile spring Chinook habitat generally becomes unsuitable at velocities greater than 1.15 feet per second and depths below 0.75 feet and above 3.5 feet (Figures 3 and 4). Relatively deep, low-velocity areas are sparse throughout the Lampson reach, which is explainable by the lack of complex hydraulics created by channel structure, meanders, and floodplain/off-channel connectivity. In other words, the project reach has become primarily composed of relatively shallow riffles. Our findings are consistent with Hoverson and Schwartz (2005) and the prevailing opinion of area scientists.

Hydrology

As part of this project, GeoEngineers completed a hydrologic evaluation of the Walla Walla River at the Lampson site. The Lampson reach of the Walla Walla River is situated within Umatilla County, Oregon and is located within Hydrologic Region 2 as defined by the State of Oregon Water Resources Department (Cooper, 2006). Although the site is located in the state of Oregon, it is also situated geographically within the boundaries of the Walla Walla River watershed, Hydrologic

Region 9 as defined by the National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Washington (USGS, 2001).

Basin Characteristics

The watershed of the main-stem Walla Walla River at the lower limit of the Lampson reach is approximately 134 square miles, with a mean basin elevation of 3670 feet (NAVD 88), and a mean basin slope of approximately 39.6 percent. The Walla Walla River watershed can be characterized as a combination of forested area and agricultural fields with an annual precipitation of approximately 37.5 inches.

Peak Flows

To estimate peak flows at the site, a combination of regression equations and nearby stream gauge analysis was utilized. Each method is described in detail below. The stream gauge analysis (Log Pearson Type III) was the most conservative and therefore used for final peak flow estimates in the Lampson reach. Peak flow estimates from gauge analysis and regional regression equations are shown in Table 3.

LOG PEARSON TYPE III

USGS stream gauge #14011000 on the North Fork of the Walla Walla River near Milton, Oregon is closest applicable stream gauge with an acceptably large dataset of 38 years. Unfortunately, it is located approximately four miles upstream of the project site, upstream of the confluence of the North and South Forks of the Walla Walla River. The nearest applicable gauge on the South Fork of the Walla Walla River is USGS stream gauge #14010000, approximately 11 miles upstream of the site. The Lampson Site is located on the mainstem of the Walla Walla River approximately 2.5 miles downstream of the confluence of the North and South Forks.

Historic gauge data was analyzed using a Log Pearson Type III (LP3) Distribution completed with the USGS's PKFQWin program to estimate peak flows at the site. The PKFQWin program utilizes the methodologies discussed within USGS Bulleting 17B (USGS, 1982). The method described within Bulletin 17B utilizes a weighted skew factor based on a generalized location skew coefficient and the skew coefficient obtained from the historic data set. This weighted skew aids in correcting for short historic peak discharge records. To estimate peak flows at the Lampson site, a basin area ratio calculation was performed. This method calculates peak flows at the site by adding the percentage of flow contributed by the North and South Forks based on relative watershed area.

EASTERN WASHINGTON REGIONAL REGRESSIONS

In addition to LP3 analysis, peak flows were estimated using the United States Geological Survey (USGS) StreamStats online analysis. In Washington State, the StreamStats program is based on regression equations from the USGS Water Resources Investigations Report (WRIR) 97-4227, *Magnitude and frequency of floods in Washington* (Sumioka et. al., 1998). The Lampson site is situated within the same watershed as Region 9 of Washington State. Because the site is located in Oregon, StreamStats issued a warning stating the results are invalid. However, due to the fact that natural watershed boundaries cross state lines, we consider the USGS StreamStats peak flow estimate valid.

EASTERN OREGON REGIONAL REGRESSIONS

The USGS StreamStats program does not reference regional regression equations in eastern Oregon. However, the Oregon Water Resources Department (OWRD) has developed a similar program which delineates watersheds based on a specific input location (the site), and calculates watershed area, precipitation and soil storage capacity within the watershed. The OWRD Interactive Mapping Program analysis in eastern Oregon is based on regression equations from the OWRD Open File Report SW 06-001, *Estimation of peak discharges for rural, unregulated streams in eastern Oregon* (Cooper, 2006). The Lampson site is situated within Region 2 of Oregon State.

TABLE 3. DISCHARGE SUMMARY TABLE (DISCHARGES IN CFS)

Peak Flow Estimation Method	Flood Frequency (Years)							
	1.25	1.5	2	5	10	25	50	100
LP3	1,082	1,313	1,625	2,545	3,271	4,332	5,232	6,232
Eastern Washington Regression	-	-	1,450	2,450	3,160	4,230	5,140	6,120
Eastern Oregon Regression	-	-	1,370	2,120	2,730	3,610	4,310	5,050
Peak Flows Used in Design	1,082	1,313	1,625	2,545	3,271	4,332	5,232	6,232

Hydraulics

Using the results of the hydrologic analysis along with the topographic floodplain survey and channel cross section survey by the US Army Corps of Engineers (USACE) in 1999 and the supplemental channel cross sections by the CTUIR in 2009, we were able to create a one-dimensional, steady state, hydraulic model of the Walla Walla River through the project reach. We utilized version 4.0 of the USACE Hydraulic Engineering Center – River Analysis System (HEC-RAS) hydraulic computer model to build the model.

The floodplain topography from the USACE was obtained in a digital format; however, the cross sections showing the channel bathymetry were available solely in hardcopy and were digitized into CAD for use within the model. These seven cross sections were then supplemented with additional channel cross sections surveyed by the CTUIR and provided to GeoEngineers in CAD format in December 2009.

The limits of effective flow and roughness coefficients for the model were adjusted to represent the physical features of the structures, river and corresponding floodplain. These parameters were adjusted based on firsthand knowledge of the river, floodplain, overflow points and any pertinent structures. The existing condition model was run in a subcritical flow regime in accordance with FEMA modeling practices for detailed flood zones. A subcritical flow regime requires the designation of a downstream boundary condition. For all flood recurrence intervals the approximate normal depth calculation based off of average downstream channel slope was utilized except for the 100-year flood. The 100-year flood condition utilized the corresponding FEMA base flood profile elevation at most downstream cross section. This provides a smooth transition from the downstream FEMA flood profile into the project reach and updated model.

The hydraulic properties from the existing condition model facilitated the development and assessment of the proposed river enhancements including structure size, location, placement, etc. Due to the limited changes in channel morphology and the proposed design to layback slopes, increase floodplain access, and overall ease the flooding conditions, the existing conditions model results were utilized for the proposed design. This provided conservative estimates for the hydraulic factors (channel velocities, shear stresses, etc.) utilized in design. It should be noted that a proposed conditions model will be necessary for the future completion and submittal of a CLOMR/LOMR to FEMA.

DESIGN

Design Alternatives

As discussed in the Alternatives Analysis Report (GeoEngineers, 2010), GeoEngineers and the CTUIR collaboratively developed three design alternatives that targeted the vision, goals and objectives noted above. These alternatives, which are briefly discussed below, progressively increased in complexity, site disturbance, habitat benefits and cost.

- Alternative 1 involved relatively minor enchantments in and along the existing channel, laying back the banks of the main channel and creating a small channel and floodplain for the existing spring. In-stream benefits would have largely been realized passively through the enhancements rather than through extensive in-stream work
- Alternative 2 involved the creation of a relatively large, single threaded, secondary channel north of the main channel; laying back the banks of the main channel; excavating in-stream pools; excavating a wider floodplain along the main channel and secondary channel, extenuating two bends in the main channel and creating a small channel and floodplain for the existing spring
- Alternative 3 involved the creation of several relatively large, side channels north of the main channel; laying back the banks of the main channel; excavating in-stream pools; excavating a wider floodplain along the main channel and side channels, extenuating two bends in the main channel and creating a small channel and floodplain for the existing spring

A variation of Alternative 2, which reduced the size of the proposed secondary channel, was ultimately selected by the CTUIR because it resulted in a suitable balance between the overall project costs and benefits. It is the design of this alternative that is described in this design package.

Proposed Enhancements

The proposed river design includes the following elements:

- Excavating a relatively large, single threaded, secondary channel and floodplain north of the main channel
- Selectively retaining desirable riparian vegetation along the banks and floodplains
- Removing the existing levee, riprap and debris along the north bank of the main channel

- Selectively laying back portions of the north bank of the main channel
- Extenuating two bends along the north bank of the main channel
- Sculpting/excavating in-stream pools in select locations along the main channel
- Slightly raising the existing channel elevation in between the excavated pool areas
- Installing both LWD and rock habitat structures throughout the main channel and side channel
- Creating a small channel and floodplain for the existing spring

Collectively these enhancements will achieve the desired vision, goals and objectives. Sheet 3.2 lists and describes the specific enhancements proposed as well as their intended benefits. Sheet 3.2 also doubles as a legend for the more detailed plan and profile drawings presented as Sheets 7.1 through 7.7. Sheet 5.1 provides an overview of these proposed enhancements and Sheet 5.2 depicts and quantifies the anticipated habitat benefits.

Sheet 8.1 lists the generalized geomorphic parameters for the proposed secondary channel. Sheets 8.2 through 8.4 graphically depict the existing and proposed channel and floodplain cross-sections at select locations throughout the project site.

The proposed design utilizes a number of typical LWD and rock structures and treatments. Typical details of these treatments are presented on Sheets 9.1 through 9.6. These details also explain the general purpose of each of these structures as provide detailed design specifics of each structure.

The ultimate success of these types of river enhancement projects relies largely upon establishing appropriate riparian vegetation throughout the disturbed areas. In addition to providing stability and erosion resistance along the banks and floodplain, the vegetation supports the desired habitat in terms of both cover and overall ecosystem function. Sheet 10.1 shows the planting plan for the proposed project. Sheets 10.2 and 10.3 present typical planting schemes and species-specific planting guidelines, respectively.

The proposed enhancements will require excavation along the river banks and throughout the proposed secondary channel and floodplain area. It will also require excavation and the installation of habitat structures in the river channel itself. A construction sequencing plan has been developed to provide construction guidance to the contractor and to help minimize the impacts that could potentially result from these disturbances. Key elements of this plan, which are depicted on Sheets 11.1 and 11.2, include the following:

- Performing in-stream construction during the allowable fish window between July 1 and September 30
- Performing the majority of the secondary channel and floodplain excavation under dry conditions
- Utilizing the proposed secondary channel as a diversion while a large portion of the enhancements are being constructed/installed in the main channel
- Isolating active construction zones from active river flow with floating cofferdams in the locations where diversion through the side channel is not possible

- Utilizing safety measures such as pumping and sediment ponds to manage localized, short-term sediment issues
- Implementing appropriate Best Management Practices (BMPs) before, during and after the construction efforts
- Implementing the proposed planting plan to establish both short-term and long-term stability

And finally, the last sheet in the design package includes construction quantities to facilitate contractor bidding.

RESULTS AND CONCLUSIONS

In collaboration with the CTUIR, GeoEngineers developed a river enhancement design that focuses on achieving the overall vision of this project. That is to say that this design will increase and enhance habitat for juvenile and adult anadromous fish by targeting limiting habitat factors within the limits of river geomorphology, property ownership, public safety, environmental regulations and project economics. To this end, this design package explains and supports the fundamental rationale for the proposed design. It also provides the detail necessary to support the CTUIR's acquisition of environmental permits for the project. Additionally, this package will facilitate contractor bidding as well as construction by an experienced, well qualified contractor under and engineer-led construction contract arrangement.

LIMITATIONS

We have prepared this report for the CTUIR and their authorized agents and regulatory agencies for river enhancements along the Lampson Reach of the Walla Walla River near Milton-Freewater, Oregon.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of stream and river habitat enhancement, stabilization and restoration design engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty or other conditions, expressed or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments should be considered a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to the appendix titled "Report Limitations and Guidelines for Use" for additional information pertaining to the use of this report.

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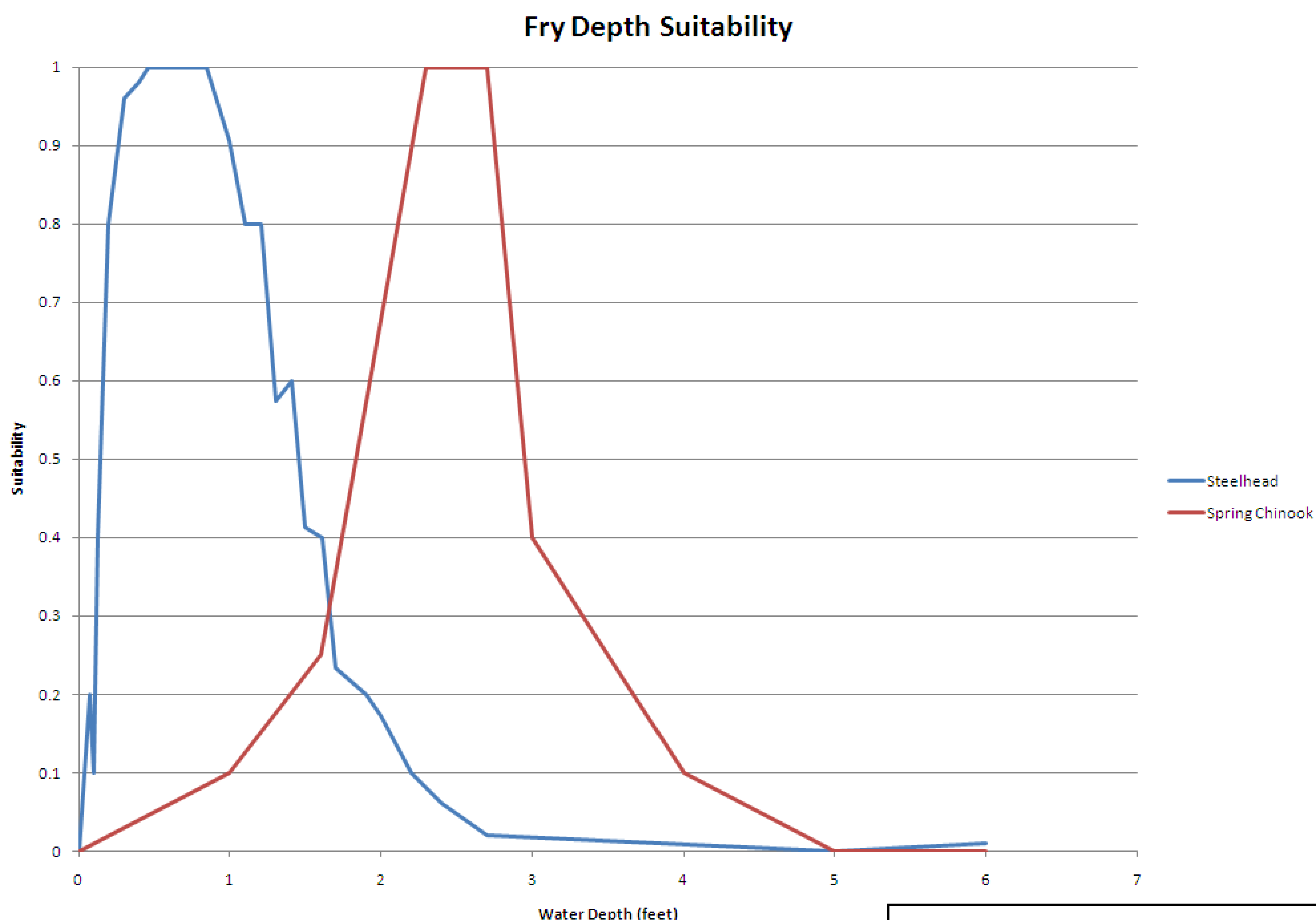
FIGURES

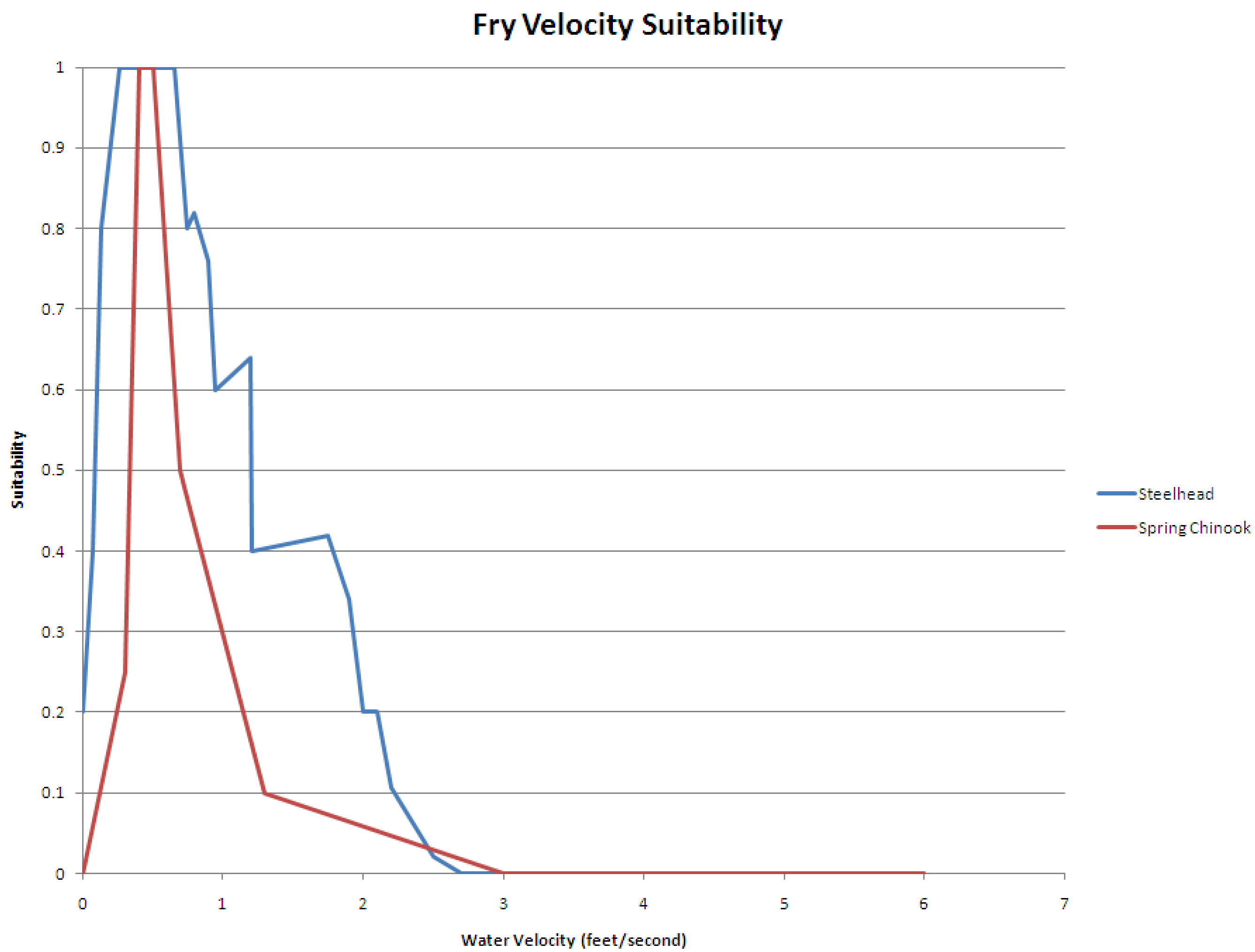


Fry Depth Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 1

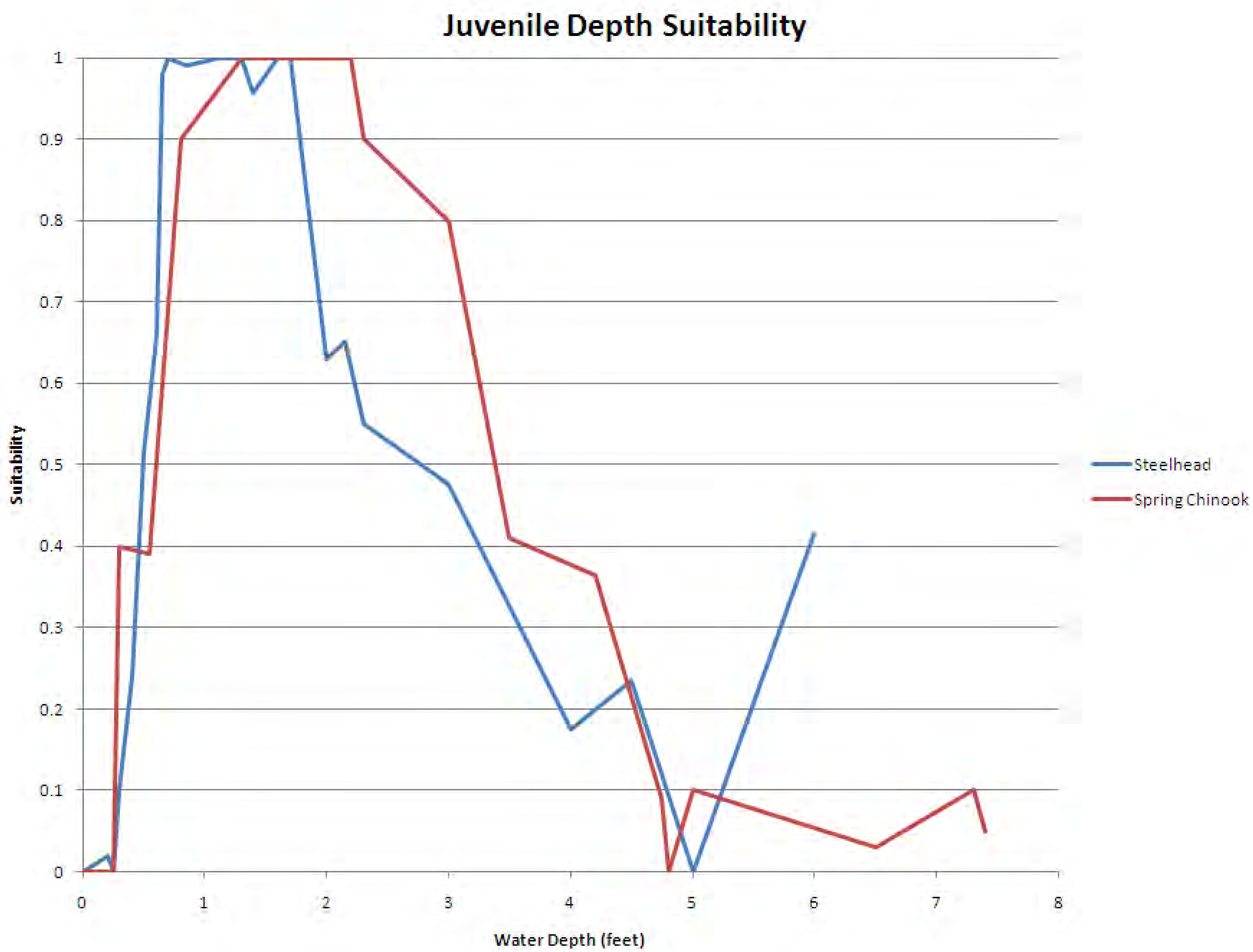


Fry Velocity Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 2

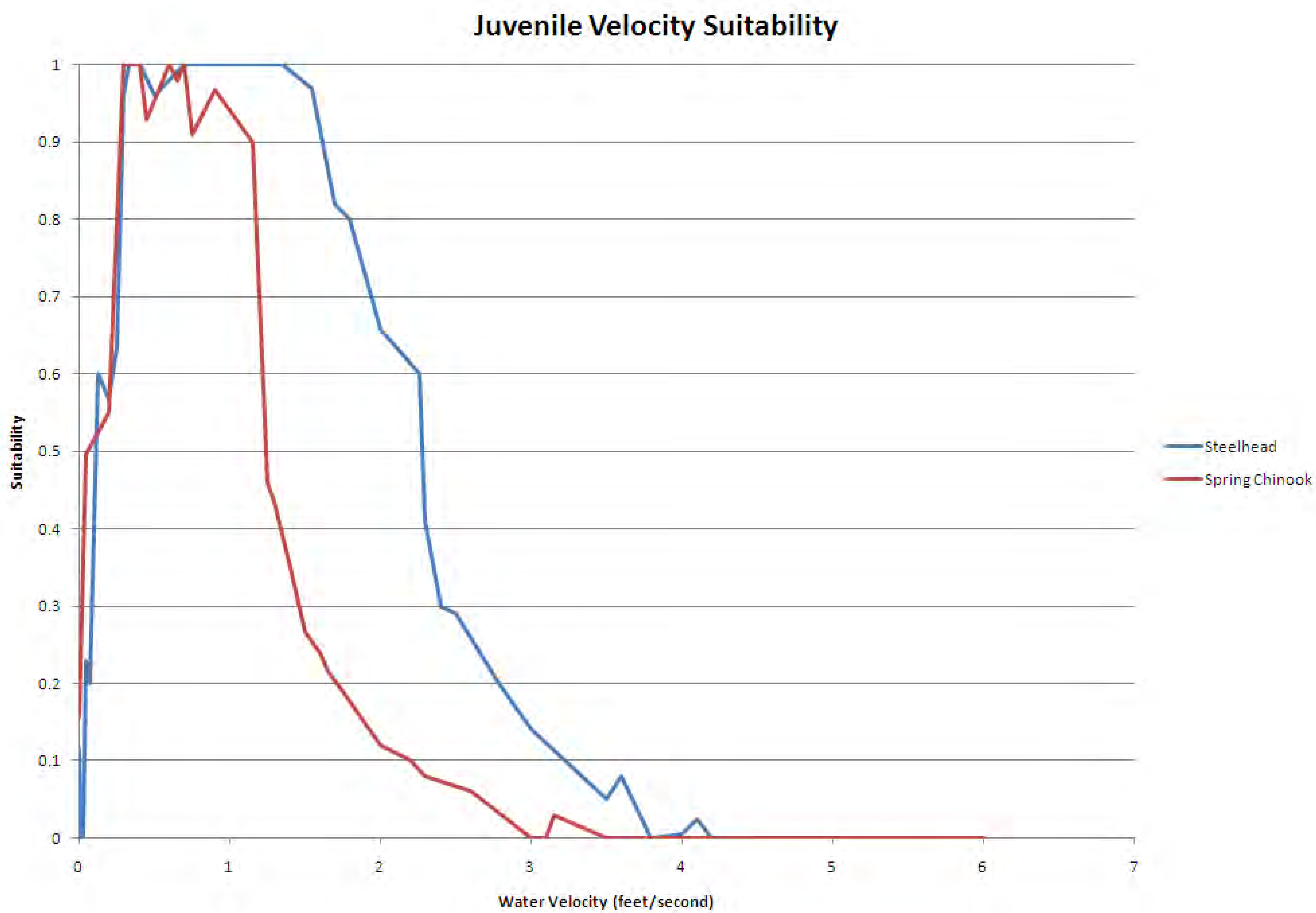


Juvenile Depth Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 3



Juvenile Depth Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 4

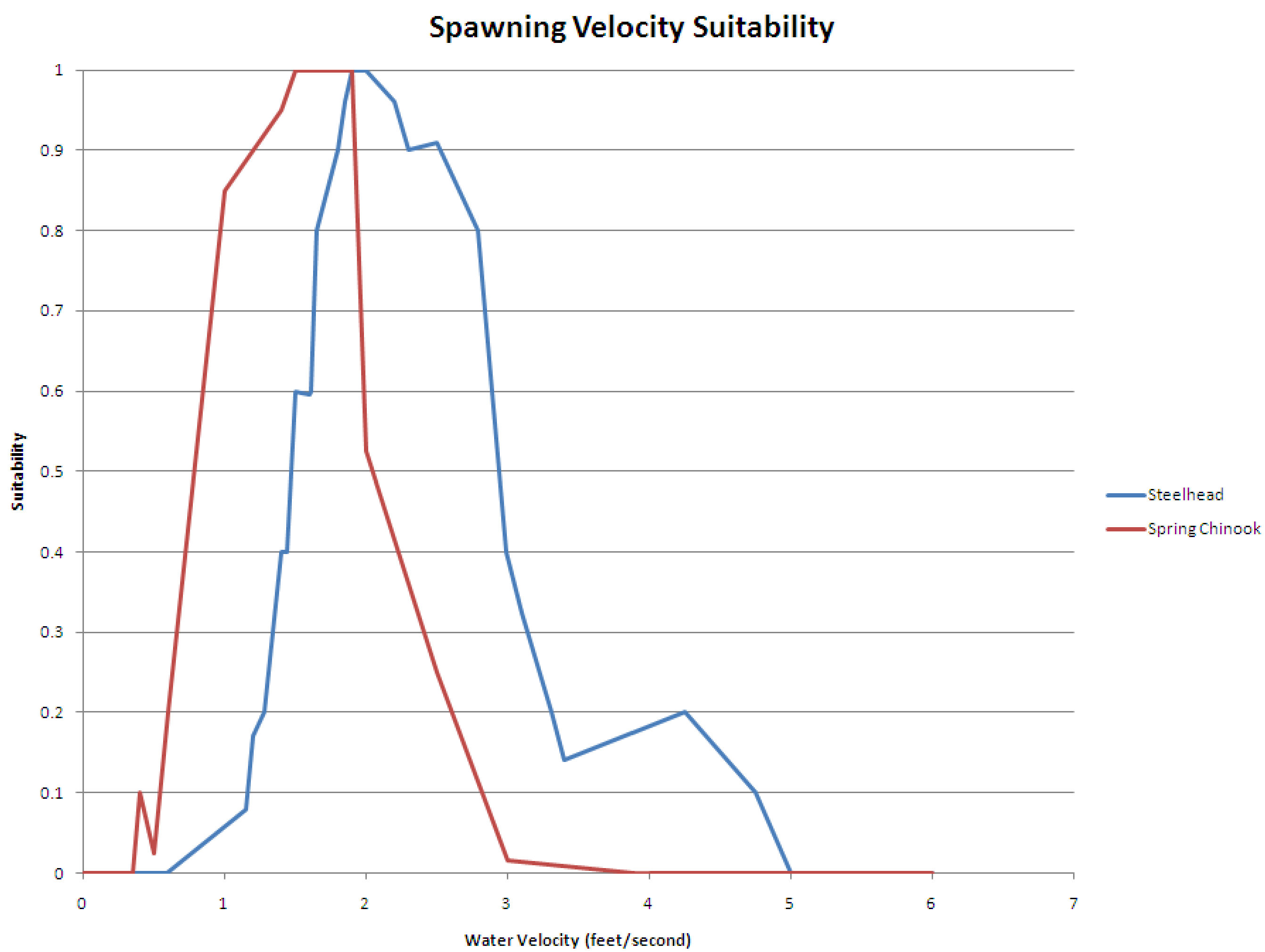
Spok:\P:\02\2698-006\01\finals\Figures1_6 JRS:tlm 02/25/10

Spawning Depth Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 5



Spawning Velocity Suitability

Upper Walla Walla River Lampson Reach
Umatilla County, Oregon

GeoEngineers

Figure 6

APPENDICES

GeoEngineers

APPENDIX A
Report Limitations and Guidelines for Use

APPENDIX A
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Stream and River Design Engineering Services Are Performed for Specific Purposes, Persons and Projects

We have prepared this report exclusively for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) for the above-mentioned enhancement project on the Walla Walla River. The information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. No party other than the CTUIR may rely on the product of our services unless we agree to such reliance in advance and in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions.

GeoEngineers' services have been performed in general accordance with the Technical Services Agreement authorized by GeoEngineers and CTUIR on March 23, 2009, the first Contract Amendment authorized on September 24, 2009 and the second Contract Amendment issued on December 21, 2009 (Agreements). Within the limitations of scope, schedule and budget, our services have been executed in general accordance with these Agreements and generally accepted practices in this area at the time this report was prepared. Use of this report is not recommended for any purpose or project except the one originally contemplated.

A Stream or River Design Engineering Report is Based on A Unique Set of Project-Specific Factors

We have prepared this report exclusively for the CTUIR for the above-mentioned enhancement concepts on the Walla Walla River. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- Not prepared for you
- Not prepared for your project
- Not prepared for the specific site
- Completed before important project changes were made

If important changes are made after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

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[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

Conditions Can Change

This report is based on conditions that existed at the time the study/design was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability, stream flow fluctuations or stream channel fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Report Recommendations and Designs Are Not Final

Do not over-rely on the conceptual recommendations included in this report. These recommendations are not final, because they were developed principally from GeoEngineers' professional judgment and opinion. GeoEngineers' recommendations can be finalized only by observing actual site-specific conditions revealed during construction.

We recommend that you allow sufficient monitoring and consultation by GeoEngineers during construction to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated and to evaluate whether construction activities are completed in accordance with our recommendations. GeoEngineers is unable to assume responsibility for the recommendations in this report without performing construction observation.

The designs depicted herein are approximate and are intended to express the overall design intent of the project. These designs will need to be adjusted in the field during construction in order to meet the specific-site conditions and intended function.

Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

To help prevent costly problems, we recommend giving contractors the complete report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report's accuracy is limited. In addition, encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Instream Habitat Structures

Instream habitat, stabilization, enhancement and/or restoration structures (Structures) involve the placement of large logs, logs with root wads, large rocks and other natural and artificial materials and/or features in and adjacent to creeks, streams and rivers (streams). They are designed for various purposes including but not limited to: improvement of aquatic and riparian habitat; stabilization of eroding stream banks and channels; restoration of stream channels; creation or improvement of recreational uses; irrigation; and flood management.

Hazards of Instream Habitat Structures

Instream habitat structures create potential hazards, including, but not limited to: humans falling from the Structures and associated injury or death; collisions of recreational users' watercraft with the Structures and associated risk of injury or death, with partial or total damage of the watercraft; mobilization of a portion or all of the Structures during high water flow conditions and related damage to downstream properties, utilities, roads, bridges and other infrastructure, and injury or death to humans; flooding; erosion; and channel avulsion. In some cases, instream habitat structures are only intended to be temporary, providing temporary stabilization while riparian vegetation becomes established while or stream/river processes stabilize. This gradual deterioration with age and vulnerability to major flood events make temporary Structures inherently dangerous with increasing age.

It is strongly recommended that the Client address the necessary safety concerns appropriately. This would include warning construction workers of hazards associated with working in or near deep and fast moving water and on steep, slippery and unstable slopes. In addition, signs should be placed along the enhanced stream reaches in prominent locations to warn recreational users of the potential hazards noted above.

Increased Flood Elevations and Wetland Expansion Are Possible

The proposed stream enhancements may result in increased flood elevations and expansion of wetlands. The analysis of these impacts, which are generally considered advantageous for aquatic and riparian habitat in the project locations of these stream systems, may need to be considered and quantified if they were beyond the context of GeoEngineers' scope of services.

Channel Erosion and Migration Are Possible

In general, river and stream enhancements are intended to result in more stable streambeds, banks and floodplains. In some cases, stream enhancement and channel stability means reestablishing the natural balance of sediment erosion, distribution and deposition, which induces channel meandering and migration. Therefore, channel erosion, channel migration and/or avulsions can be expected to occur over time.

Importance of Monitoring and Maintenance

Piles, anchors, chains, cables, reinforcing bars, bolts and similar fasteners may have purposely been excluded from woody habitat structures with the intent of mimicking naturally-occurring instream wood structures. Conversely, such fasteners may have purposely been included in woody habitat Structures if considered appropriate. While the Structures are designed to be relatively stable during flood events, movement of these Structures should be expected. As noted in the text of this report, we recommend that the Client implement appropriate monitoring and maintenance procedures to minimize potential adverse impacts at or near areas of concern, such as at downstream diversion, siphon, road, bridge and/or culvert crossings. This would include replacing, adjusting and removing damaged, malfunctioning or deteriorated components of Structures, particularly following a major storm event.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

APPENDIX B
Construction Quantities and Cost Estimate

Restoration Cost Workbook

Project:	Upper Walla Walla River Enhancement	**Analyst:**	LMS
Project Number:	2698-006-01	**Latest Revision:**	03/02/10

Workbook Description

- This workbook contains spreadsheets that facilitate the analysis and/or design of this project.
- This spreadsheet lists the general project and workbook information that is consistent throughout the workbook.
- It also lists the titles of the spreadsheets contained in this workbook.
- This workbook is intended for use with ENGLISH UNITS.

Filename: *\\geoengineers.com\wan\Spokane\Projects\2\2698006\01\Working\[269800601_Cost Estimat*

Sheet Titles:

Restoration Cost Workbook
Unit Costs
Summary of Construction Quantities
Summary of Restoration Costs

Unit Costs

Project: Upper Walla Walla River Enhancement **Analyst:** LMS

Project Number: 2698-006-01 **Latest Revision:** 3/2/2010

- This spreadsheet calculates the costs associated with site preparation. Unit costs include materials, labor, equipment, overhead and contractor profit.
- Reference used for "unit costs" include:
  (1) R.S. Means Heavy Construction Cost Data Manual, 2010 (Means)
  (2) Engineering Experience & Recent Similar Projects
  (3) Contractor or Supplier
- Inflation adjustment is negligible.
- Additional adjustments are based on engineering judgement, experience and site-specific degree of difficulty.
- Blank rows are provided at the bottom for additional items. Add new items & unit costs on this sheet, if necessary. These will be used to calculate costs on subsequent sheets.
- General mark-up percentages are also provided at the bottom.

0	= Adjustment for inflation from to 2010 to 2010 (Construction) (%)	(consumer price index calculator http://www.bls.gov/data/inflation_calculator.htm)
-5.5	= Location Factor (Richland, WA) (%) (Adjustment from national average)	
0	= Additional Location Factor (NA) (%)	

Item #	Item Description	Ref. ID	Ref. #	Page #	Units	Unit Cost ($)	Inflation & Location Adjustments (%)	Additional Adjustments (%)	Adjusted Unit Price ($)
1	Temporary Stream Diversion	2			LS	10,000	0	0	10000.00
2	Construction Staking	1	01-71-23.13-1100	20	Day	1,075	-5.5	0	1015.88
3	Selectively Lay Back Steep Slopes. Retain 50% trees. (2 CY Excavator, 12 CY Truck, Grade spoils w/ Dozer)	2			Acre	14,000	0	0	14000.00
4	Selective Floodplain Grading. Retain 70 to 90% trees. (Minimal tree density)	2			Acre	14,000	0	0	14000.00
5	Clearing, grubbing, stockpile trees & roots. (Small to Medium Trees)	1	31-11-10.10-0250		Acre	3,925	-5.5	0	3709.13
6	Floodplain Excavation, haul, sockpile & rough grade stockpile.	2			CY	5	0	0	5.00
7	Fine Grade (Sculpt) dry pools, riffle, banks.	2			Acre	4,000	0	0	4000.00
8	In-Water Grading of pools, riffles. No Haul. Excavator Only. Includes isolating work zone from active flow w/ floating cofferdam.	2			Day	3,000	0	0	3000.00
9	Boulder acquisition, haul & placement in stream. 2 to 6 feet in diameter. (Ave. 4-ft used for cost)	2			Each	125	0	0	125.00
10	Install woody habitat structure. Acquire wood from site, mostly small. Assume 25% anchored.	2			Piece	350	0	0	350.00
11	Acquire, haul & install woody habitat structure. Assume 25% anchored.	2			Piece	750	0	0	750.00
12	Best Management Practices, including installation & maintenance.	2			LS	7,500	0	0	7500.00
13	Pumping dirty water from in-water work overboard into settling basin.	2			Day	800	0	0	800.00
14	Riparian Planting, live willow stakes, cottonwood poles, some conifers, seeding.	2			Acre	7,500	0	0	7500.00
15	Transitional Zone Planting, live willow stakes, cottonwood poles, shrubs, bushes,	2			Acre	4,500	0	0	4500.00
16	VACANT								
101	Mobilization (Lump Sum)							0	20000
102	Taxes (as % of Construction Sub-Total)							0	
103	Incidentals not included in items above (as % of Construction Sub-Total)							10	
104	Contingency (as % of Construction Sub-Total)							15	
105	Permitting & Design (as % of Construction Sub-Total)							0	
106	Construction Observation (as % of Construction Sub-Total)							5	

Summary of Construction Quantities

Project: Upper Walla Walla River Enhancement
Project Number: 2698-006-01

Analyst: LMS
Latest Revision: 3/2/2010

- This spreadsheet summarizes the construction quantities for all design componenents and alternatives considered.

Item #	Item Description	Units	Unit Cost	No. of Units	Total Cost ($)
1	Temporary Stream Diversion	LS		1	
2	Construction Staking	Day		5	
3	Selectively Lay Back Steep Slopes. Retain 50% trees. (2 CY Excavator, 12 CY Truck, Grade spoils w/ Dozer)	Acre		1.4	
4	Selective Floodplain Grading. Retain 70 to 90% trees. (Minimal tree density)	Acre		5.4	
5	Clearing, grubbing, stockpile trees & roots. (Small to Medium Trees)	Acre		6.6	
6	Floodplain Excavation, haul, sockpile & rough grade stockpile.	CY		28500	
7	Fine Grade (Sculpt) dry pools, riffle, banks.	Acre		2.1	
8	In-Water Grading of pools, riffles. No Haul. Excavator Only. Includes isolating work zone from active flow w/ floating cofferdam.	Day		7	
9	Boulder acquisition, haul & placement in stream. 2 to 6 feet in diameter. (Ave. 4-ft used for cost)	Each		560	
10	Install woody habitat structure. Acquire wood from site, mostly small. Assume 25% anchored.	Piece		100	
11	Acquire, haul & install woody habitat structure. Assume 25% anchored.	Piece		225	
12	Best Management Practices, including installation & maintenance.	LS		1	
13	Pumping dirty water from in-water work overboard into settling basin.	Day		7	
14	Riparian Planting, live willow stakes, cottonwood poles, some conifers, seeding.	Acre		6.2	
15	Transitional Zone Planting, live willow stakes, cottonwood poles, shrubs, bushes,	Acre		8.0	
16	VACANT	0		0	
	Construction Sub-Total				
101	Mobilization (as % of Construction Sub-Total)				
102	Taxes (as % of Construction Sub-Total)				
103	Incidentals not included in items above (as % of Construction Sub-Total)				
104	Contingency (as % of Construction Sub-Total)				
105	Permitting & Design (as % of Construction Sub-Total)				
106	Other (as % of Construction Sub-Total)				
	Final Construction Cost				

Summary of Restoration Costs

Project: Upper Walla Walla River Enhancement **Analyst:** LMS

Project No: 2698-006-01 **Latest Revision:** 3/2/2010

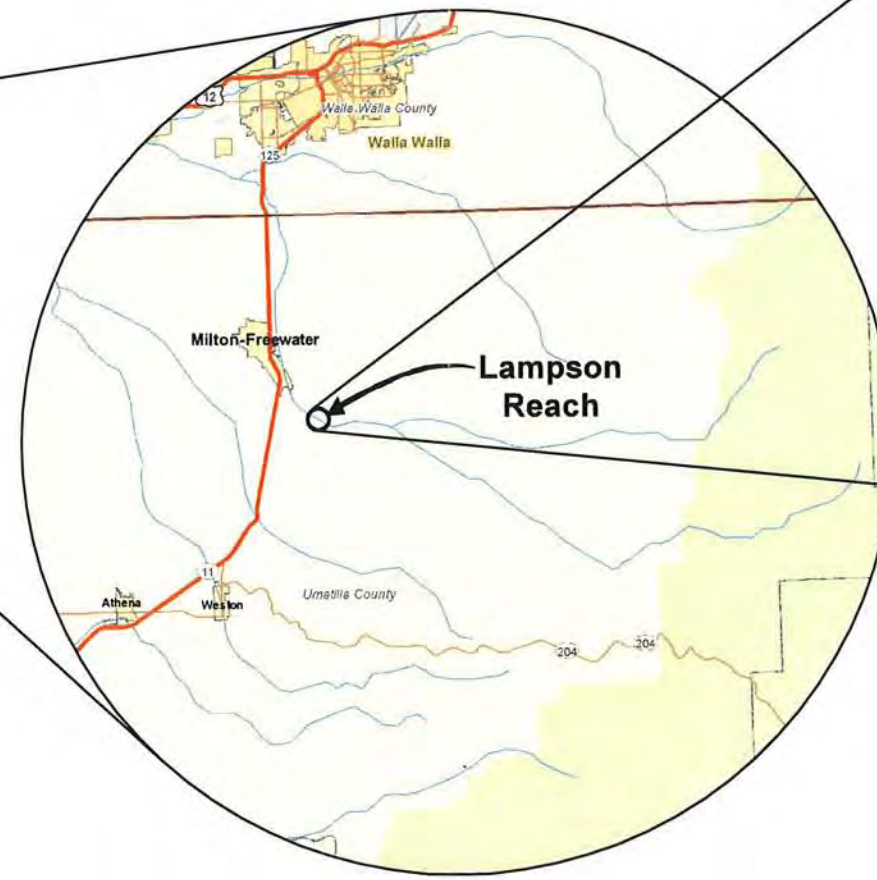
- This spreadsheet summarizes the costs for all design componenents and alternatives considered.

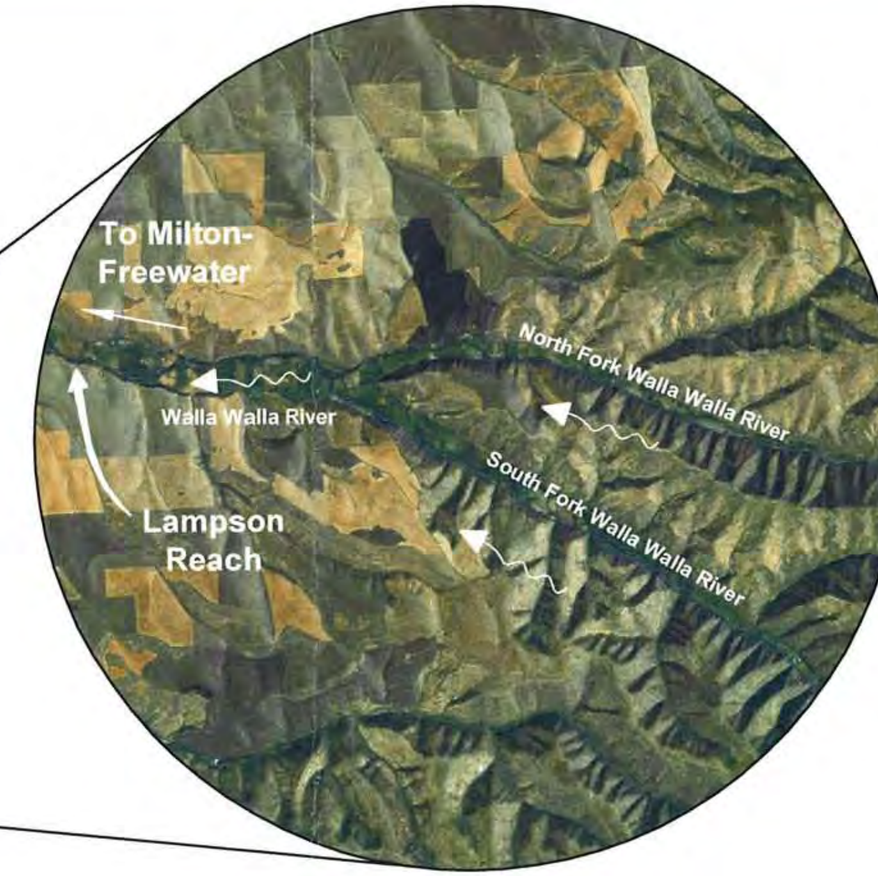
Summary Table

Item #	Item Description	Units	Unit Cost	No. of Units	Total Cost ($)
1	Temporary Stream Diversion	LS	$10,000.00	1	$10,000
2	Construction Staking	Day	$1,015.88	5	$5,079
3	Selectively Lay Back Steep Slopes. Retain 50% trees. (2 CY Excavator, 12 CY Truck, Grade spoils w/ Dozer)	Acre	$14,000.00	1.4	$19,600
4	Selective Floodplain Grading. Retain 70 to 90% trees. (Minimal tree density)	Acre	$14,000.00	5.4	$75,600
5	Clearing, grubbing, stockpile trees & roots. (Small to Medium Trees)	Acre	$3,709.13	6.6	$24,480
6	Floodplain Excavation, haul, sockpile & rough grade stockpile.	CY	$5.00	28500	$142,500
7	Fine Grade (Sculpt) dry pools, riffle, banks.	Acre	$4,000.00	2.10	$8,400
8	In-Water Grading of pools, riffles. No Haul. Excavator Only. Includes isolating work zone from active flow w/ floating cofferdam.	Day	$3,000.00	7.0	$21,000
9	Boulder acquisition, haul & placement in stream. 2 to 6 feet in diameter. (Ave. 4-ft used for cost)	Each	$125.00	560	$70,000
10	Install woody habitat structure. Acquire wood from site, mostly small. Assume 25% anchored.	Piece	$350.00	100	$35,000
11	Acquire, haul & install woody habitat structure. Assume 25% anchored.	Piece	$750.00	225	$168,750
12	Best Management Practices, including installation & maintenance.	LS	$7,500.00	1	$7,500
13	Pumping dirty water from in-water work overboard into settling basin.	Day	$800.00	7	$5,600
14	Riparian Planting, live willow stakes, cottonwood poles, some conifers, seeding.	Acre	$7,500.00	6	$46,500
15	Transitional Zone Planting, live willow stakes, cottonwood poles, shrubs, bushes,	Acre	$4,500.00	8.0	$36,000
16	VACANT	0	$0.00		$0
SUBTOTAL CONSTRUCTION COST					$606,010
101	Mobilization (Lump Sum)				$20,000
102	Incidentals not included in items above (as % of Construction Sub-Total)			10%	$60,601
103	Contingency (as % of Construction Sub-Total)			15%	$90,901
104	Permitting & Design (as % of Construction Sub-Total)				
105	Construction Observation (as % of Construction Sub-Total)			5%	$30,300
FINAL CONSTRUCTION COST					$807,812

APPENDIX C
River Enhancement Design Drawings

LAMPSON PROPERTY
WALLA WALLA RIVER ENHANCEMENT DESIGN DRAWINGS





SHEET	SHEET TITLE
S-1	COVER SHEET
S-2	GENERAL NOTES
S-3.1	VISION, GOALS AND OBJECTIVES
S-3.2	GENERAL LEGEND AND TREATMENTS
S-4.1	EXISTING AERIAL PHOTO (2005)
S-4.2	EXISTING SOILS
S-4.3	EXISTING TOPOGRAPHY
S-4.4	EXISTING HABITAT
S-4.5	EXISTING FLOODPLAIN
S-5.1	PROPOSED CONDITIONS
S-5.2	PROPOSED HABITAT
S-6	REACH INDEX
S-7.1	PROPOSED CHANNEL PLAN AND PROFILE, STA. 15+00 TO STA. 21+50
S-7.2	PROPOSED CHANNEL PLAN AND PROFILE, STA. 21+50 TO STA. 28+00
S-7.3	PROPOSED CHANNEL PLAN AND PROFILE, STA. 28+00 TO STA. 34+50

SHEET	SHEET TITLE
S-7.4	PROPOSED CHANNEL PLAN AND PROFILE, STA. 34+50 TO STA.41+00
S-7.5	PROPOSED CHANNEL PLAN AND PROFILE, STA.22+00 TO STA 28+50
S-7.6	PROPOSED CHANNEL PLAN AND PROFILE, STA. 28+50 TO STA. 33+19
S-7.7	PROPOSED SPRING CHANNEL PLAN
S-8.1	TYPICAL CHANNEL GEOMETRY
S-8.2	TYPICAL SECTIONS
S-8.3	TYPICAL SECTIONS
S-8.4	TYPICAL SECTIONS
S-9.1-S9.6	TYPICAL DETAILS
S-10.1	PLANTING PLAN
S-10.2	PLANTING PLAN
S-10.3	PLANTING PLAN
S-11.1	CONSTRUCTION SEQUENCING
S-11.2	CONSTRUCTION SEQUENCING NOTES
S-11.3	CONSTRUCTION QUANTITIES

REGISTERED PROFESSIONAL ENGINEER 62799PE OREGON JAN. 11, 2000 MICHAEL K. HOMZA

Expires: 6-30-2011

Reference: Aerial image obtained from NAIP, 07/2005, base map obtained from ESRI.

Revision No:	Date:	Description:	Initials:	
				Designed: JJF
				Drawn: MGF
		BID DOCUMENTS		Checked: MKH
		Not For Construction.		Date: 02/24/10
				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
Umatilla Indian Reservation

GEOENGINEERS
523 East Second Avenue
Spokane, Washington 99202

Cover Sheet

Lampson Design Drawings

Sheet S-1

GENERAL NOTES:

These designs and drawings have been prepared for the exclusive use of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and their authorized agents. No other party may rely on the product of our services unless GeoEngineers Inc. (GeoEngineers) agrees in writing in advance of such use.

1. These Lampson Site Walla Walla River enhancement plans represent an engineer-led (design/build) contract and are intended for construction bidding purposes. These plans are not intended for construction without the direct supervision of a qualified GeoEngineers representative.
2. The drawings contained within should not be applied for any purpose or project except the one specified; specifically the habitat enhancements on the Walla Walla River along the Lampson property as located on Sheet 1.
3. These designs and drawings are copyrighted by GeoEngineers, Inc. Any use, alteration, deletion, or editing of this document without explicit written permission from GeoEngineers is strictly prohibited. Any other unauthorized use of this document is prohibited.
4. The contractor shall construct the stream enhancement in accordance with the plans stamped "Approved for Construction." These plans will be provided to the contractor by the engineer or project inspector prior to construction. Work shall not be done without the current set of approved construction plans.
5. These plans are for construction bidding purposes only.
6. The enhancement designs depicted herein are approximate and are intended to express the overall design intent of the project. These designs will need to be adjusted in the field during construction in order to meet the specific site conditions and intended function. These stream improvements have been developed with the understanding that a qualified GeoEngineers engineer and/or scientist be on-site to provide construction guidance while the stream enhancements are constructed to ensure the overall intent of the design is met.
7. Geomorphic conditions can change and these designs are based on conditions that existed at the time the design was performed. The results of these designs may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying these designs to determine if they remain applicable.
8. All streams, rocks and woody habitat structures are potentially dangerous. This proposed stream enhancement design is intended to address a wide variety of constraints which target more naturally functioning stream systems and habitat; they are inherently dangerous. It is therefore strongly recommended that the CTUIR address the necessary safety concerns appropriately with the landowner. Signs placed along the enhanced stream reaches in prominent locations to warn of the potential hazards should be considered a minimum.
9. The project is located in a detailed Flood Zone AE as identified on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) 410204 0250B for Umatilla County, Oregon (Community Number 410204), dated March 4, 1987. Changes to flood elevations and flood extents potentially resulting from the proposed enhancements have not been addressed by GeoEngineers as part of this project. The CLOMR/LOMR process has not been initiated.
10. In general, the proposed enhancements are intended to result in a more stable streambed, banks and floodplain, while increasing in stream habitat for steelhead and other fish. However, channel erosion, channel migration and/or avulsions can be expected to occur over time. These channel processes are natural and appropriate for these stream systems.
11. These figures were originally produced in color.
12. Refer to GeoEngineers accompanying stream enhancement design report for applicable design and contractual limitations.
13. All elevations are based on the National Geodetic Veritcal Datum of 1929. A detailed topographic survey was not performed for portions of this project. All existing and proposed stream features shown are approximate. Topography was obtained from a topographic survey completed by the US Corps of Engineers in 1999.

CONSTRUCTION NOTES:

All contractors working within the project boundaries are responsible for compliance with all applicable safety laws. The contractor shall be responsible for all barricades, safety devices and control of traffic within and around the construction area.

1. All material and workmanship furnished on or for the project must meet the minimum requirements of project permits, approving agencies, specifications as set forth herein, or whichever is more restrictive.
2. Contractor shall not work within any wetland area until the owner has obtained a 404 permit from the United States Army Corps of Engineers. All work within or adjacent to any wetland area shall comply with the conditions of the 404 permit.
3. Contractor shall obtain all necessary permits prior to any dewatering activities on site.
4. The contractor shall install and maintain appropriate sediment control devices throughout the whole project site, including the construction staging area and stockpile area throughout the project's construction. Temporary construction and permanent erosion control measures shall be designed, constructed and maintained in accordance with all applicable local, state and federal regulations.
5. Stream construction shall occur during the fish window for the project area (July 1 - September 30).
6. Fish exclusion shall be conducted in the project area prior to any dewatering activities, or construction within or directly adjacent to the channel.
7. Surface and groundwater shall be drained away from active construction and into a sediment pond/trap to eliminate sediment from flowing into active stream channels.
8. Discharges entering active streams on site shall satisfy all state and federal standards and project permit requirements for contaminants and turbidity.
9. Diverted and controlled streamflow can be used to test and adjust newly constructed stream structures prior to permanently activating new stream segments.
10. Construction shall minimize disturbance to, and maximize reuse of, existing riparian vegetation.
11. All material not used on site shall be disposed of onsite as directed by the CTUIR and landowner or shall be hauled offsite and properly disposed of.
12. Record information shall be accurately recorded by the contractor and supplied to the owner for future use, reference and monitoring. Submittal of record information is a condition of final acceptance.

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				Designed: JJF
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		BID DOCUMENTS		Checked: MKH
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				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
Umatilla Indian Reservation

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General Notes

Lampson Design Drawings

Sheet
S-2

Vision → Goals → Objectives

Vision

Increase and enhance juvenile and adult anadromous fish habitat by targeting limiting habitat factors within the limits of river geomorphology, property ownership, public safety, environmental regulations and project economics.

Goals

Increase and Enhance Habitat

Diversify In-Stream Habitat Complexity
- Multiple Habitats Close Together
- Primary Pool Habitat
- Substrate Diversification
- Structure
- Side Channel/Off Channel Habitat
- Floodplain Connectivity

Increase, Enhance Diversify Riparian Habitat
- Diverse Vegetation (Cover, Temperture, Recruitment, Macroinvertebrates)
- Bio-Engineering (Native Plants. Channel, Floodplain and Habitat Stability)

Geomorphic Stability
- Reduces Erosion, Sedimentation, Property Loss
- Self-Sustaining, Self-Maintaining
- Minimize Maintenance
- Cost Effective

Benefits to Other Species (Water fowl, Song Birds, Upland Species)

Design Practicality

Accommodate Physical, Practical and Regulatory Site Constraints

Objectives

Treatment Options

In-Stream Habitat Structures
- Woody Habitat Structures
- Roughened Channels, Boulder Structures

Floodplain Connectivity
- Layback Steep Existing Slopes
- Levee Removal and/or Setback
- Floodplain Benching
- Floodplain Excavation

Side Channel / Off Channel Habitat
- Create Spring Channels
- Meander Creation (Side Channel, Main Channel)
- Wetlands
- Backwater Habitat

Preserve, Enhance and Minimize Disturbance to High-Value Resources

Vegetation Plan

Practical Design Considerations

- Public Safety
- Flood Management
- Geomorphic Stability (Minimizes Avulsions, Erosion, Sedimentation, Habitat Destruction)
- Zoning, Easements, Setbacks, Floodplains, Zones
- Property Boundaries
- Landowner Desires
- Neighboring Properties
- Bridges, Utilities, Water Rights
- Grades, Access, Views
- Permits, Schedule, Budget, Maintenance, Constructability
- Economics

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Revision No:	Date:	Description:	Initials:						
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Treatments			Benefits												
Symbol	Name	Description	Stream Function *				Stream & Flood Management *			Habitat					
			Dissipates Energy	Maintains Deeper Water	Focuses, Directs or Turns Flow	Promotes Gravel Sorting	Lowers Flood Elevation	Bank and Erosion Protection	Avulsion (Stream Movement) Protection	Fish Holding	Fish Rearing	Fish Cover and Refuge	Fish Food Source	Fish Spawning	Riparian and Upland Habitat Continuity
	Boulder Drop/Roughened Channel	Multiple boulders at upstream end of pool.	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Boulders	Boulders placed in stream or at bank toe.	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Riffle	Boulders, cobbles and large gravel downstream of pools.	✓		✓	✓				✓	✓	✓	✓	✓	
	Pool	Deeper water. Typically on bends or below boulder drops.	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	
Not Shown	Pool Run Out (Run)	Downstream end of pool. Slow, deep, quite water.	✓	✓	✓	✓					✓		✓	✓	✓
Not Shown	Gravel Bar	Gravel on islands, banks or at downstream ends of pools, some with vegetation.				✓					✓		✓	✓	✓
	New Channel	New Channel Meander, Side or Backwater Channel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Woody Habtat Structure	Large trees with or without rootwads buried in banks or in stream.	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
	Lay Back Bank Slope	Selectively excavate high steep banks to bankfull elevation. Reduce sideslope. Save good trees. Plant.	✓				✓	✓					✓		✓
	Spring Channel	Create new off channel stream from spring/irrigation return (Lampson)								✓	✓	✓	✓	✓	✓
	Selective Floodplain Excavation and Grading	Selectively excavate and grade floodplain. Retain 70% to 95% of trees. Plant.	✓				✓	✓	✓			✓	✓		✓
Not Shown	Maintain existing bankfull depth	Where channel banks are lowered, maintain existing channel depth to maintain sediment conveyance.				✓			✓						
	Accentuate select stream bends	Accentuate select stream bends to decrease local gradient and create better pool & fish habitat.	✓	✓	✓	✓		✓	✓	✓	✓	✓			
	Wetlands	Wetland Vegatation													✓

* All of the proposed stream enhancements will collectively promote stream stability, enhance aquatic (fish) habitat and safely manage flooding in the project reach and in neighboring reaches.

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Revision No:	Date:	Description:	Initials:	
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				Drawn: MGF
				Checked: MKH
				Date: 02/24/10
				Project No: 2698-006-01

BID DOCUMENTS
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Walla Walla River
Umatilla County, Oregon
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General Legend and Treatments

Lampson Design Drawings

Sheet
S-3.2

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				Drawn: MGF
				Checked: MKH
	BID DOCUMENTS	Not For Construction.		Date: 02/24/10
				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
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Existing Aerial Photo (2005)

Lampson Design Drawings

Sheet **S-4.1**

MKH : MGF

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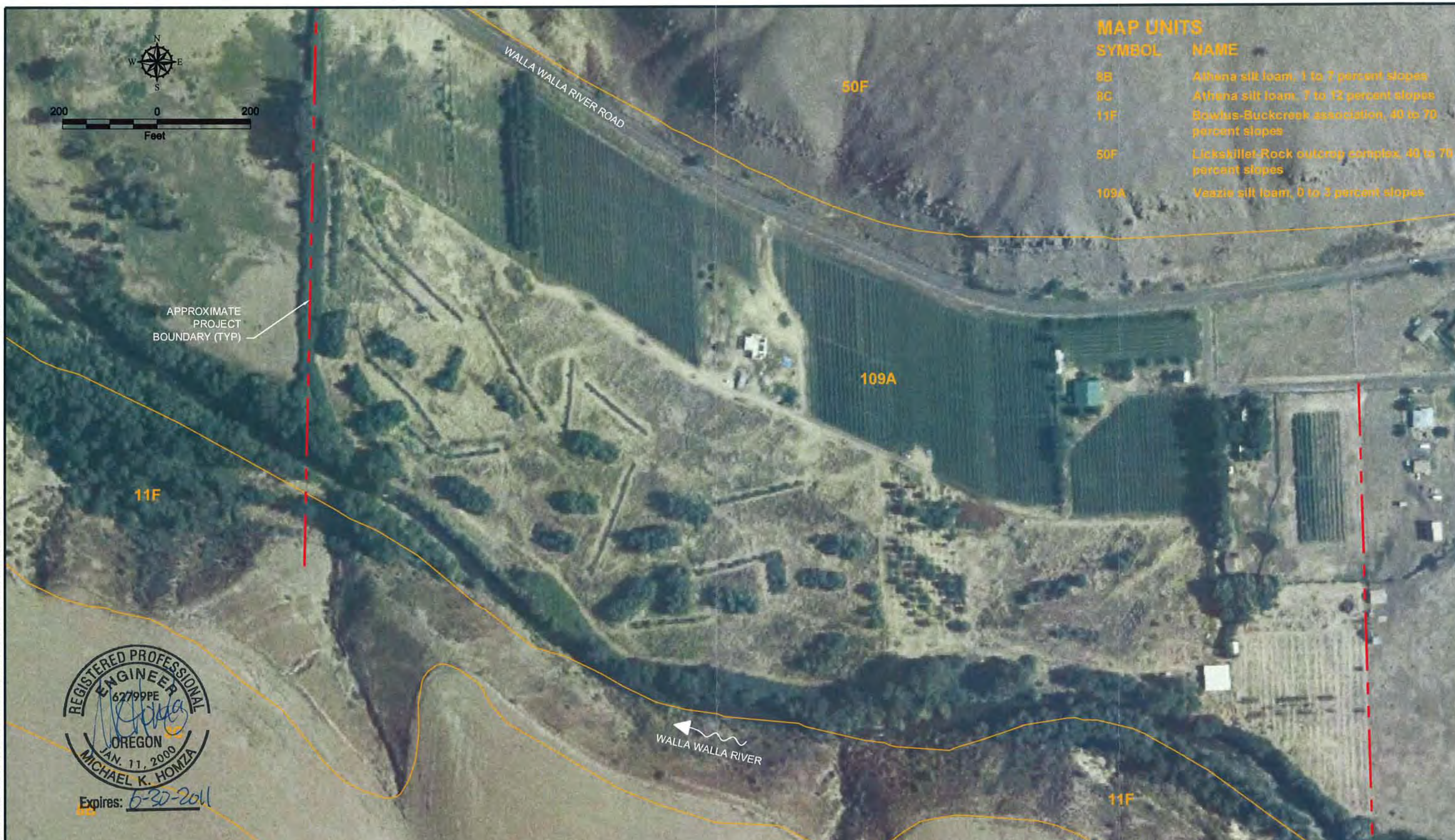

Reference: Aerial obtained from NAIP, 2005. Soil data obtained from the USDA NRCS Web Soil Survey on 5/28/2009.

Revision No:	Date:	Description:	Initials:					
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MKH : MGF

Reference: Aerial obtained from NAIP, 7/25/2005, existing topography based on US Army Corps of Engineers Data.

Revision No:	Date:	Description:	Initials:	
		BID DOCUMENTS Not For Construction.		Designed: JJF
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				Checked: MKH
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Existing Topography

Lampson Design Drawings

Sheet **S-4.3**

MKH : MGF

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Revision No:	Date:	Description:	Initials:	
		BID DOCUMENTS Not For Construction.		Designed: JJF Drawn: MGF Checked: MKH Date: 02/24/10 Project No: 2698-006-01

Walla Walla River
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Existing Habitat

Lampson Design Drawings

Sheet **S-4.4**

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MKH : MGF

Reference: Aerial obtained from NAIP, 7/25/2005. Flood data obtained from FEMA FIRM, Community-Panel Number 410204 0250 B, Revised March 4, 1987.

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				Designed: JJF
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		BID DOCUMENTS		Checked: MKH
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				Project No: 2698-006-01

Walla Walla River
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Existing Conditions and Floodplains

Lampson Design Drawings

Sheet
S-4.5

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MKH : MGF

Reference: Aerial obtained from NAIP, 7/25/2005.

Revision No:	Date:	Description:	Initials:	
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Walla Walla River
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Proposed Conditions

Lampson Design Drawings

Sheet **S-5.1**

MKH : MGF

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LEGEND	EXISTING AREA (acre)	PROPOSED AREA (acre)	CHANGE (acre)	CHANGE (%)
Spawning habitat	0.15 ac	0.59 ac	0.44 ac	304%
Juvenile habitat	0.19 ac	0.96 ac	0.77 ac	404%
Upland habitat	20.5 ac	16.0 ac	-4.49 ac	-22%
Riparian habitat	5.4 ac	9.4 ac	3.99 ac	74%
Open water	3.1 ac	3.6 ac	0.50 ac	16%
Total	29.0 ac	29.0 ac		

Reference: Aerial obtained from NAIP, 7/25/2005.

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Walla Walla River
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Proposed Habitat

Lampson Design Drawings

Sheet **S-5.2**

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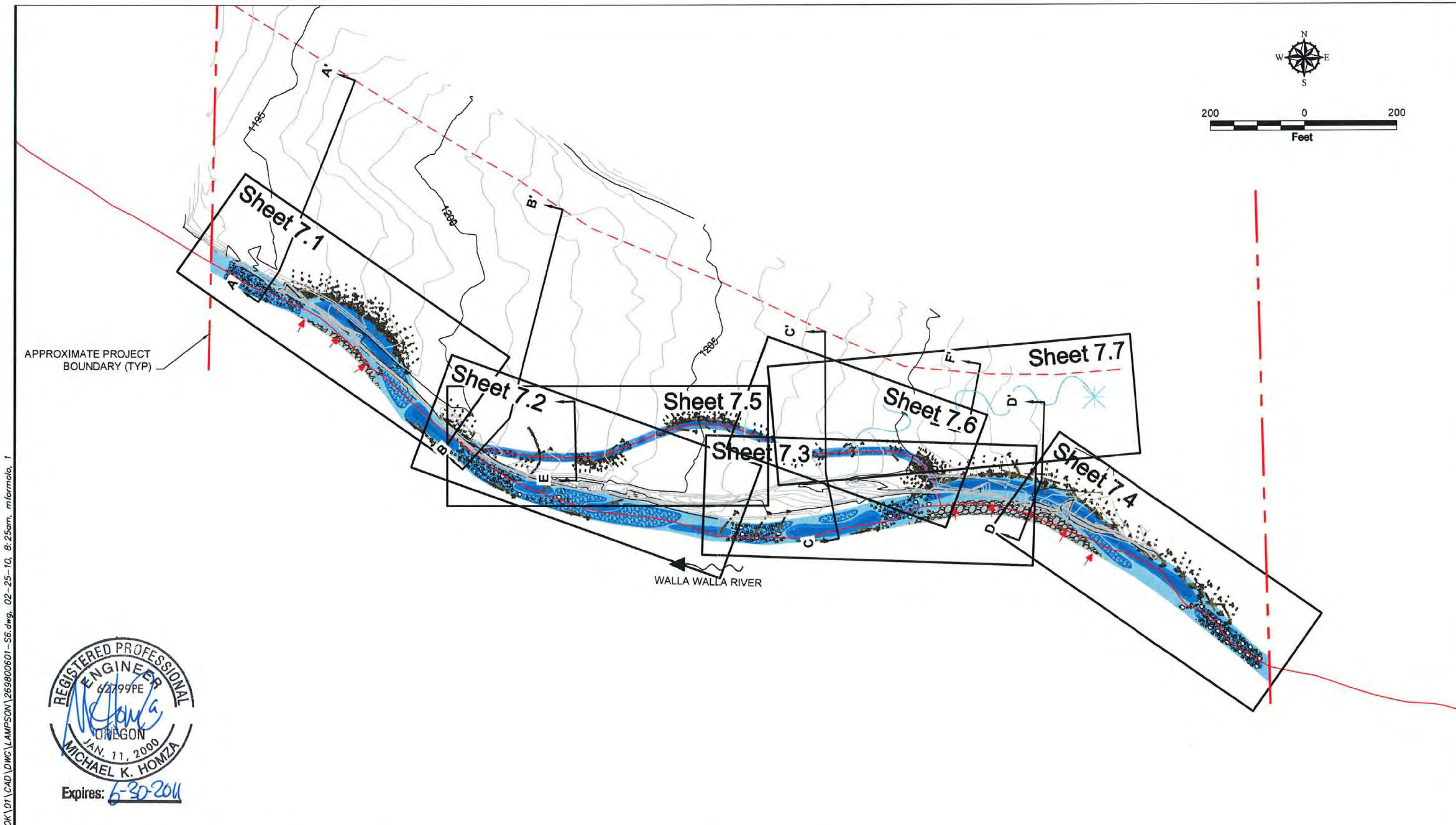

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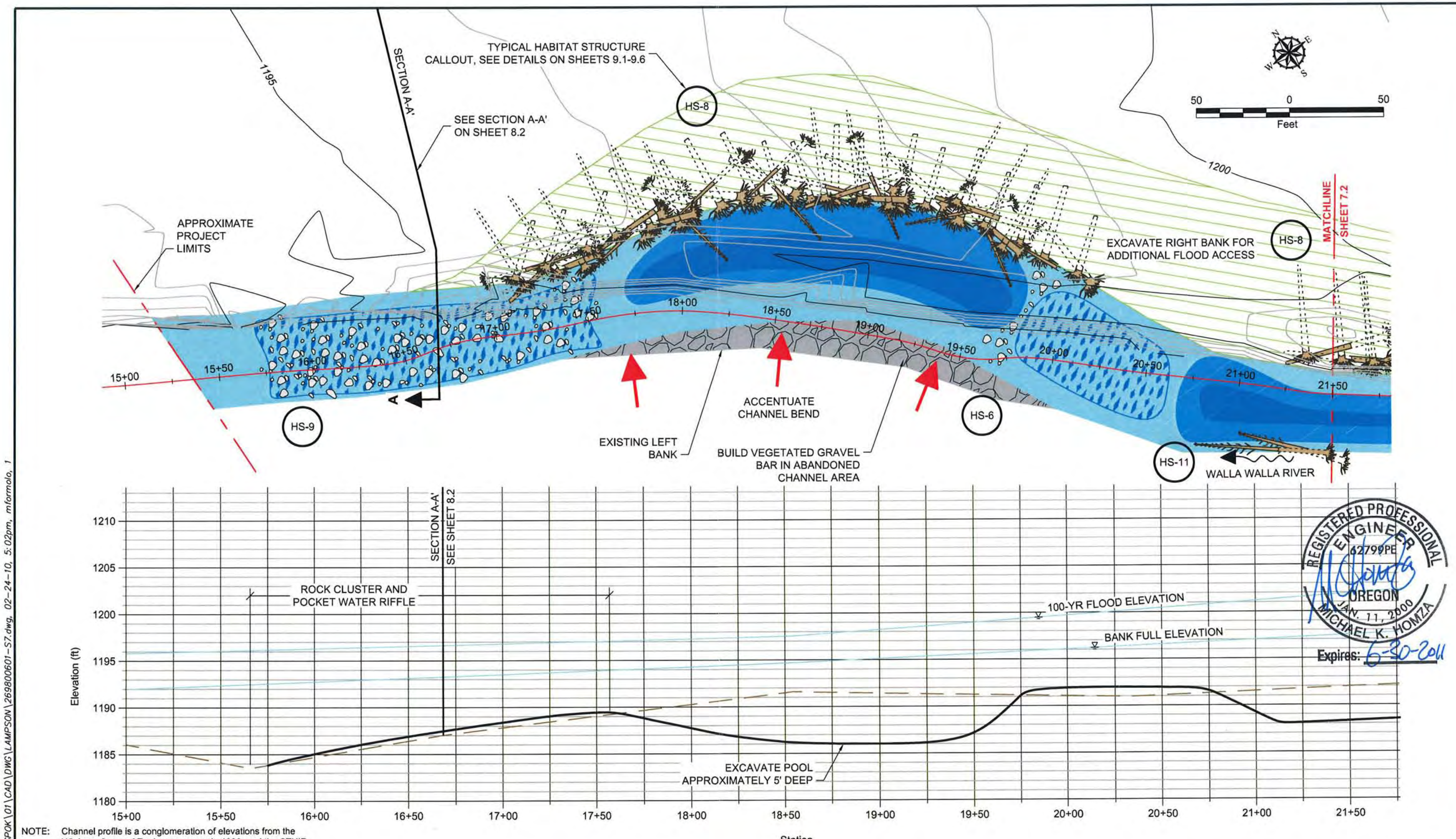
Reference: Site topography is from US Army Corps of Engineers survey in 1999.

Revision No:	Date:	Description:	Initials:						
				Designed: JJF	Walla Walla River Umatilla County, Oregon Confederated Tribes of the Umatilla Indian Reservation		GEOENGINEERS 523 East Second Avenue Spokane, Washington 99202	Sheet Index	Sheet
				Drawn: MGF					
		BID DOCUMENTS		Checked: MKH				Lampson Design Drawings	S-6
		Not For Construction.		Date: 02/24/10					
				Project No: 2698-006-01					



NOTE: Channel profile is a conglomeration of elevations from the US Army Corps of Engineers survey in 1999, and the CTUIR survey in 2009.

Revision No:	Date:	Description:	Initials:	
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				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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Proposed Plan and Profile
Sta. 15+00 to Sta. 21+50

Lampson Design Drawings

Sheet
S-7.1

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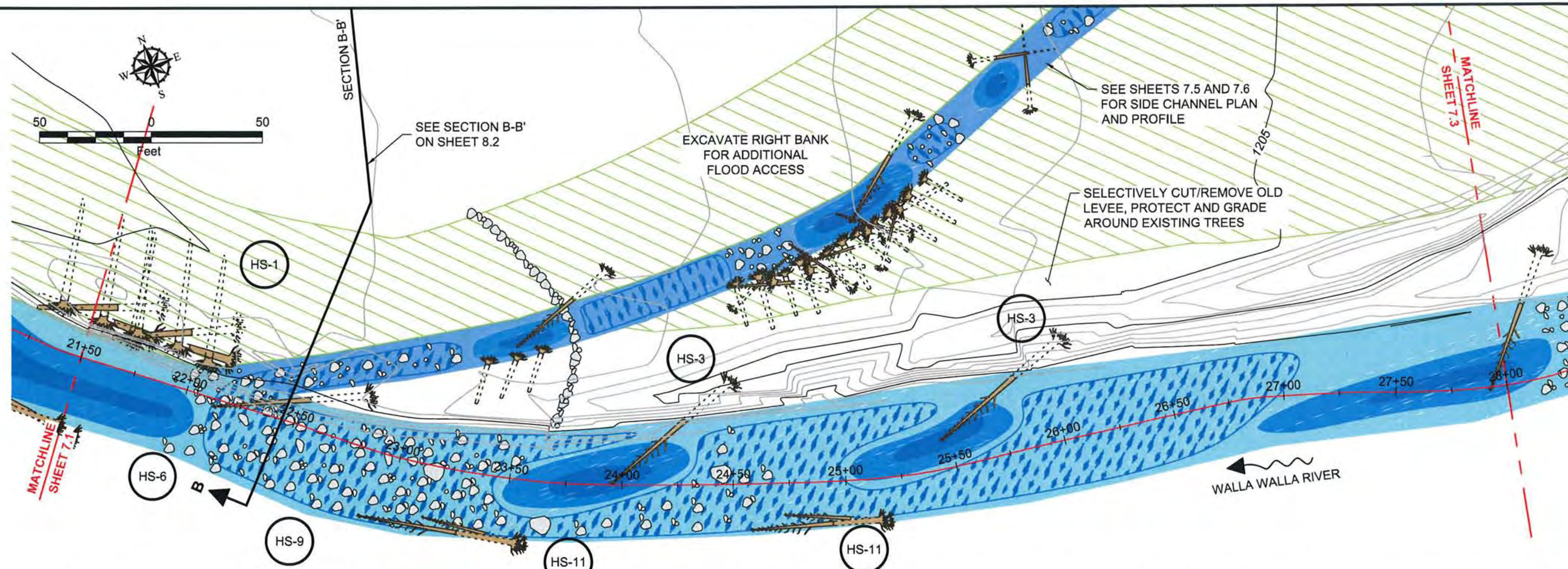

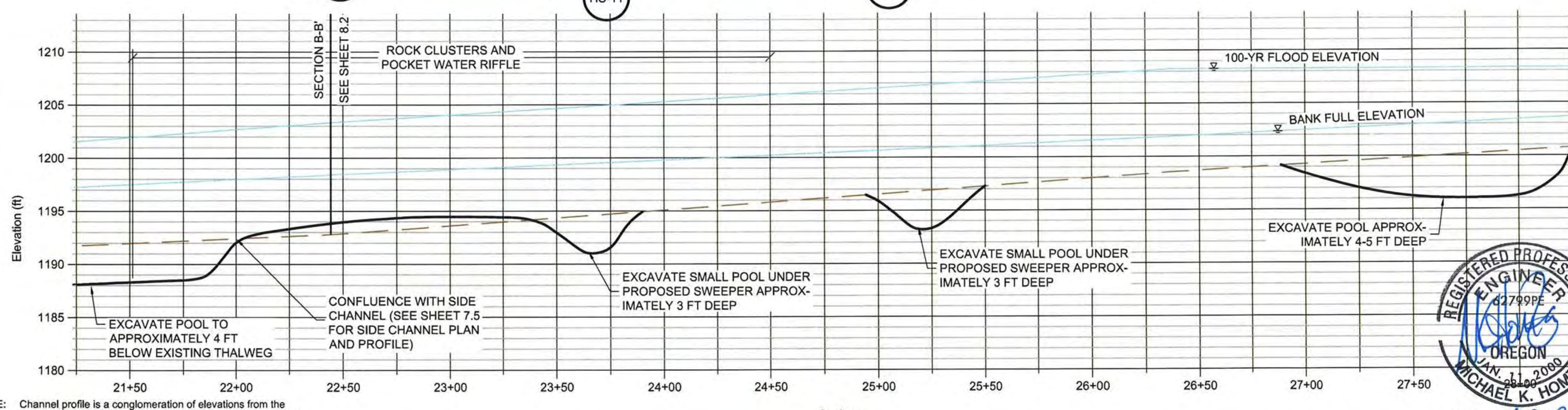

NOTE: Channel profile is a conglomeration of elevations from the US Army Corps of Engineers survey in 1999, and the CTUIR survey in 2009.

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				Designed: JJF
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		BID DOCUMENTS		Checked: MKH
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Walla Walla River
Umatilla County, Oregon
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Proposed Plan and Profile
Sta. 21+50 to Sta. 28+00

Lampson Design Drawings

Sheet **S-7.2**

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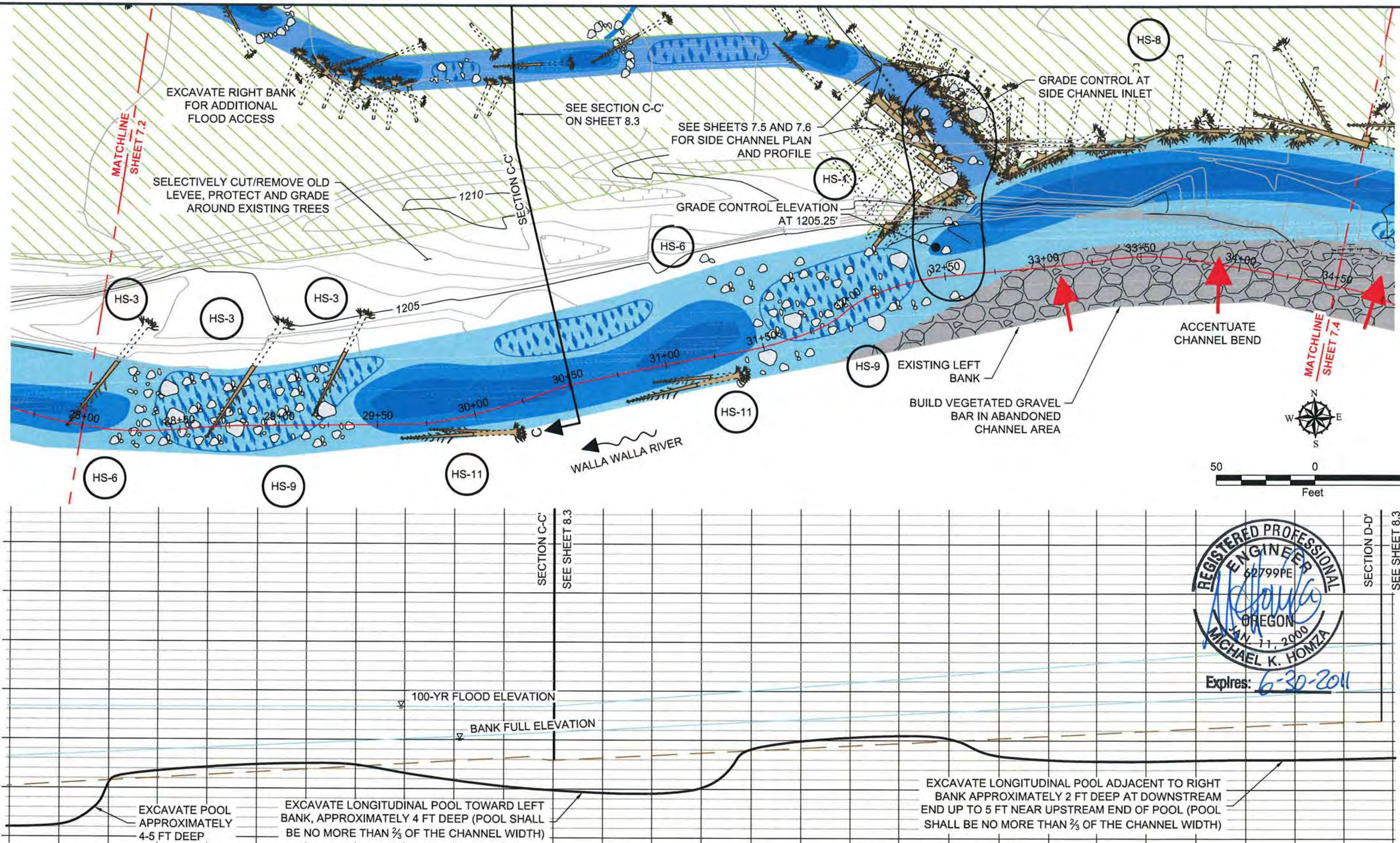

NOTE: Channel profile is a conglomeration of elevations from the US Army Corps of Engineers survey in 1999, and the CTUIR survey in 2009.

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				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the Umatilla Indian Reservation

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Proposed Plan and Profile
Sta. 28+00 to Sta. 34+50

Lampson Design Drawings

Sheet **S-7.3**

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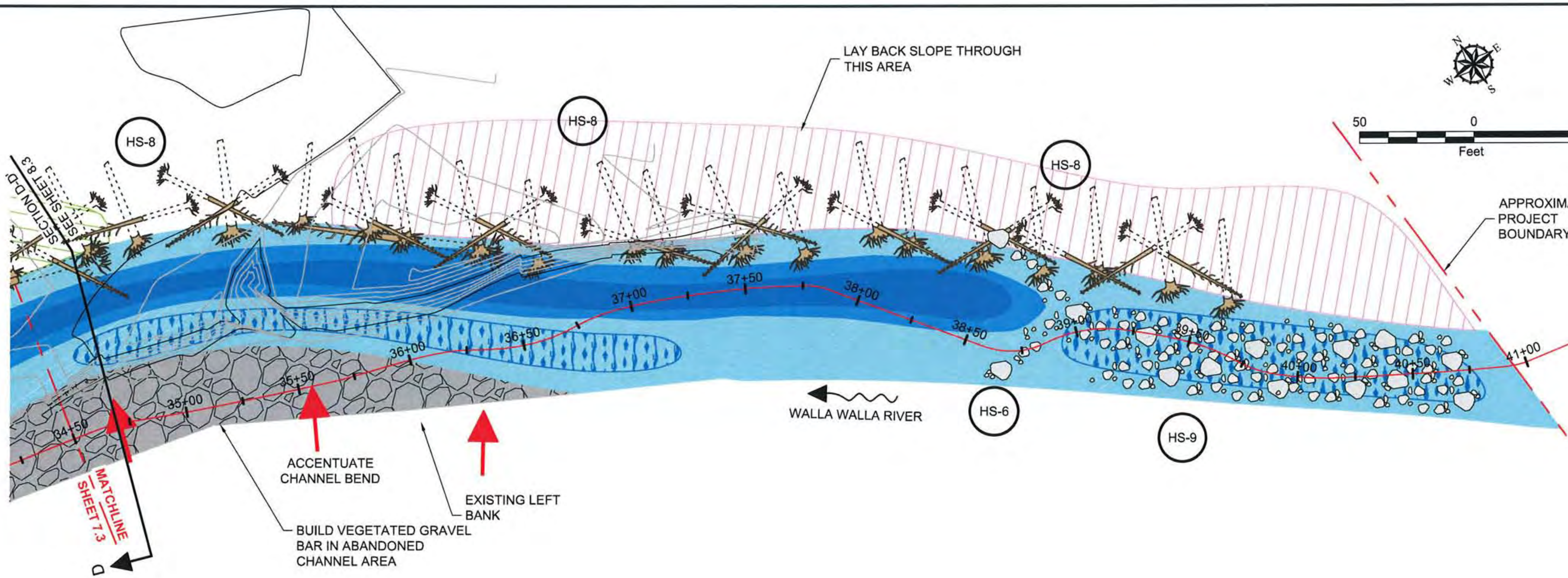

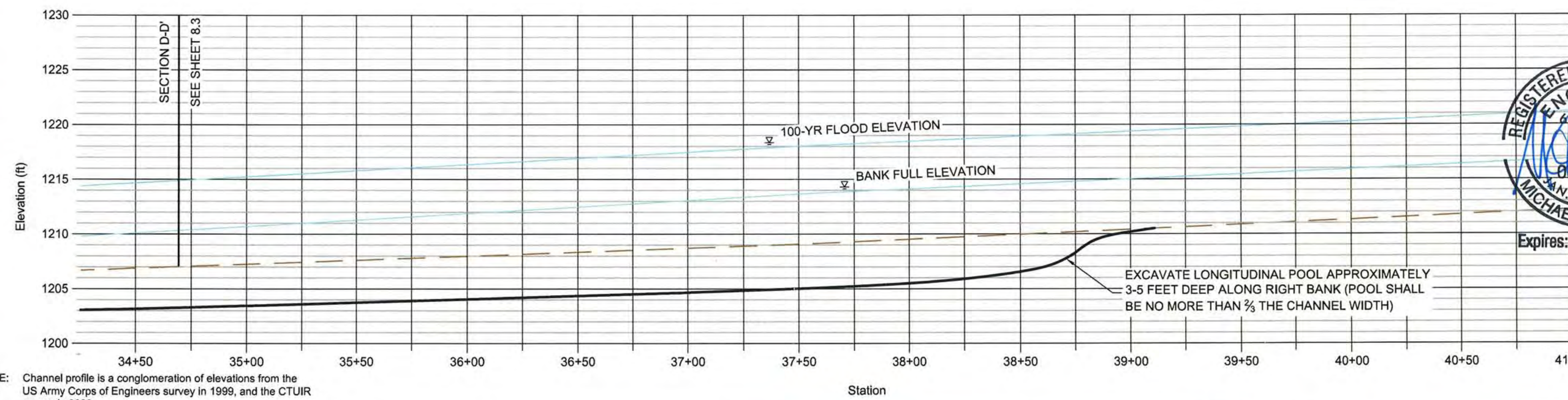

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Walla Walla River
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Proposed Plan and Profile
Sta. 34+50 to Sta. 41+00

Lampson Design Drawings

Sheet
S-7.4

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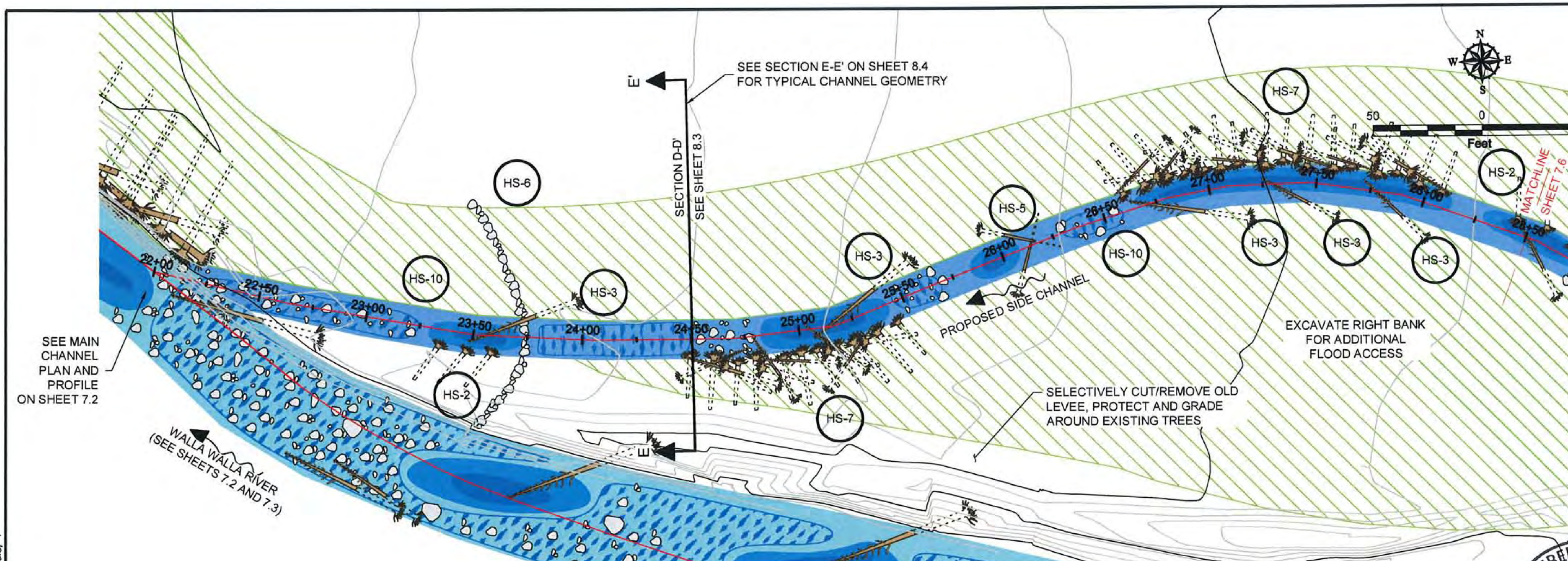

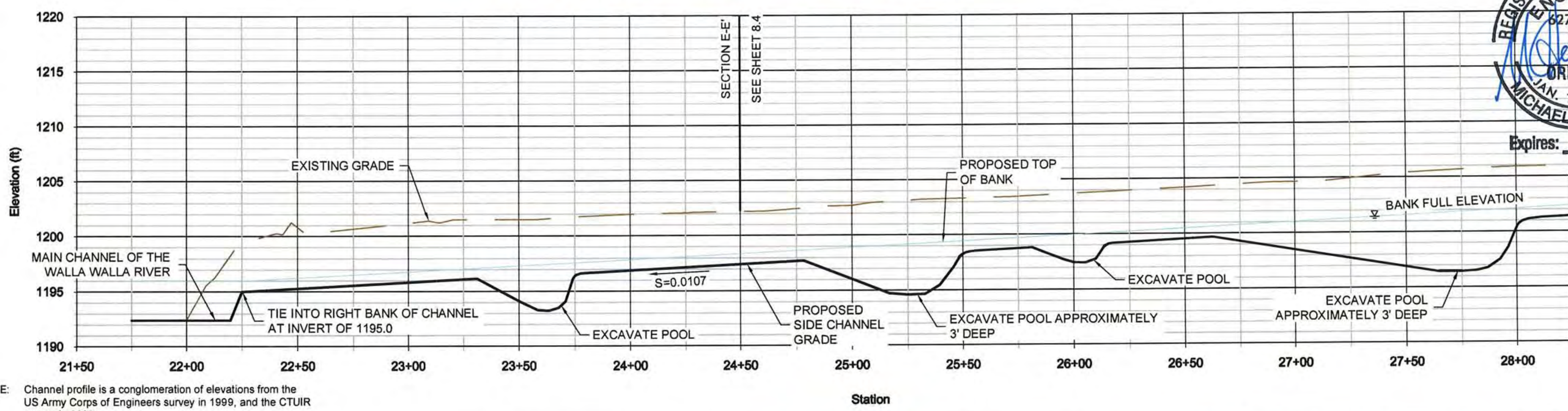

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Walla Walla River
Umatilla County, Oregon
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Proposed Side Channel Plan & Profile
Sta. 22+00 to Sta. 28+00

Lampson Design Drawings

Sheet **S-7.5**

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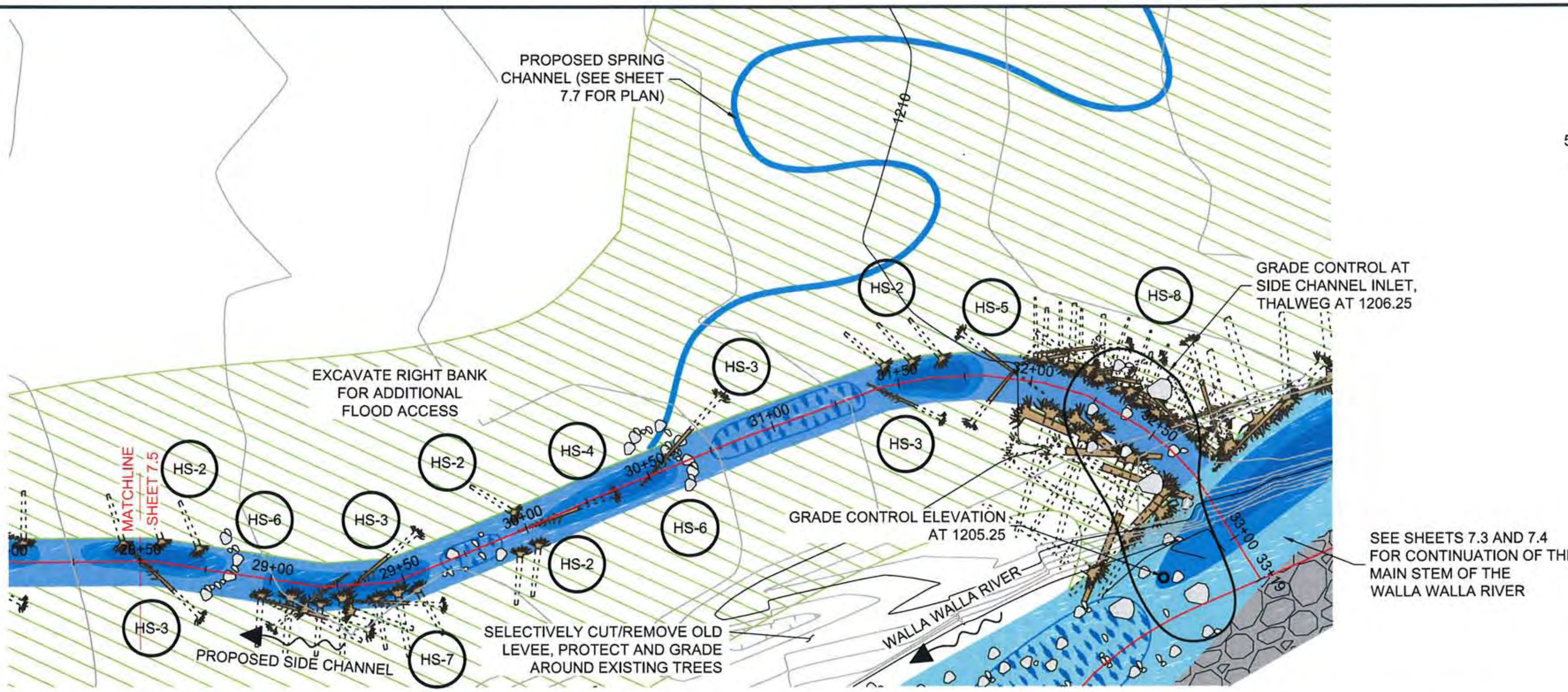

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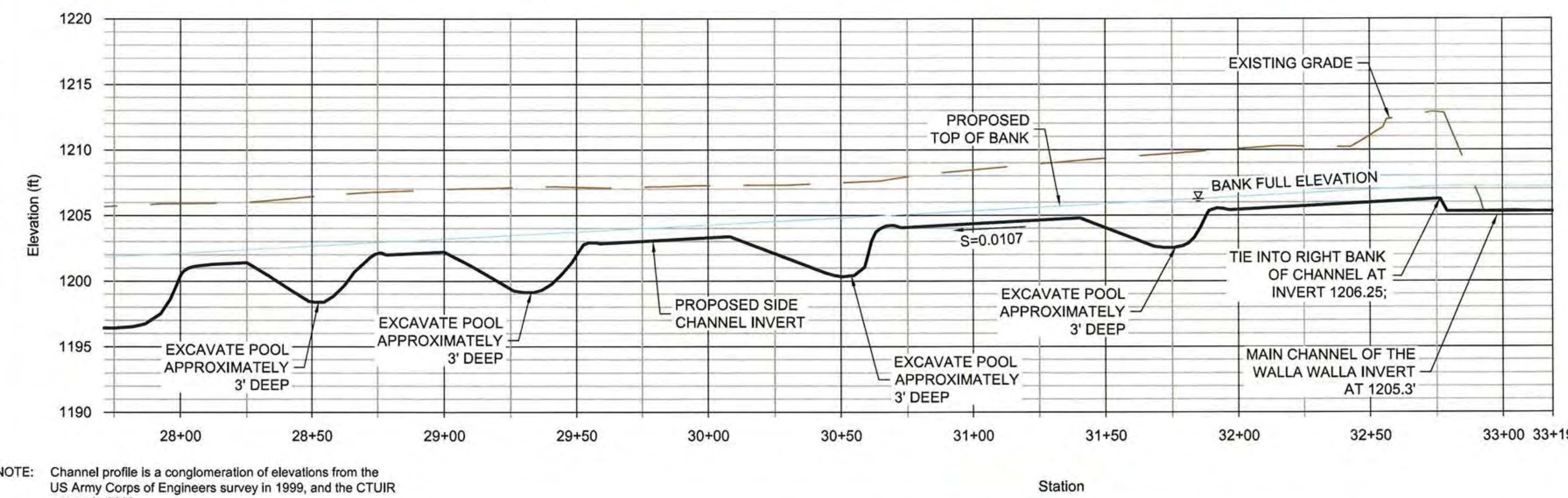

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Expires: 6-30-2011

NOTE: Channel profile is a conglomeration of elevations from the US Army Corps of Engineers survey in 1999, and the CTUIR survey in 2009.

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Revision No:	Date:	Description:	Initials:	
				Designed: JJF
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				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the Umatilla Indian Reservation

GEOENGINEERS
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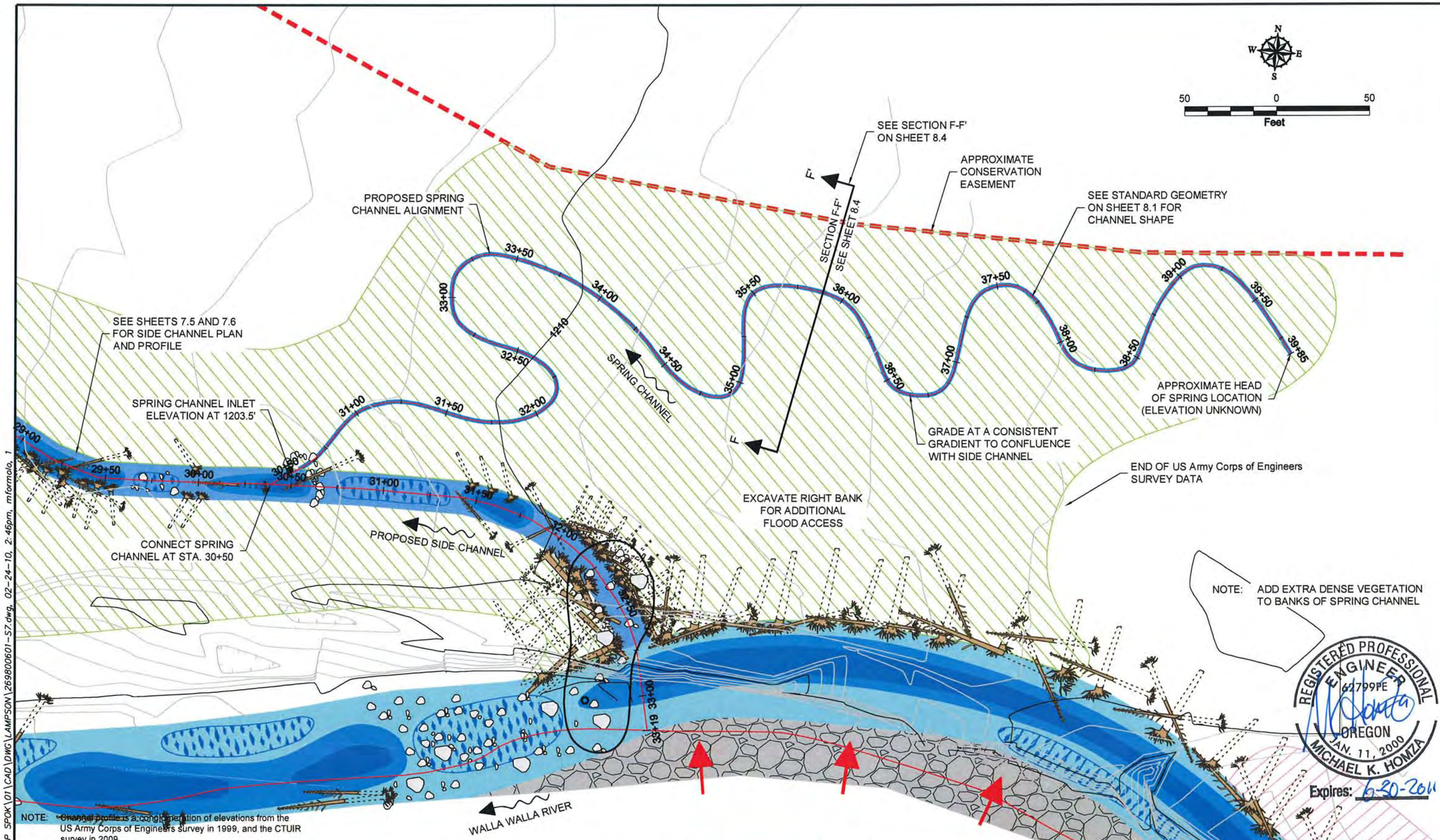
Proposed Side Channel Plan & Profile
Sta. 28+00 to Sta. 33+19

Lampson Design Drawings

Sheet
S-7.6



Revision No:	Date:	Description:	Initials:	
				Designed: JJF
				Drawn: MGF
		BID DOCUMENTS		Checked: MKH
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		Not For Construction.		Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
Umatilla Indian Reservation

GeoEngineers
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Proposed Spring Channel Plan

Lampson Design Drawings

Sheet
S-7.7

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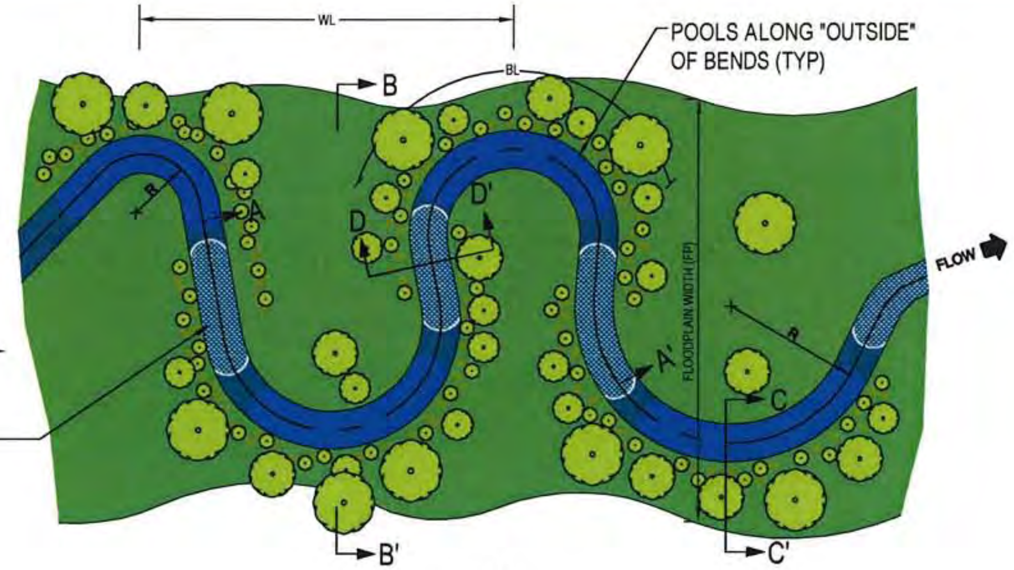
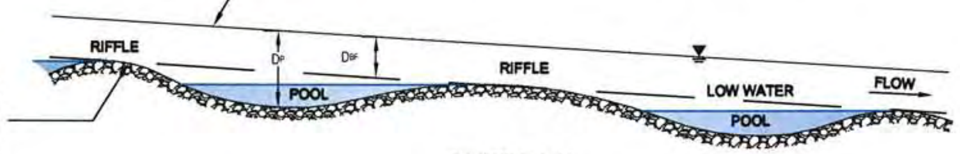
MKH : MGF

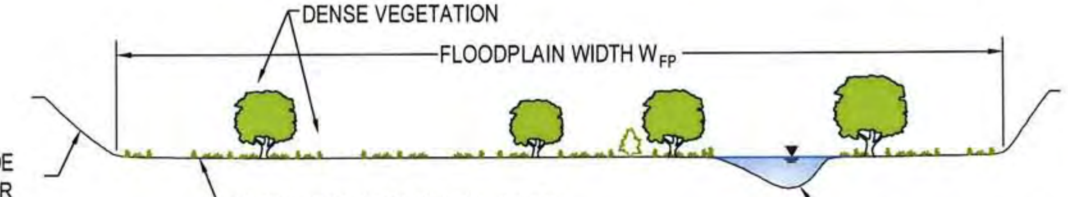


PLAN
NOT TO SCALE

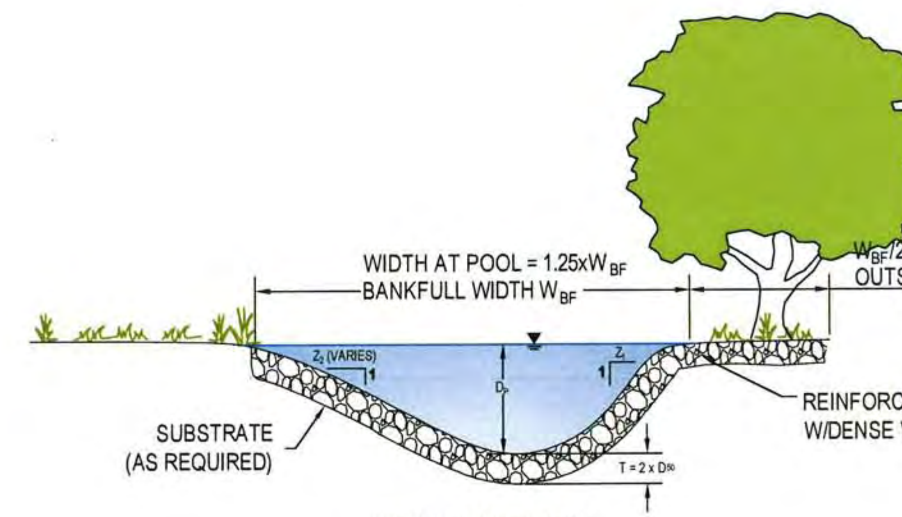


PROFILE A-A'
NOT TO SCALE

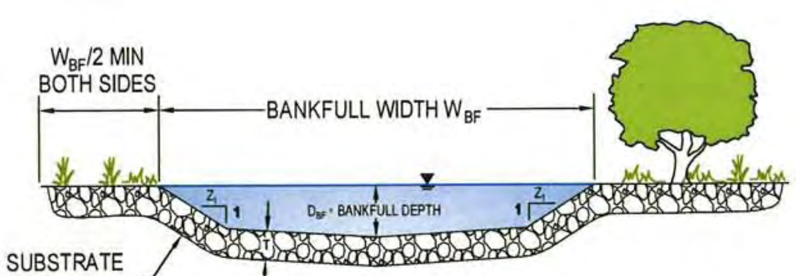
Stream Geometry Summary Table				
Side Channel		Spring Channel	Stream Geometry/Parameters	
C3		See Typical Section on Sheet 8.4		= Rosgen Stream Type
1.12				= Sinuosity
6				= Width / Depth Ratio
21				= Minimum Entrenchment Ratio
0.0101				= Average Valley Gradient (ft/ft)
0.0107				= Average Creek Gradient (ft/ft)
1,000				= Valley Length (ft)
1,119				= Creek Length (ft)
105				= Bankfull Discharge (cfs)
6,232				= 100-Year Flood Discharge (cfs)
3.7				= Average Bankfull Velocity (fps)
15.00			= W_{BF}	= Bankfull Width (ft)
2.40			= D_{BF}	= Bankfull Depth (At Riffle) (ft)
6.10			= D_P	= Pool Depth at Bankfull Flow (ft) (Ranges from $2.0D_{BF}$ to $3.5D_{BF}$)
1.25			= Z_1	= Channel Sideslope (Horizontal Ratio)
2.5			= Z_2	= Channel Sideslope on Inside of Bend, Approximate (Horizontal Ratio)
3.00			= D_{16}	= Riffle Substrate Size (in) (16% of material this size or smaller)
6.00			= D_{50}	= Riffle Substrate Size (in) (50% of material this size or smaller)
8.00			= D_{84}	= Riffle Substrate Size (in) (84% of material this size or smaller)
9.00			= D_{100}	= Riffle Substrate Size (in) (100% of material this size or smaller)
12.0			= T	= Minimum Substrate Layer thickness (in)
130	500		= WL	= Range of Acceptable Meander Wavelengths (ft)
85	330		= BL	= Range of Bend Length (ft)
70	310		= FP	= Range of Acceptable Minimum Floodplain Widths (ft)
25	90		= R	= Range of Acceptable Radii of Curvature (ft)
40	250		= P/P	= Range of Acceptable Pool To Pool Spacing (ft)



SECTION B-B'
NOT TO SCALE



SECTION C-C' (AT POOL)
NOT TO SCALE



SECTION D-D' (AT RIFFLE)
NOT TO SCALE

NOTES:

1. STREAM AND FLOODPLAIN SHALL BE CONSTRUCTED TO MEET THESE GEOMETRIES.
2. CONSTRUCT FLOODPLAIN FIRST. MAKE FLOODPLAIN LEVEL FROM SIDE TO SIDE. EXCAVATE BANKFULL SIDE CHANNEL SECOND. PLACE SOIL FROM CHANNEL ON FLOODPLAIN. GRADE FLOODPLAIN TO CREEK AT 20H:1V (MAX) SLOPE. GRADE TO APPEAR NATURAL. GRADE FLOODPLAIN WITH GENTLE HIGH AND LOW SPOTS.
3. PLANT STREAMBANKS AND FLOODPLAINS AS SPECIFIED IN PLANTING PLAN.
4. ADD TREES, WOOD HABITAT STRUCTURES TO CREEK TO INCREASE CHANNEL ROUGHNESS.

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OREGON
JAN. 11, 2000
MICHAEL K. HOMZA
Expires: 6-30-2011

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Revision No:	Date:	Description:	Initials:	
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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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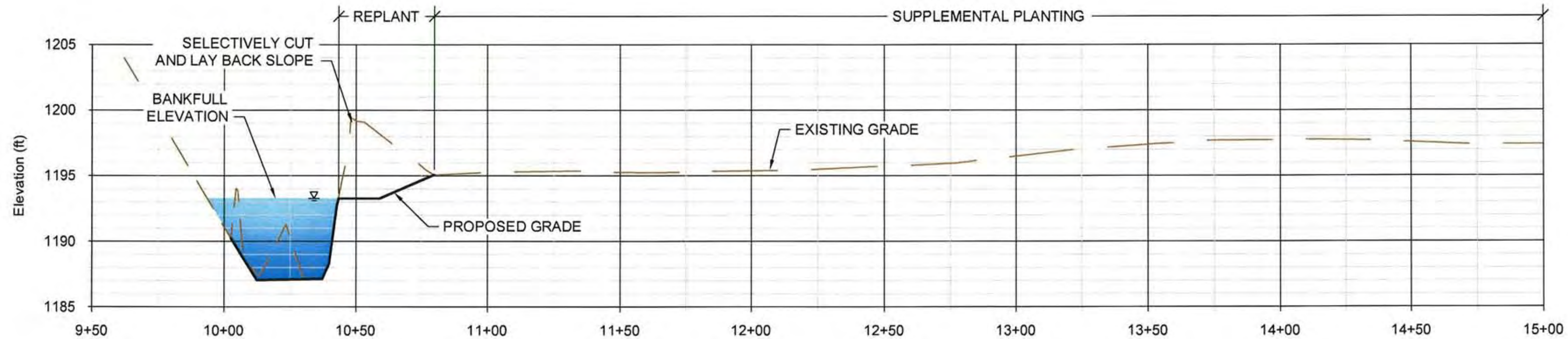
Typical Channel Geometry

Lampson Design Drawings

Sheet **S-8.1**



Section A-A'
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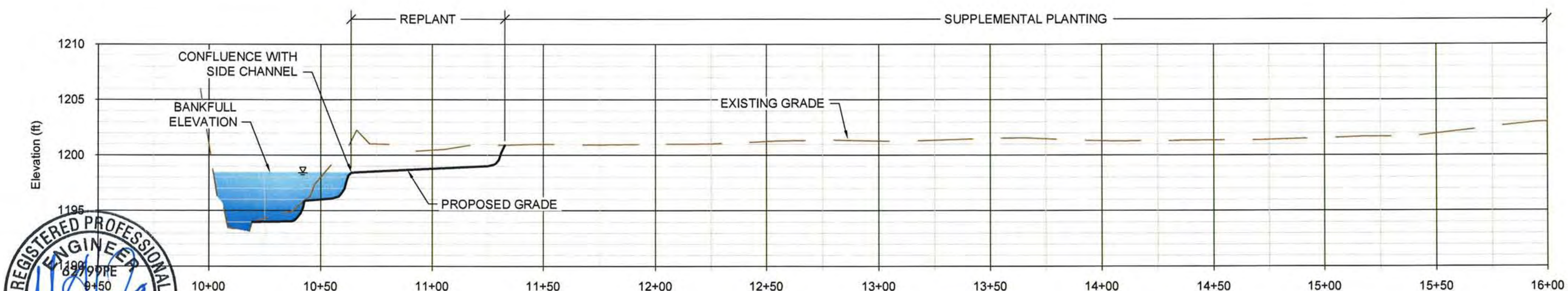
Vertical Scale: 1" = 10'



Section B-B'
Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 10'

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JAN. 11, 2000
MICHAEL K. HOMZA
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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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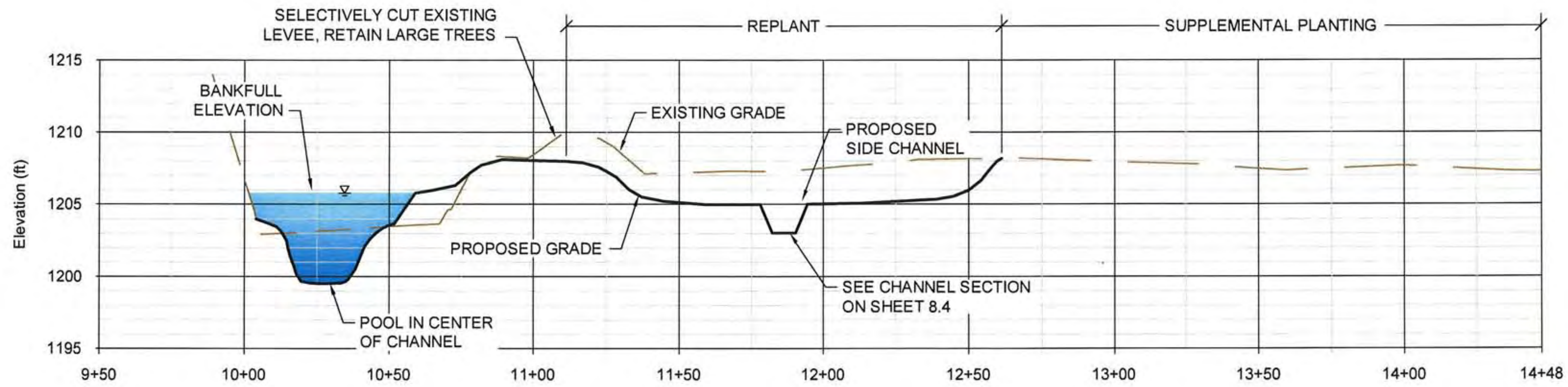
Typical Sections

Lampson Design Drawings

Sheet **S-8.2**

MKH : MGF

P:\2698006 TEMP SPOK\01\CAD\DWG\LAMPSON\269800601-S8.2-S8.3.dwg\TAB:Sheet 8.2 modified on Feb 24, 2010 - 3:02pm



Section C-C'
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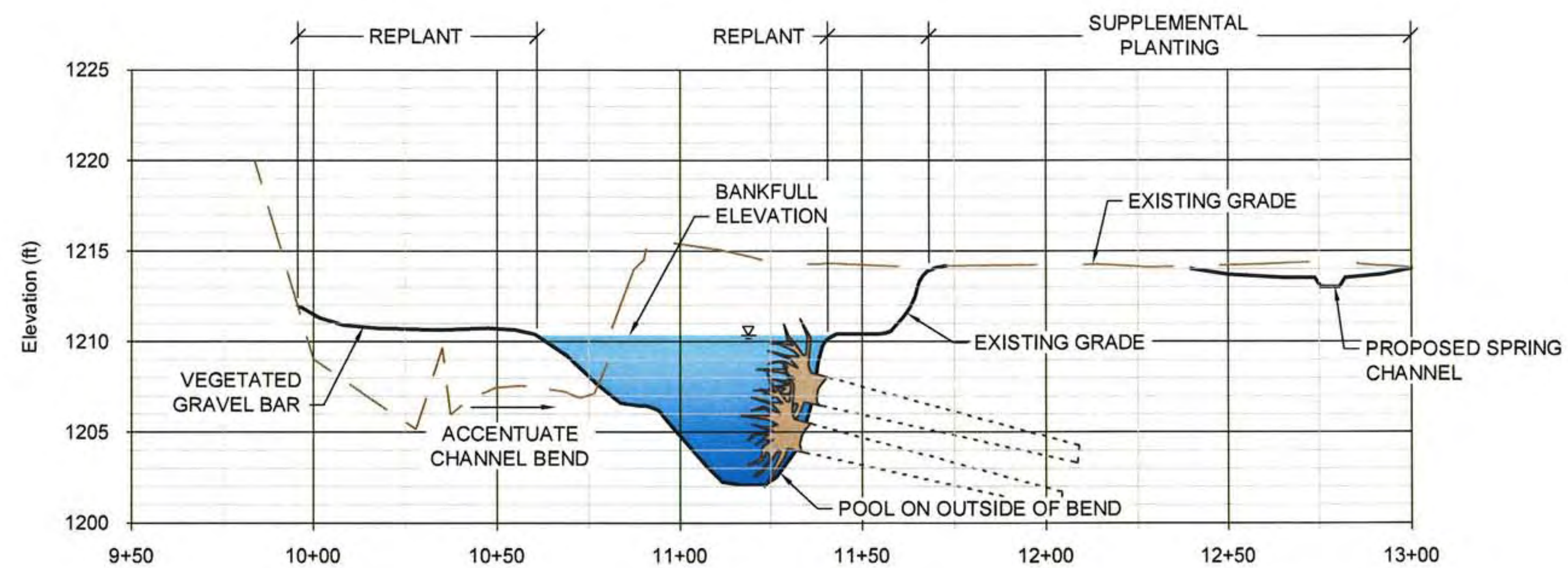
Vertical Scale: 1" = 10'



Section D-D'
Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 10'

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OREGON
JAN. 11, 2000
MICHAEL K. HOMZA
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Walla Walla River
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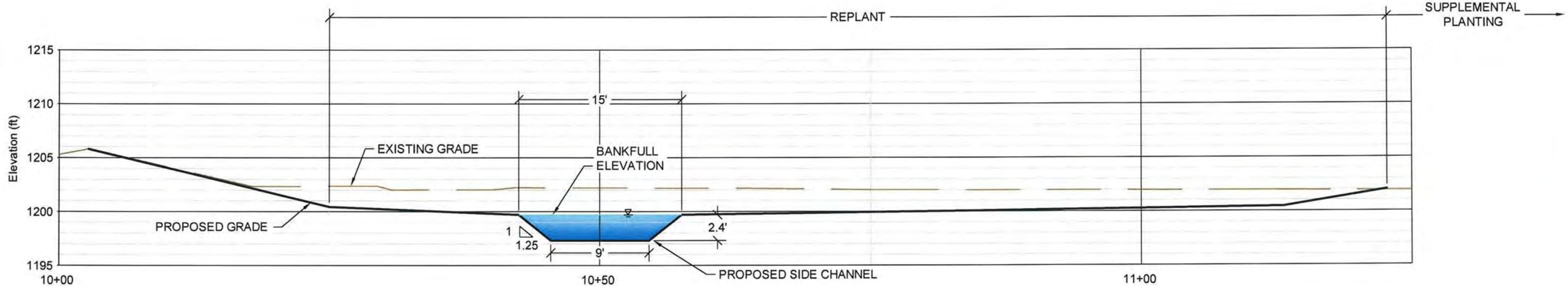
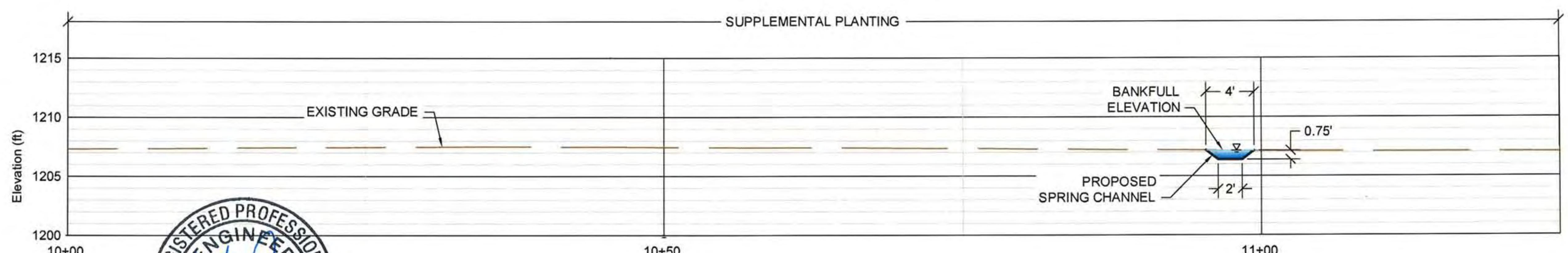
Typical Sections

Lampson Design Drawings

Sheet
S-8.3



Section E-E'
Horizontal Scale: 1" = 10'
Vertical Scale: 1" = 5'



Section F-F'
Horizontal Scale: 1" = 10'
Vertical Scale: 1" = 5'

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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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Typical Sections

Lampson Design Drawings

Sheet
S-8.4

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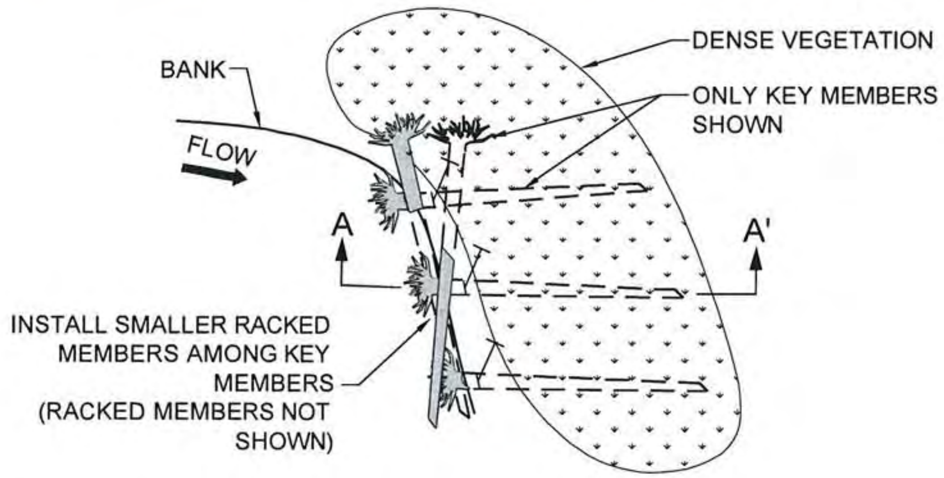
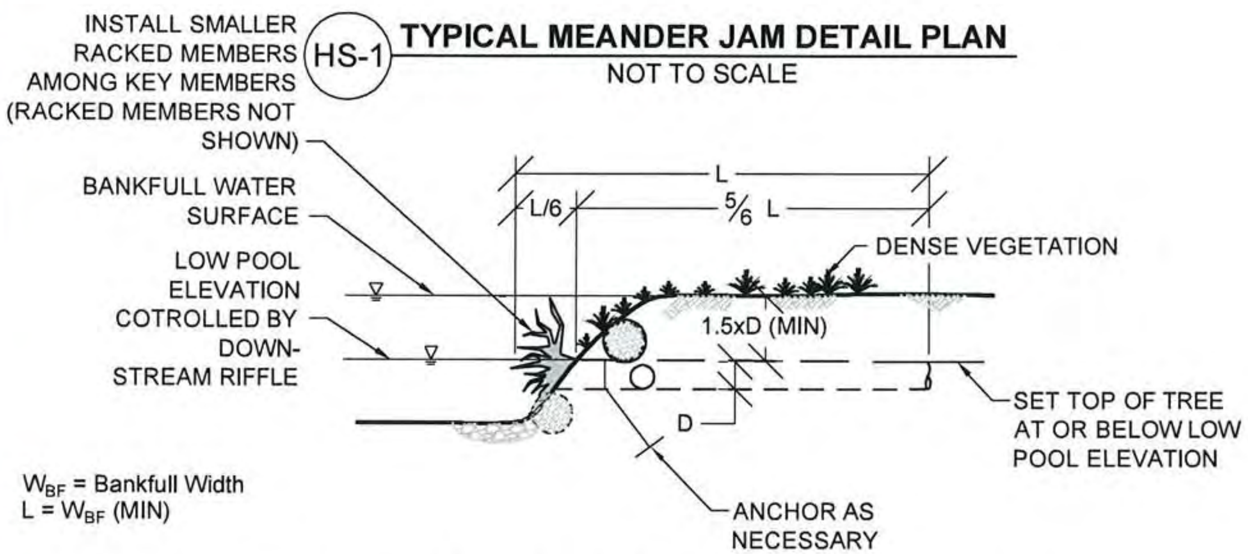
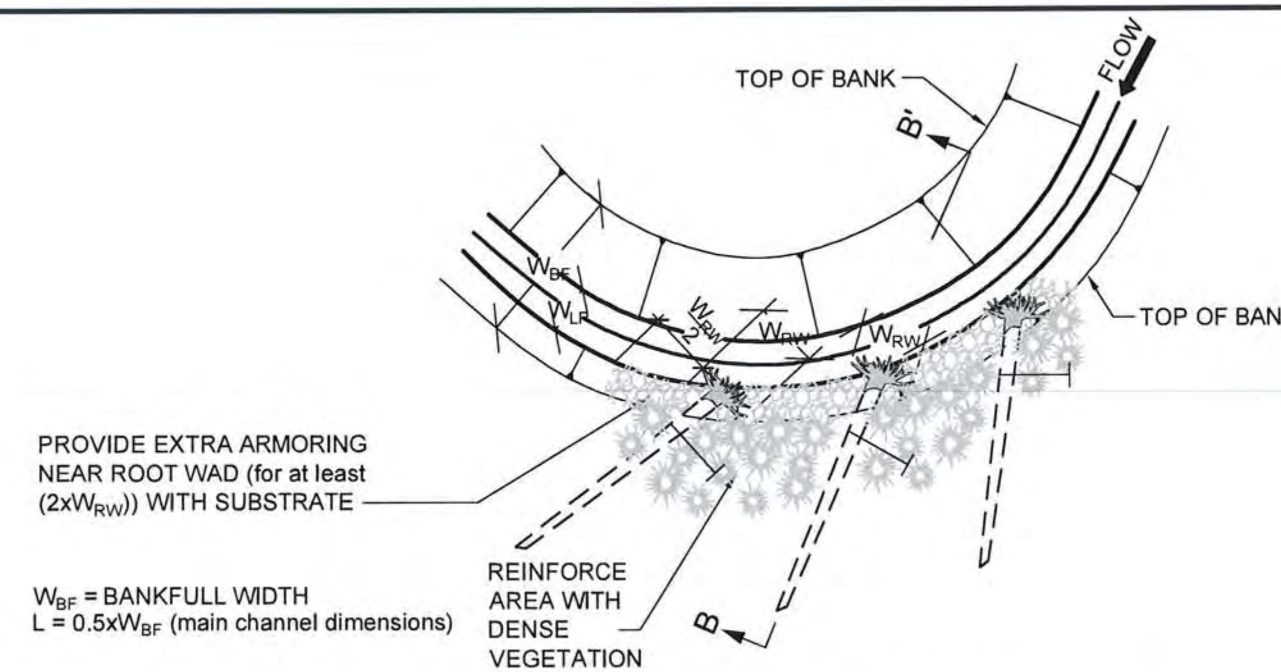


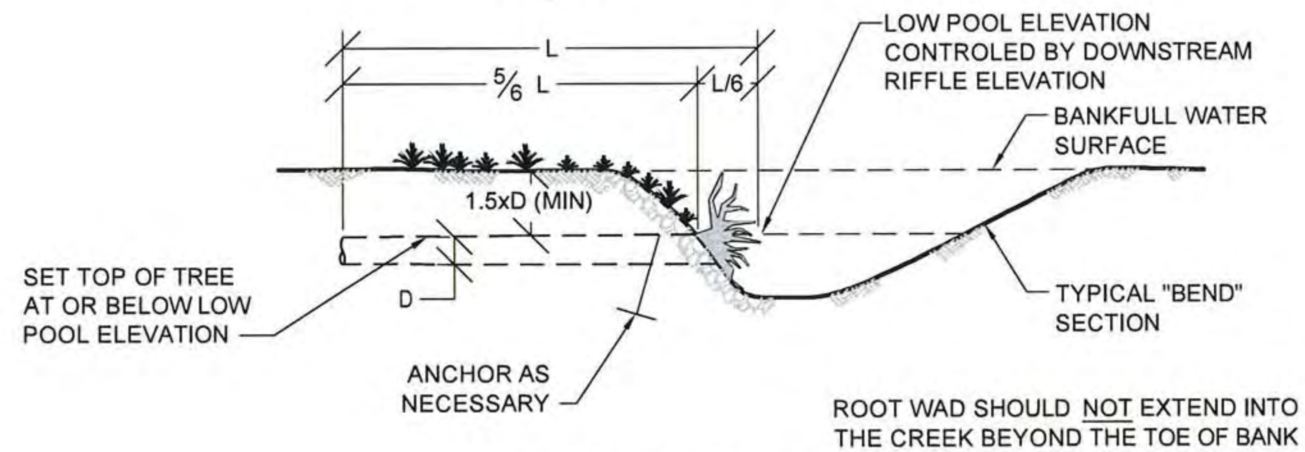
HS-1 **TYPICAL MEANDER JAM DETAIL PLAN**
NOT TO SCALE



A-A' **TYPICAL MEANDER JAM DETAIL SECTION A-A'**
NOT TO SCALE



HS-2 **TYPICAL ROOT WAD DETAIL PLAN**
NOT TO SCALE



B-B' **TYPICAL ROOT WAD DETAIL SECTION B-B'**
NOT TO SCALE

NOTES:

Purpose:
- Limit channel migration, protect banks, restore aquatic and riparian habitat.
- Enhances fish habitat: creates large bankside pools for fish holding and sediment sorting.

Design Specifics:
- Top of rootwad (roots) should not extend more than ½-ft above top of bank.
- Place along outsides of channel bends.
- Relatively large "Key Members" secured into banks with backfill (and/or anchors).
- Smaller "Racked Members" wedged between Key Members.
- Jam designed to collect more debris over time.
- Backfill with Stream Substrate & plant dense vegetation on top to bank.
- Install vegetation among armoring and root wads while installing root wads.
- Irrigate vegetation as required.

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NOTES:

Purpose:
- Increases pool depth.
- Inhibits lateral migration.
- Prevents bank erosion.

Design Specifics:
- Orient root wads so the creek's flow attacks them "head on" as much as possible. Anchors should be oriented towards flow.
- Top of rootwad (roots) should not extend more than ½-ft above top of bank.
- Place root wads along outside of bends.
- Install vegetation among armoring and root wads while installing root wads.
- Irrigate vegetation as required.
- Rootwad diameter = Pool Depth. If greater than depth, bury deeper.

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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the Umatilla Indian Reservation

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Typical Habitat Structures

Lampson Design Drawings

Sheet S-9.1

MKH : MGF

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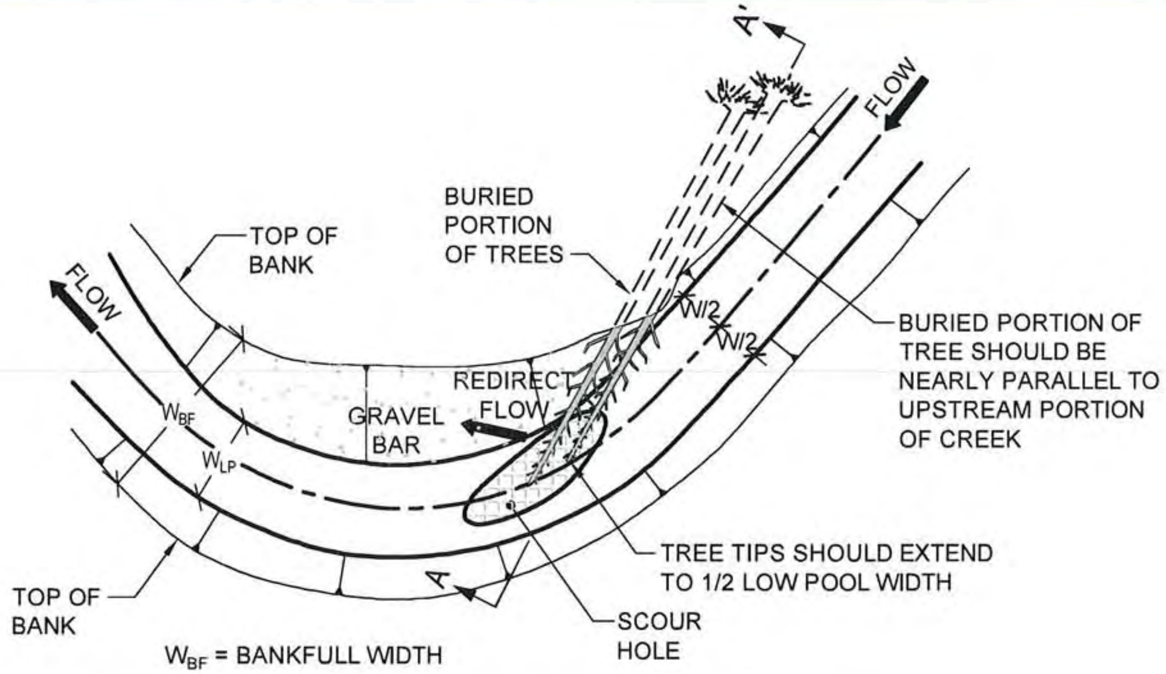
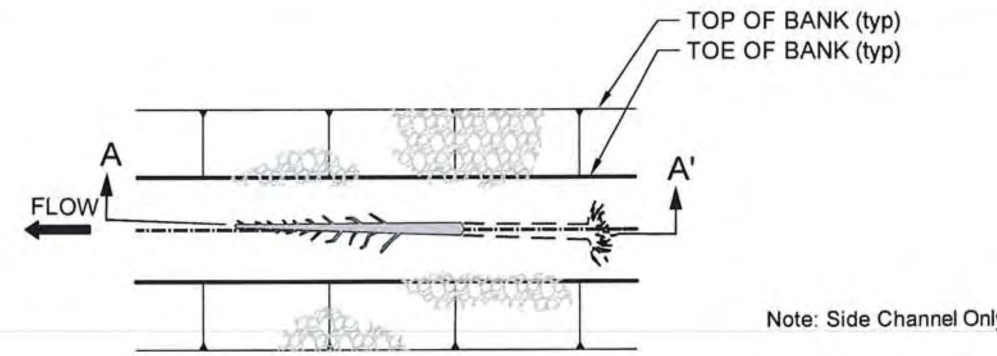
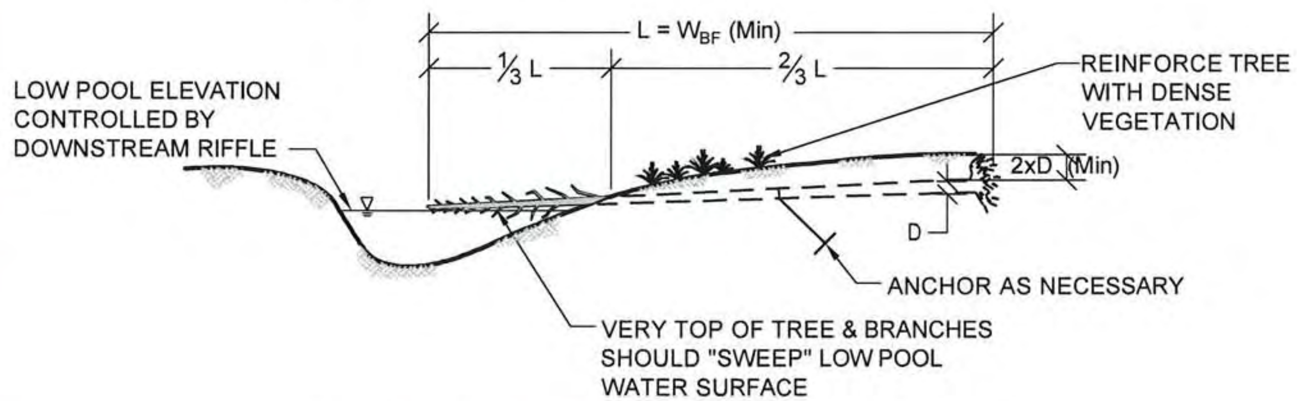


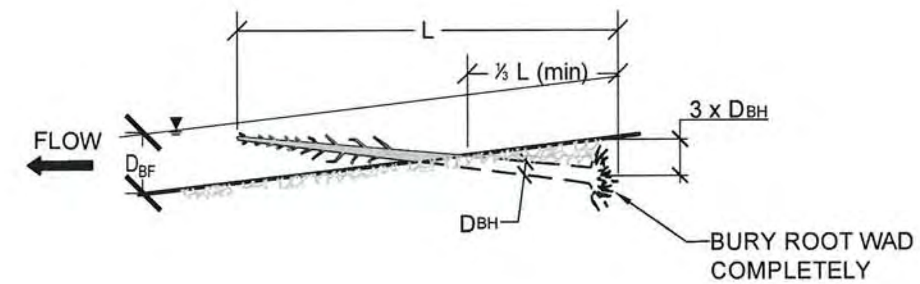
HS-3 **TYPICAL SWEEPER DETAIL PLAN**
NOT TO SCALE



HS-4 **TYPICAL BURIED SNAG DETAIL PLAN**
NOT TO SCALE



A-A **TYPICAL SWEEPER DETAIL SECTION A-A'**
NOT TO SCALE



A-A **TYPICAL BURIED SNAG DETAIL SECTION A-A'**
NOT TO SCALE

NOTES:

Purpose:
- Redirects flow.
- Creates scour holes.
- Encourages gravel deposition.

Design Specifics:
- Bury at least 2/3 of the tree length and root wad or secure "dry" end of log with anchors.
- Place sweeper at upstream end of bend.
- Trees with branches or multiple trunks preferred.

NOTES:

Purpose:
- Slows creek velocity.
- Creates diverse fish habitat.
- Encourages sediment sorting.

Design Specifics:
- Tree length (L) and diameter at breast height (DBH) may vary (smaller snags are acceptable).
- Place/locate snag as shown on plans and/or as directed in field.
- Snags may be parallel or angled to flow.
- Trees with branches and/or multiple trunks preferred.
- Root wads may be placed on top of channel if anchored.

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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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Typical Habitat Structures
Lampson Design Drawings

Sheet **S-9.2**

MKH : MGF
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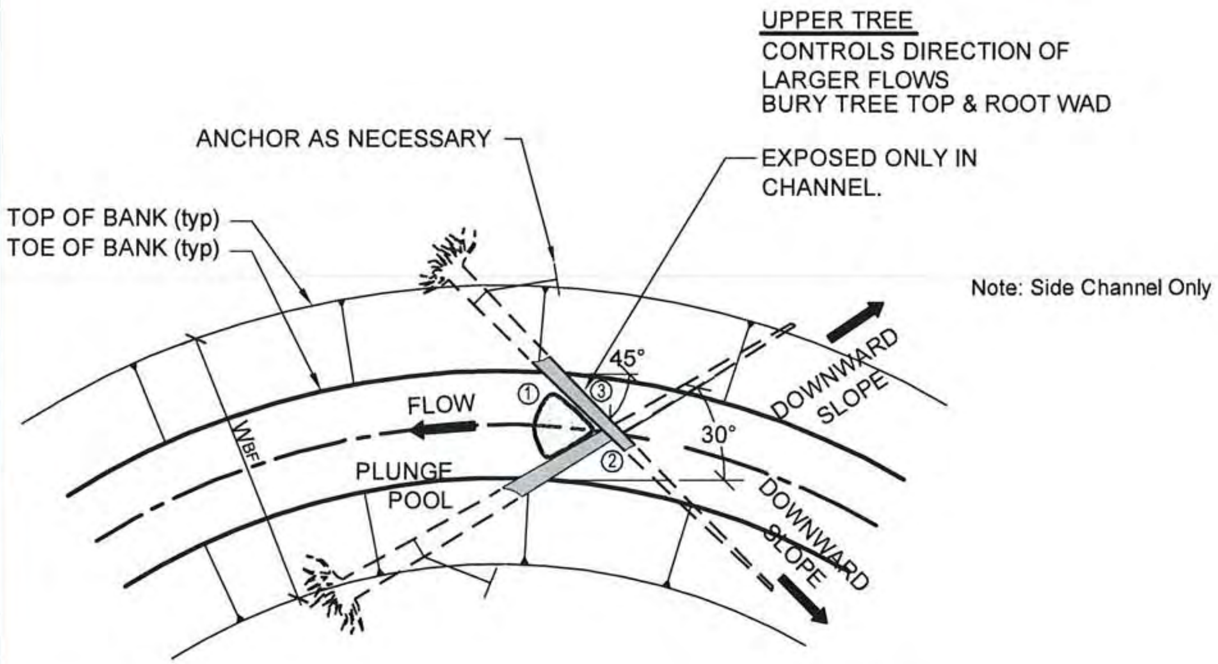

HS-5 TYPICAL STEP TURN DETAIL PLAN

NOT TO SCALE

NOTES:

Purpose:
- Redirects flow.
- Creates scour holes.
- Appropriate in steeper reaches.

Design Specifics:
- Step 1 is a plunge pool.
- Step 1 is lower than step 2 (6" max).
- Step 2 is lower than step 3 (6" max).
- Notch intersection of trees and secure with chain (if necessary).
- Exposed portion of tree = ¼ L (L = tree length).
- Secure trees with anchors, (3 min).
- L = 3 x WBF (min).
- Backfill upstream portions of structure (steps 2 and 3) with larger rock, small trees and branches to prevent flow under trees.
- Maximum total step height = 12"
- Bury upstream portion of trees deeper into channel bed (downward sloping in upstream direction).
- Place turning step at upstream end of pool/bend.
- Use only in small streams or side channels.

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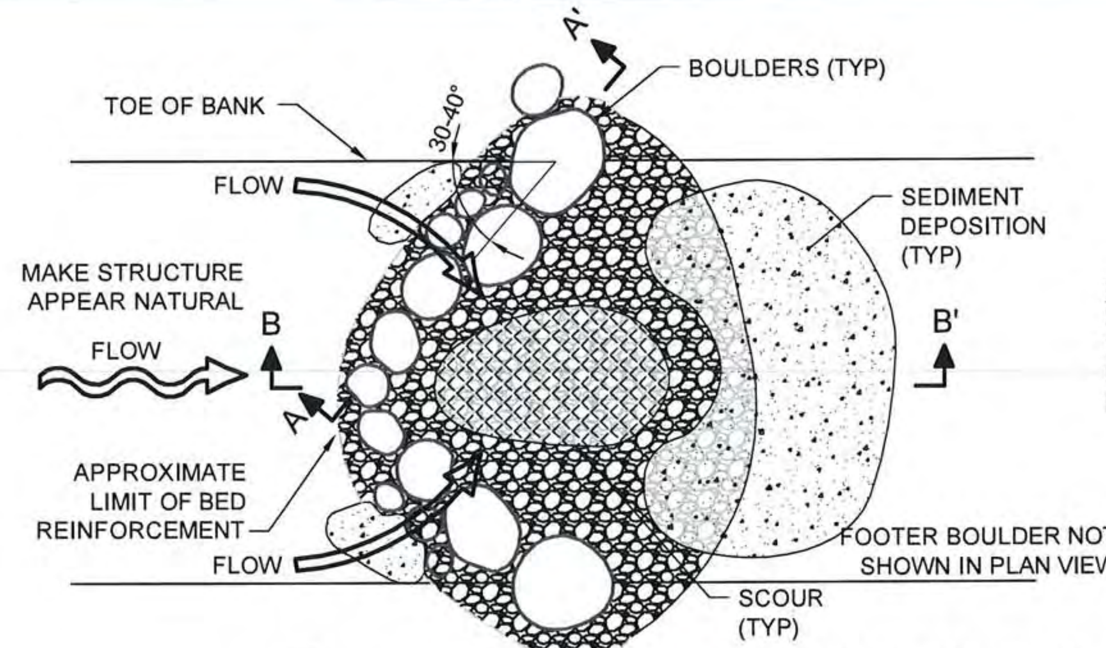


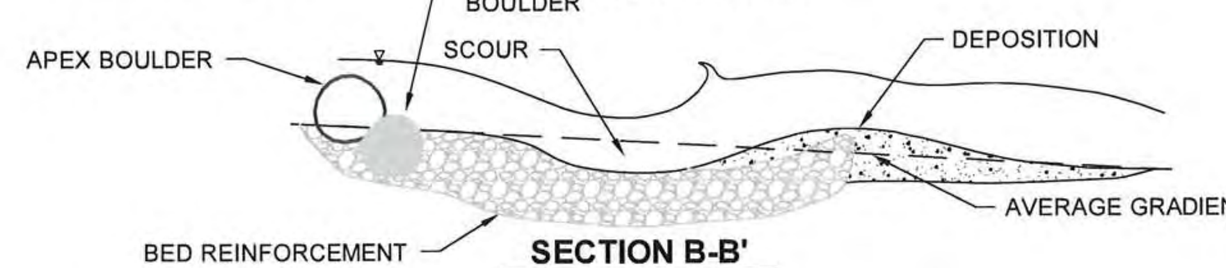
BOULDER GRADATION
D_{100} = 48"
D_{85} = 36"
D_{50} = 28"
D_{16} = 14"

HS-6 TYPICAL BOULDER CLUSTER DETAIL PLAN

NOT TO SCALE

SECTION A-A'

NOT TO SCALE



SECTION B-B'

NOT TO SCALE

NOTES:

Purpose:
- Enhances fish habitat: creates large mid-stream pools, fish holding in eddies and sorts sediment.
- Directs flow for full range of flow.

Design Specifics:
- Generally large, stream-wide structure with center coincident with channel centerline or thalweg.
- Place largest boulders closest to banks. Boulders decrease in size towards channel center. Or use same size boulders & bury center boulders deeper.
- Decreasing boulder size causes structures to slope downwards towards center.
- "Upstream Vee" configuration directs water to center of channel.
- Key largest Boulders into bank so they do not overtop or become "out-flanked" during flood flows.
- Plant dense vegetation along banks.
- Reinforce channel bed with footer boulders and cobbles to prevent scour at/below boulders.
- Place structure upstream of bends or upstream of desired stream-wide pools locations.

Variations:
- Large woody debris may be wedged between boulders. (Jam rootwads between boulders with tree bole hanging downstream as a sweeper for added fish habitat.)
- "Single Vane" structures may be used to direct water away from bank.
- Relatively large but stable cobbles may be used in lieu of boulders in smaller, cobble dominated streams.

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Walla Walla River
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Typical Habitat Structures

Lampson Design Drawings

Sheet **S-9.3**

MKH : MGF

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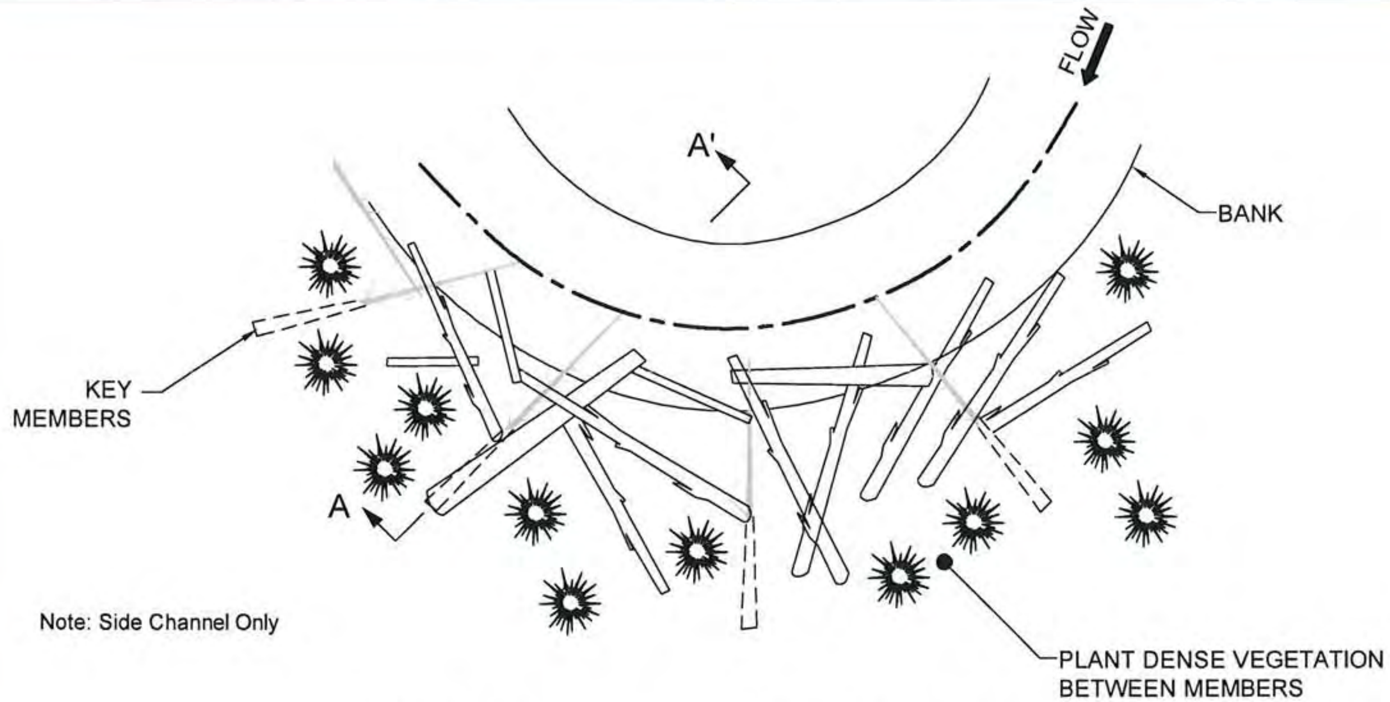
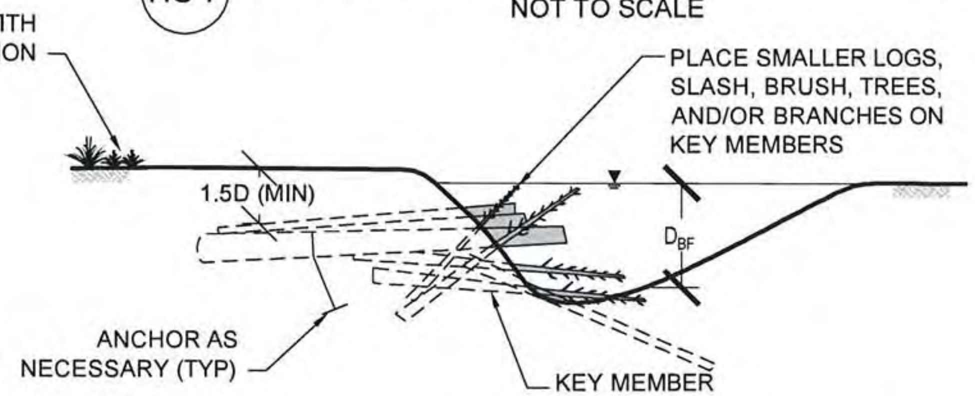


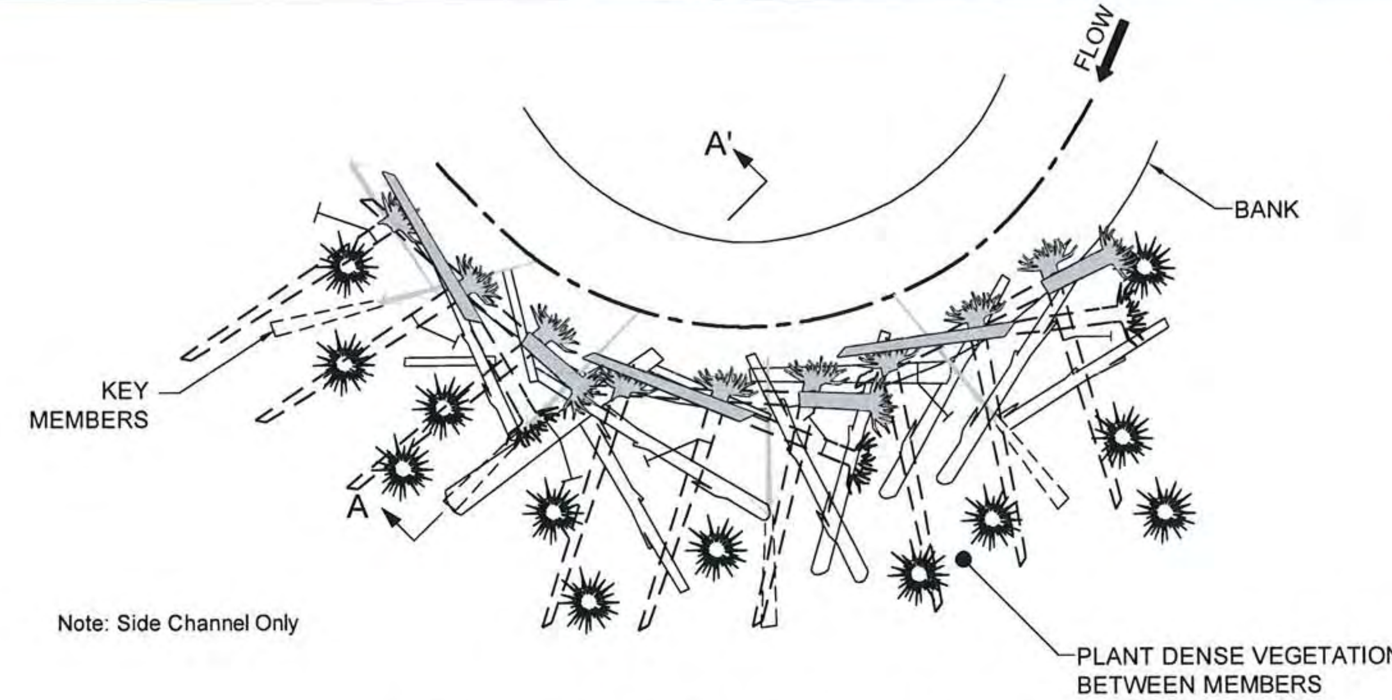
HS-7 **TYPICAL SMALL WOODY DEBRIS DETAIL PLAN**
NOT TO SCALE



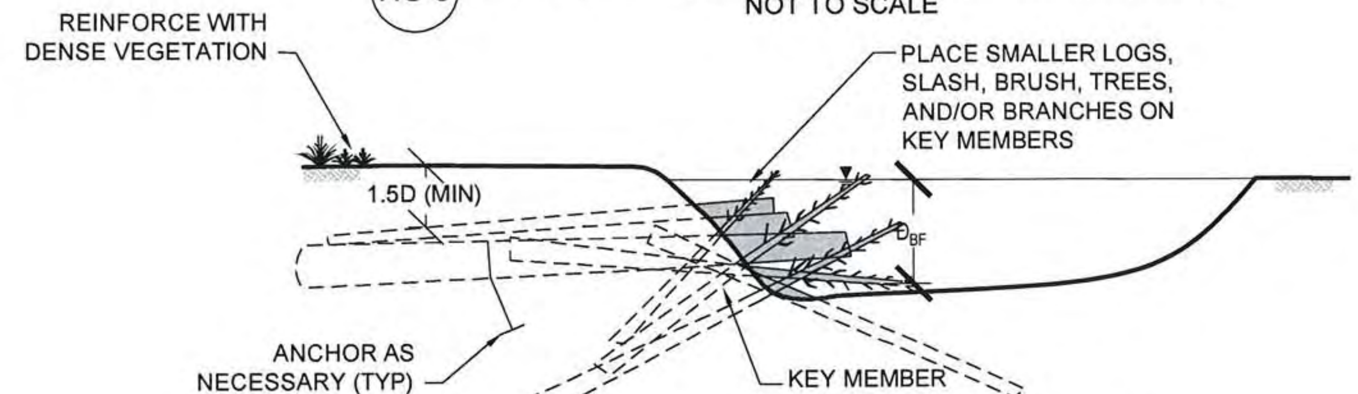
A-A' **TYPICAL WOODY DEBRIS DETAIL SECTION A-A'**
NOT TO SCALE

NOTES:
Purpose:
- Increases stream diversity.
- Provides fish habitat and cover.
- Decreases bank erosion.
- Mimics natural stream structures.

Design Specifics:
- Use medium to small logs (8" TO 18" DBH).
- Bury at least ⅔ the length of the key members in the bank.
- Place similarly sized logs randomly on and between key members. Members may be tied together with rope or wire.
- Scatter brush, slash, branches, and other woody debris among the larger members.
- Reinforce area with dense vegetation between woody debris.
- Minimum length of key members is 3xW BF.



HS-8 **TYPICAL LARGE WOODY DEBRIS DETAIL PLAN**
NOT TO SCALE



A-A' **TYPICAL WOODY DEBRIS DETAIL SECTION A-A'**
NOT TO SCALE

NOTES:
Purpose:
- Increases stream diversity.
- Provides fish habitat and cover.
- Decreases bank erosion.
- Mimics natural stream structures.

Design Specifics:
- Use large logs (18" TO 30" DBH).
- Bury at least ⅔ the length of the key members in the bank.
- Place similarly sized logs randomly on and between key members. Members may be tied together with rope or wire.
- Scatter brush, slash, branches, and other woody debris among the larger members.
- Reinforce area with dense vegetation between woody debris.
- Minimum length of key members is 3xW BF.

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OREGON
JAN. 11, 2000
MICHAEL K. HOMZA
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Confederated Tribes of the
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GEOENGINEERS
523 East Second Avenue
Spokane, Washington 99202

Typical Habitat Structures
Lampson Design Drawings

Sheet **S-9.4**

MKH : MGF
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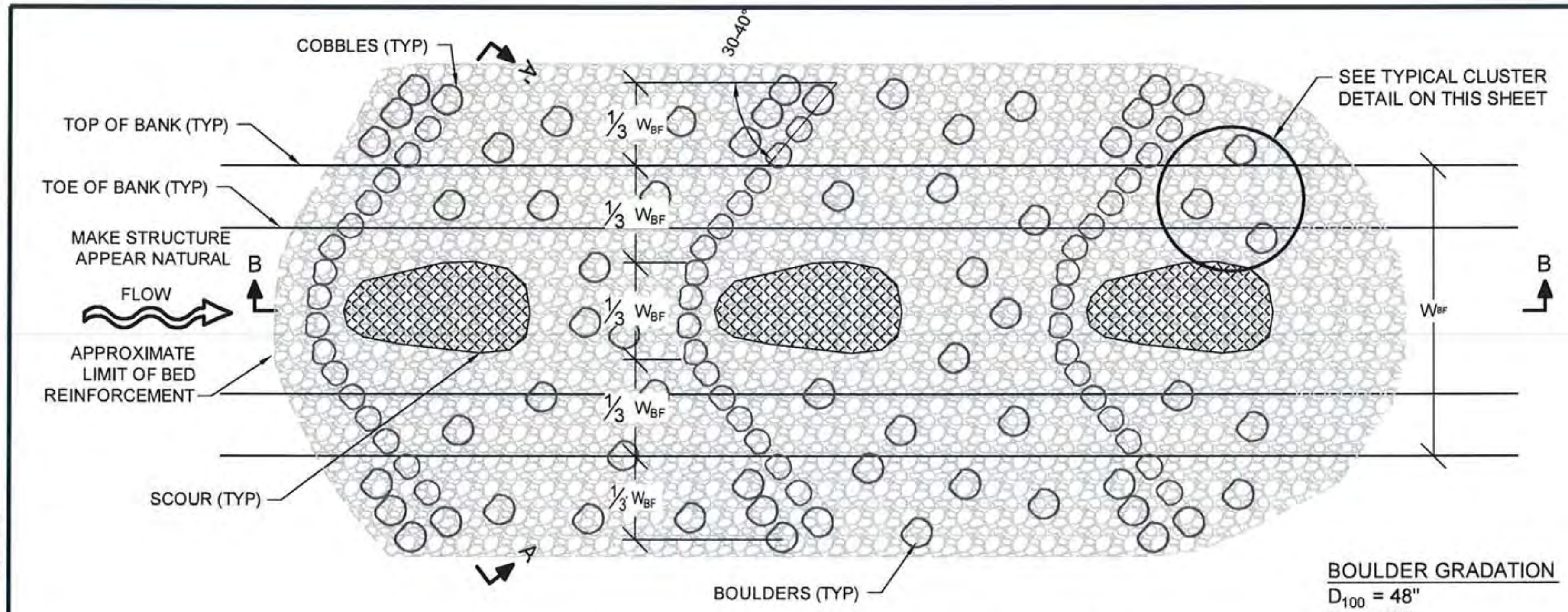
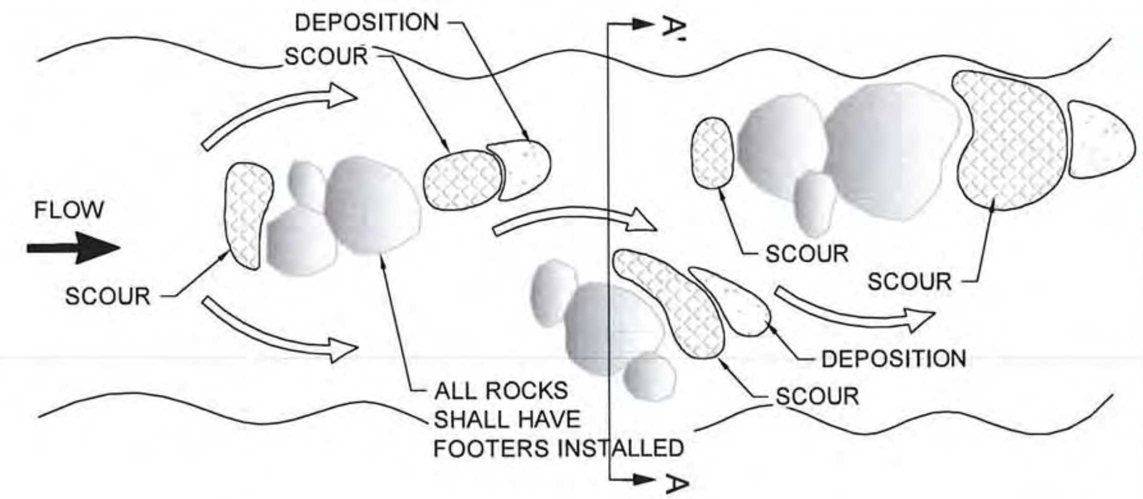
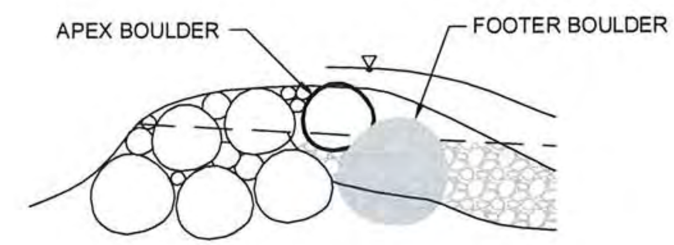


HS-9 **TYPICAL ROUGHENED CHANNEL PLAN**
NOT TO SCALE

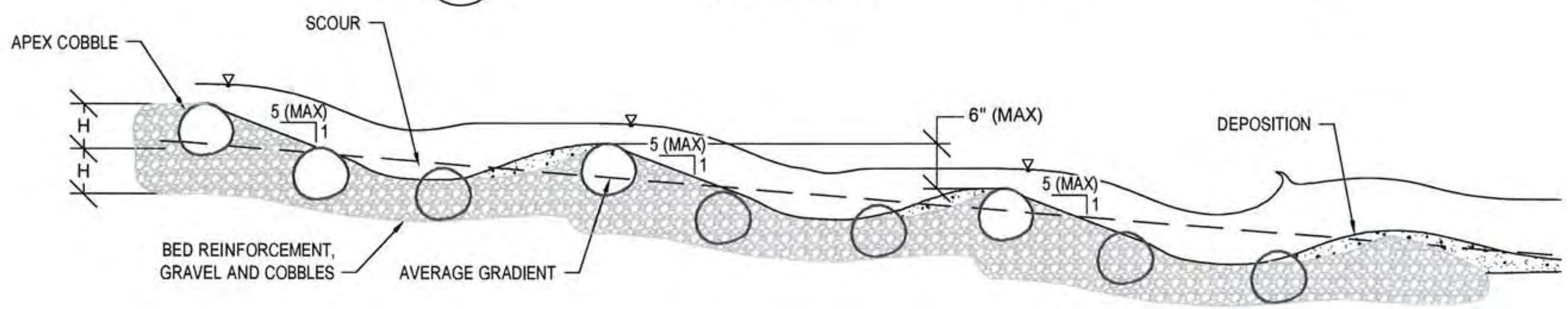
BOULDER GRADATION
D_{100} = 48"
D_{85} = 36"
D_{50} = 28"
D_{16} = 14"



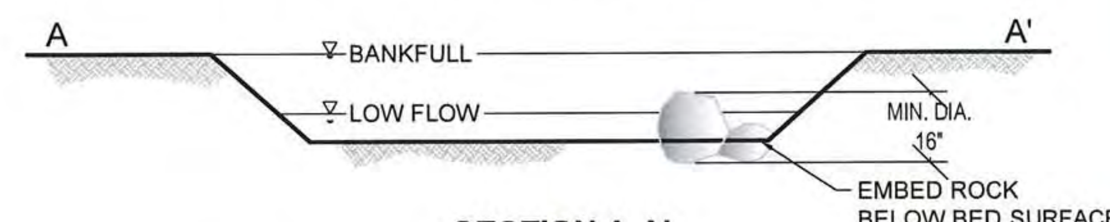
HS-10 **TYPICAL POCKET WATER DETAIL PLAN**
NOT TO SCALE



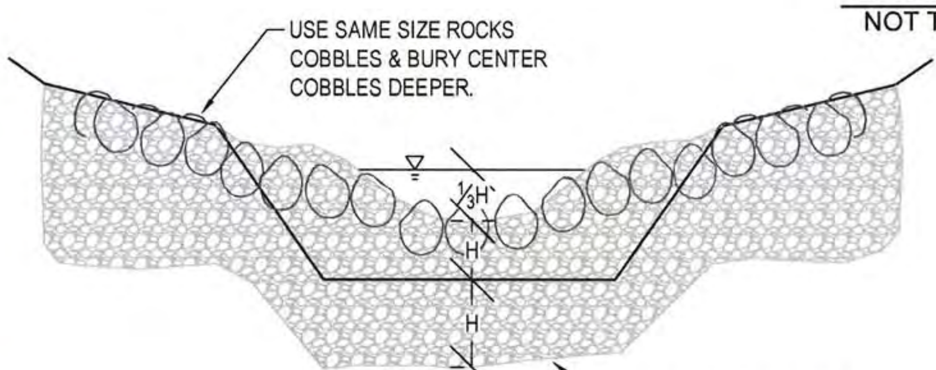
FOOTER DETAIL
NOT TO SCALE



SECTION B-B'
NOT TO SCALE



SECTION A-A'
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

NOTES:

Purpose:
- Enhances fish habitat: creates large mid-stream pools, fish holding in eddies and sorts sediment.
- Protects channel against headcutting.

Design Specifics:
- Generally large, stream-wide structure with center coincident with channel centerline or thalweg.
- Structures to slope downwards towards center.
- "Upstream Vee" configuration directs water to center of channel.
- Plant dense vegetation along banks.
- Reinforce channel bed with mixture of boulders, cobbles and gravel to prevent scour and roughen channel.
- Place structure upstream of desired stream-wide pool locations and downstream of sensitive areas that are prone to head cutting.
- Grade and place boulders to appear natural.

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				Project No: 2698-006-01

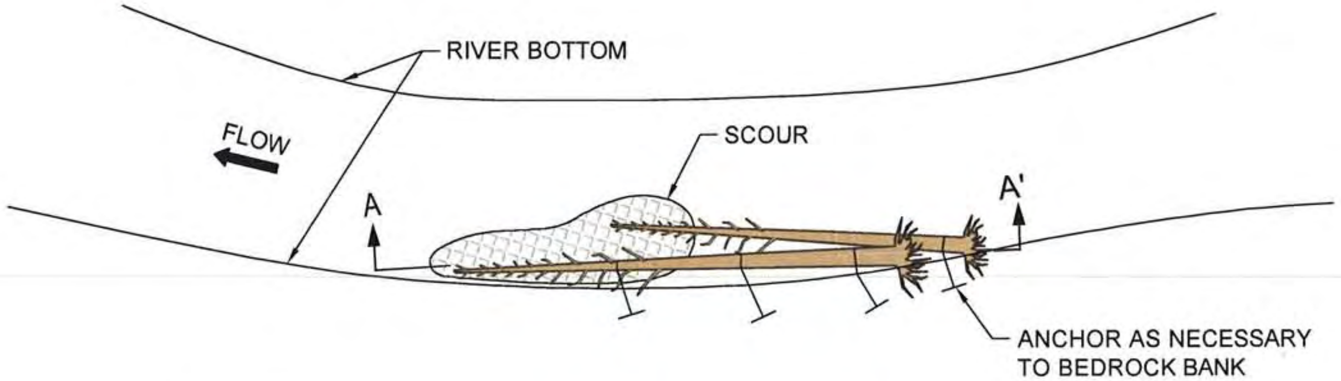
Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the Umatilla Indian Reservation

GEOENGINEERS
523 East Second Avenue
Spokane, Washington 99202

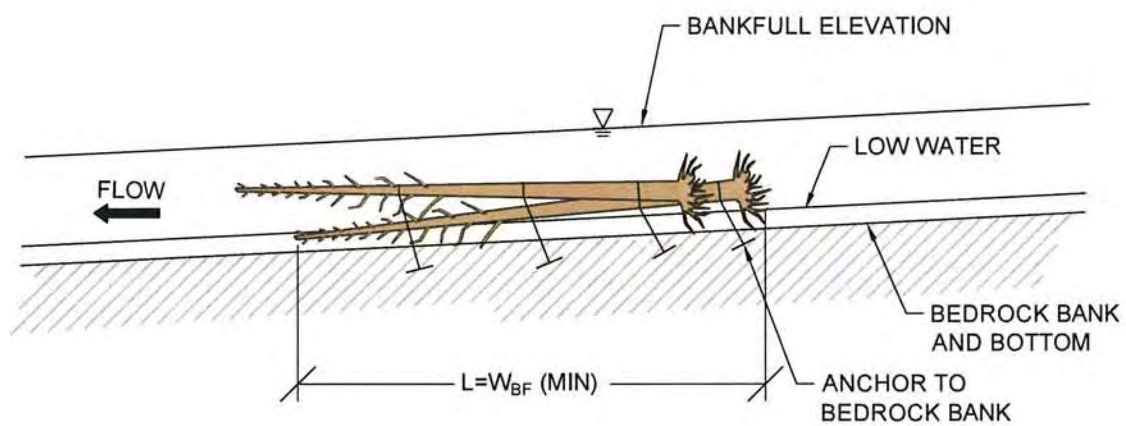
Typical Habitat Structures

Lampson Design Drawings

Sheet **S-9.5**



HS-11 **TYPICAL LONGITUDINAL LOG DETAIL PLAN**
NOT TO SCALE



A-A **SECTION A-A'**
NOT TO SCALE

NOTES:

Purpose:
- Creates scour holes.
- Holds gravel upstream.
- Creates diverse fish habitat.
- Provides cover.

Design Specifics:
- Place through straight reaches and along outside of bends on bedrock banks.
- Place root wad on or in stream bed.
- Trees with branches or multiple trunks preferred.
- Minimum DBH shall be 18".
- Trees must be securely anchored to bedrock to prevent loss of structure.

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				Designed: JJF	Walla Walla River Umatilla County, Oregon Confederated Tribes of the Umatilla Indian Reservation		GEOENGINEERS 523 East Second Avenue Spokane, Washington 99202	Typical Habitat Structures	Sheet
				Drawn: MGF					
		BID DOCUMENTS		Checked: MKH				Lampson Design Drawings	S-9.6
		Not For Construction.		Date: 02/24/10					
				Project No: 2698-006-01					

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NOTES:

1. THE BANK ZONE SHALL BE PLANTED WITH BANK ZONE VEGETATION FROM THE LOW WATER LEVEL TO 5 FEET BEYOND THE TOP OF BANK PER THE TYPICAL SECTION ON SHEET 10.2.
2. THE REPLANT ZONE SHALL BE PLANTED WITH EITHER RIPARIAN OR TRANSITIONAL VEGETATION AS DESIGNATED BY ELEVATION PER THE TYPICAL SECTION ON SHEET 10.2.
3. THE SUPPLEMENTAL PLANTING ZONE SHALL BE PLANTED WITH EITHER RIPARIAN OR TRANSITIONAL PLANTINGS AROUND EXISTING NATIVE VEGETATION AS PREVIOUSLY ESTABLISHED BY THE CTUIR PER THE TYPICAL SECTION ON SHEET 10.2.
4. NATIVE VEGETATION PREVIOUSLY ESTABLISHED BY THE CTUIR SHALL BE MAINTAINED TO THE BEST EXTENT POSSIBLE.

Reference: Aerial obtained from NAIP, 2005.

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				Project No: 2698-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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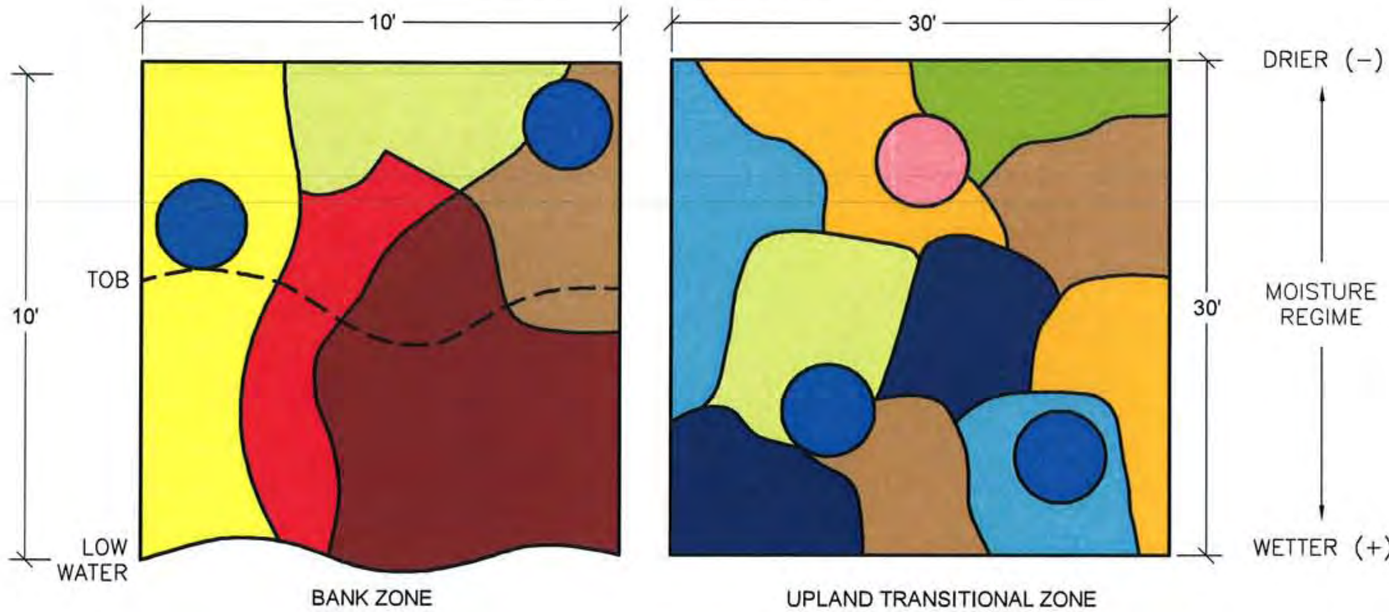
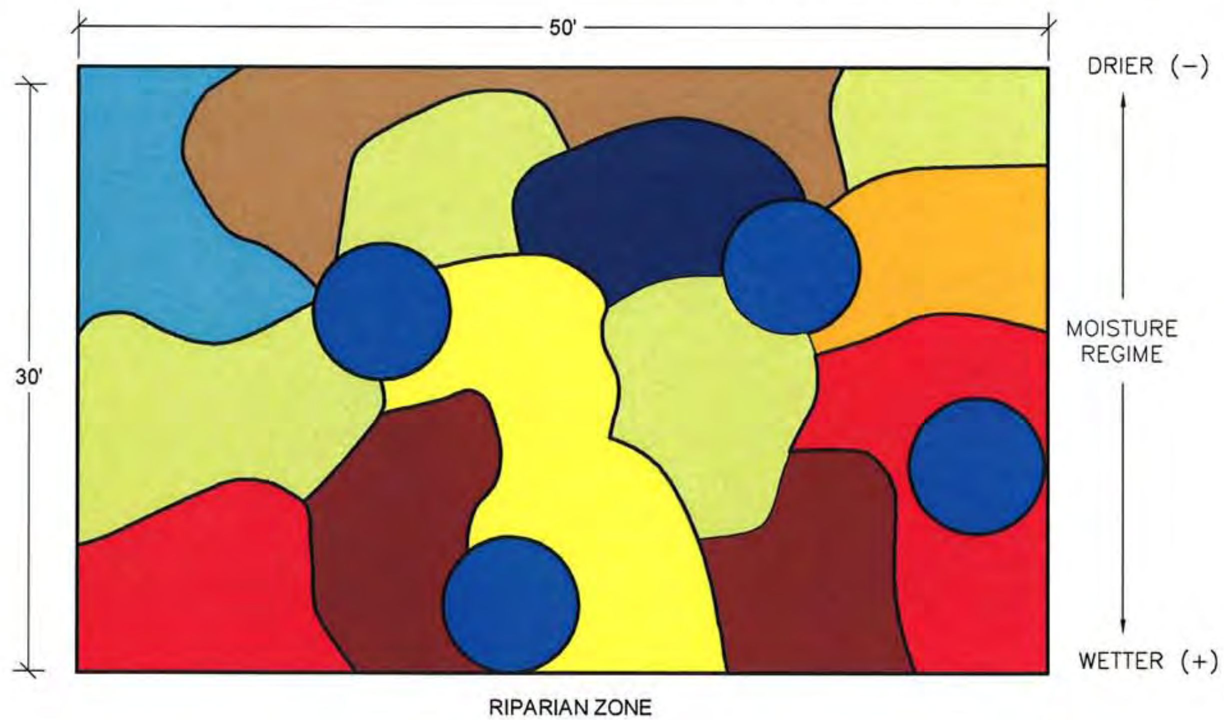
Planting Plan

Lampson Design Drawings

Sheet S-10.1

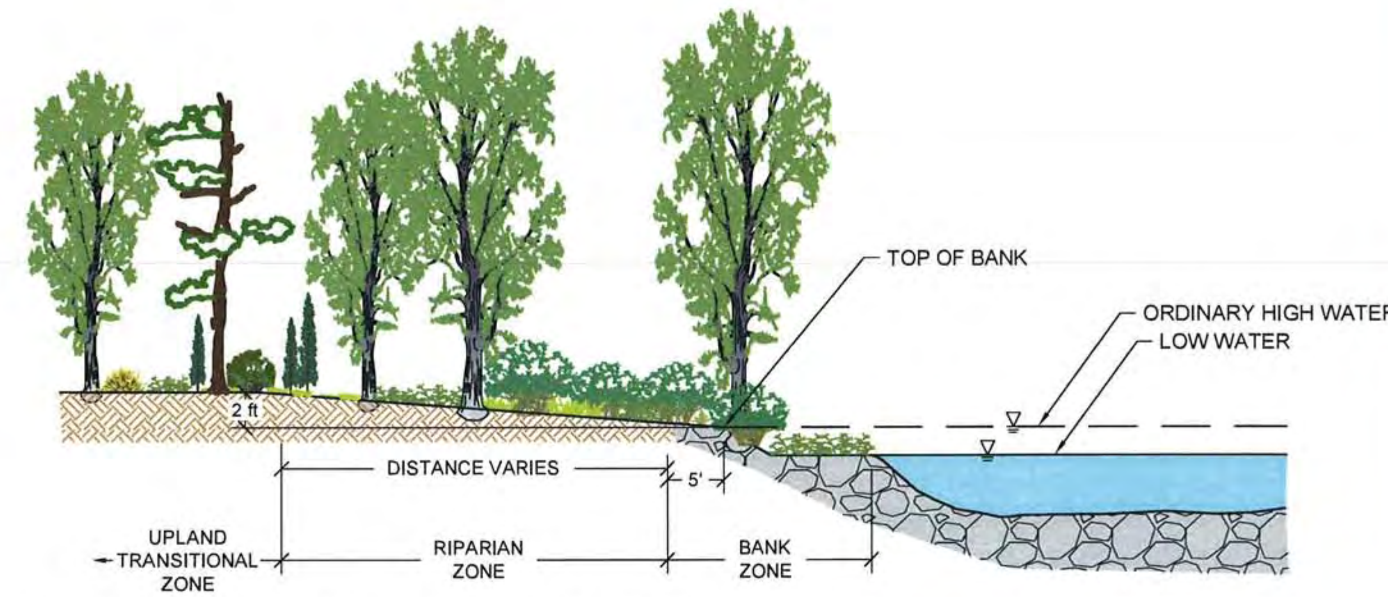
TYPICAL PLANTING CONFIGURATIONS





NOTES:
TOB = TOP OF BANK

TYPICAL PLANTING CONFIGURATIONS (PLAN VIEW)



REFER TO TABLE BELOW TO DETERMINE PLANTING APPLICATIONS.

TYPICAL PLANTING ZONES

Not To Scale

LEGEND:

- BLACK COTTONWOOD
- PONDEROSA PINE
- RED OSIER DOGWOOD
- COYOTE WILLOW
- WOODS ROSE
- DRUMMOND'S WILLOW
- CHOKE CHERRY
- WAX CURRANT
- SNOWBERRY
- BLUE ELDERBERRY
- SERVICEBERRY

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		BID DOCUMENTS Not For Construction.		Designed: JJF Drawn: MGF Checked: MKH Date: 02/24/10 Project No: 2698-006-01	Walla Walla River Umatilla County, Oregon Confederated Tribes of the Umatilla Indian Reservation	GEOENGINEERS 523 East Second Avenue Spokane, Washington 99202	Typical Planting Plan Lampson Design Drawings	Sheet S-10.2

MKH : MGF

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Planting Specifications Table[a]

Planting Application Number	Planting Application	Instructions[b]	Vegetation	Densities/Rates	Transitional Zone	Riparian Floodplain Zone	Bank Zone
1	Grass Seed Mix	1. Add topsoil mix and/or organic mulch to disturbed areas if necessary. 2. Seed all disturbed areas. 3. Cover with straw or mulch if necessary to minimize erosion.	Sandberg's bluegrass, bluebunch wheatgrass, blue wildrye, Idaho fescue and mountain brome.	Seeding rate: 6-8 lbs per acre	X	X	
2	Wetland Seed Mix[c]	1. Add topsoil mix and/or organic mulch to disturbed areas if necessary. 2. Seed all disturbed areas. 3. Cover with straw or mulch if necessary to minimize erosion.	Beaked sedge, common spikerush, tufted hairgrass, red fescue, and Baltic rush.	Seeding rates: 6-8 lbs per acre			X
3	Upland Nursery Stock	1. Add topsoil mix and/or organic mulch at base of plants if necessary.	Ponderosa pine, snowberry, blue elderberry, woods rose, serviceberry, golden currant and chokecherry.	Space individual plants 12 ft on center (oc) for tree species and 6 ft oc for shrub species	X		
4	Riparian Nursery Stock	1. Add topsoil mix and/or organic mulch at base of plants if necessary. 2. Plant in proper hydrologic regime (see sheet 10.2)	Black cottonwood, Douglas fir, woods rose, red osier dogwood, golden currant, coyote willow, Drummond's willow, snowberry, blue elderberry and chokecherry.	Space individual plants 12 ft on center (oc) for tree species and 6 ft oc for shrub species		X	X
5	Live Cuttings[d]	1. Plant live cuttings into permanent moisture regime. 2. Plant immediately if possible.	Black cottonwood, coyote willow, Drummond's willow, and red osier dogwood.	Space individual trees 6-8 ft oc and shrubs 1-3 ft oc with highest densities in streambank protection zones, at LWD structures and along outside bends.		X	X

a. Refer to Sheet 10.2 for typical planting zone designations and typical plant groupings.
b. Planting Applications and Specifications are based on USDA-NRCS technical notes and literature.
c. Wetland seed mix shall be broadcast 1-2 years after the planting of live cuttings to allow sediment to build up on the cobble bottom. If wetland seed mix is planted immediately after construction, it shall be covered with straw and staked with live willow stakes.
d. Transplanted materials and live cuttings should be installed immediately upon completion of LWD placement.

Tree and Shrub Planting Specifications by Species

Common Name	Scientific Name	Recommended Size	Recommended Spacing
Trees			
Black cottonwood	*Populus trichocarpa*	4 ft-6 ft cuttings	6-8 ft oc
Ponderosa pine	*Pinus ponderosa*	2 gallon	12 ft oc
Shrubs			
Woods rose	*Rosa woodsii*	1 gallon	6 ft oc
Golden currant	*Ribes aureum*	1 gallon	6 ft oc
Red osier dogwood	*Cornus serices*	4 ft-6 ft cuttings	1-3 ft oc
Drummond's willow	*Salix drummondiana*	4 ft-6 ft cuttings	1-3 ft oc
Coyote willow	*Salix exigva*	4 ft-6 ft cuttings	1-3 ft oc
Snowberry	*Symphoricarpos albus*	1 gallon	6 ft oc
Blue elderberry	*Sambucus nigra*	1 gallon	6 ft oc
Serviceberry	*Amelanchier alnifolia*	1 gallon	6 ft oc
Chokecherry	*Prunus virginiana*	1 gallon	6 ft oc

Grass Seed Mix

Common Name	Scientific Name	Application Method	Pounds Per Acre
Mountain brome	*Bromus carniatus*	Broadcast	1.2
Sandberg's Bluegrass	*Poa secunda*	Broadcast	1.6
Blue Wildrye	*Elymus glaucus*	Broadcast	1.2
Bluebunch wheatgrass	*Pseudoroegneria spicata*	Broadcast	2.4
Idaho fescue	*Festuca idahoensis*	Broadcast	1.6

Wetland Seed Mix

Common Name	Scientific Name	Application Method	Pounds Per Acre
Beaked sedge	*Carex rostrata*	Broadcast	1.8
Common spikerush	*Elecharis palustris*	Broadcast	1.2
Tufted hairgrass	*Deschampsia cespitosa*	Broadcast	0.6
Red fescue	*Festuca rubra*	Broadcast	2.2
Baltic rush	*Juncus balticus*	Broadcast	1.2

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				Project No: 2598-006-01

Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the Umatilla Indian Reservation

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Typical Planting Plan
Lampson Design Drawings

Sheet **S-10.3**

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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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Construction Sequencing

Lampson Design Drawings

Sheet **S-11.1**

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CONSTRUCTION SEQUENCING

1 Access

- The main access to the site shall be from the Walla Walla River Road at the gate located on the east end of the property.
- Secondary access in the center of the property (between blueberry patches) shall be allowed with the CTUIR and landowner's permission. All fences temporarily removed shall be replaced back to their original condition by the contractor.

2 Fish Exclusion

- Prior to any dewatering, stream bypassing, or in-channel work, the Contractor shall seine the construction area and establish and maintain block nets at the upper and lower construction boundaries throughout any in-water construction.

3 Lower Reach River Construction

- River construction shall only occur during the allowable fish window (July 1 - September 30).
- River construction shall begin at the most downstream end and continue upstream.
- Work in this reach shall include isolating individual work zones from active flow with floating coffer dams.
- If needed, off line sedimentation ponds shall be constructed to control downstream transportation of sediment.
- River construction will consist of structure installation, sculpting of the channel and thalweg, and floodplain excavation on the north (right) bank.
- All river structures and channel modifications shall appear natural.

4 Side Channel Construction

- Stream construction shall only occur during the allowable fish window (July 1 - September 30).
- Side channel shall be constructed off line and prior to installation of any bypass dams.
- Stream construction shall begin at the most downstream end and continue upstream.
- If needed, off line sedimentation ponds shall be constructed to control downstream transportation of sediment.
- Stream construction will consist of structure installation, sculpting of the channel and thalweg, and floodplain excavation adjacent to both banks.
- All stream structures and channel modifications shall appear natural.

5 Bypass Dams

- The project area shall be bypassed by a bypass dam and pumps (if necessary) to divert water around the active construction areas through the proposed side channel and back into the existing channel if water is present.
- Bypass dam 1 shall be installed to direct flow into the newly constructed side channel.
- Side channel shall be tested to show adequate construction prior to full channel diversion.
- Side channel shall act as a temporary stream diversion for the full river flow during construction.
- Bypass dam 2 shall be installed to prevent backwater conditions occurring between bypass dams.
- Bypass dams can and shall be used in testing the side channel and middle reach prior to bypass removal.

6 Middle Reach River Construction

- The middle reach of the river shall be constructed in the dry after installation of bypass dams 1 and 2.
- River construction shall only occur during the allowable fish window (July 1 - September 30).
- River construction shall begin at the most downstream end and continue upstream.
- If needed, off line sedimentation ponds shall be constructed to control downstream transportation of sediment.
- River construction will consist of structure installation, sculpting of the channel and thalweg, and floodplain excavation on the north (right) bank.
- All river structures and channel modifications shall appear natural.

7 Upper Reach River Construction

- River construction shall only occur during the allowable fish window (July 1 - September 30).
- River construction shall begin at the most downstream end and continue upstream.
- Work in this reach shall include isolating individual work zones from active flow with floating coffer dams.
- If needed, off line sedimentation ponds shall be constructed to control downstream transportation of sediment.
- River construction will consist of structure installation, sculpting of the channel and thalweg, and floodplain excavation on the north (right) bank.
- All river structures and channel modifications shall appear natural.

8 Spring Channel Construction

- Spring channel construction shall only occur during the allowable fish window (July 1 - September 30).
- Spring channel shall be constructed in the dry to the extent possible.
- If needed, off line sedimentation ponds shall be constructed to control downstream transportation of sediment.
- Stream construction will consist of structure installation, sculpting of the channel and thalweg, and floodplain excavation on the north (right) bank.
- All stream structures and channel modifications shall appear natural.

9 Planting

- Immediately after construction all areas designated on sheet S-10.1 shall be reseeded and planted with native vegetation in accordance with Sheets 10.2 and 10.3. Dense vegetation shall be seeded and planted on top of all installed structures, as called out on Sheets 7.1 - 7.7, and at the head of all gravel/cobble bars. Dense vegetation shall be installed at the smallest allowable spacing as indicated on Sheets 10.2 and 10.3.

10 Cleanup

- All debris and excess material created from the project shall be spread across the active floodplain as approved by CTUIR and the landowner or hauled away for appropriate disposal.

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Revision No:	Date:	Description:	Initials:				
				Designed: JJF	Walla Walla River Umatilla County, Oregon Confederated Tribes of the Umatilla Indian Reservation	GEOENGINEERS 523 East Second Avenue Spokane, Washington 99202	Construction Sequencing Notes	Sheet S-11.2
				Drawn: MGF				
		BID DOCUMENTS		Checked: MKH			Lampson Design Drawings	
		Not For Construction.		Date: 02/24/10				
				Project No: 2698-006-01				

Item #	Item Description	Units	Unit Cost	No. of Units	Total Cost ($)
1	Temporary Stream Diversion	LS		1	
2	Construction Staking	Day		5	
3	Selectively Lay Back Steep Slopes. Retain 50% trees. (2 CY Excavator, 12 CY Truck, Grade spoils w/ Dozer)	Acre		1.4	
4	Selective Floodplain Grading. Retain 70 to 90% trees. (Minimal tree density)	Acre		5.4	
5	Clearing, grubbing, stockpile trees & roots. (Small to Medium Trees)	Acre		6.6	
6	Floodplain Excavation, haul, sockpile & rough grade stockpile.	CY		28500	
7	Fine Grade (Sculpt) dry pools, riffle, banks.	Acre		2.1	
8	In-Water Grading of pools, riffles. No Haul. Excavator Only. Includes isolating work zone from active flow w/ floating cofferdam.	Day		7	
9	Boulder acquisition, haul & placement in stream. 2 to 6 feet in diameter. (Ave. 4-ft used for cost)	Each		560	
10	Install woody habitat structure. Acquire wood from site, mostly small. Assume 25% anchored.	Piece		100	
11	Acquire, haul & install woody habitat structure. Assume 25% anchored.	Piece		225	
12	Best Management Practices, including installation & maintenance.	LS		1	
13	Pumping dirty water from in-water work overboard into settling basin.	Day		7	
14	Riparian Planting, live willow stakes, cottonwood poles, some conifers, seeding.	Acre		6.2	
15	Transitional Zone Planting, live willow stakes, cottonwood poles, shrubs, bushes,	Acre		8.0	
16	VACANT	0		0	
	Construction Sub-Total				
101	Mobilization (as % of Construction Sub-Total)				
102	Taxes (as % of Construction Sub-Total)				
103	Incidentals not included in items above (as % of Construction Sub-Total)				
104	Contingency (as % of Construction Sub-Total)				
105	Permitting & Design (as % of Construction Sub-Total)				
106	Other (as % of Construction Sub-Total)				
	Final Construction Cost				

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62799PE
OREGON
JAN. 11, 2000
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Walla Walla River
Umatilla County, Oregon
Confederated Tribes of the
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GEOENGINEERS
523 East Second Avenue
Spokane, Washington 99202

Construction Quantities

Lampson Design Drawings

Sheet S-11.3

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