

Attachment 1

FULL PROPOSAL FORM

Lewis River Aquatic Fund

Form Intent:

To provide a venue for an applicant to clearly indicate the technical basis and support for proposed project. Specifically the project's consistency with recovery plans, Settlement Agreement Fund objectives and priorities: technical studies and assessments which support the proposed action and approach.

Full Proposal format:

Please complete the following form for your Full Proposal. Maps, design drawings and other supporting materials may be attached.

The deadline for a Full Proposal Form submission is **February 3, 2020**. Please submit materials to:

Erik Lesko
PacifiCorp – LCT 1800
825 NE Multnomah Street
Portland, OR 97232
Erik.lesko@pacificorp.com

1. Project Title

Eagle Island chum spawning channel construction

2. Project Manager (name, address, telephone, email)

Todd Hillson
Environmental Planner 5
ESA/Anadromous Fish Investigations Unit Lead
5525 South 11th Street
Ridgefield WA 98642
(360) 906-6730
Hillsth@dfw.wa.gov

3. Identification of problem or opportunity to be addressed

Summarize information about the problem or opportunity addressed by your Full Proposal.

Based on historical commercial landings and habitat availability, it has been estimated that between 0.5-1 million chum salmon returned annually to the Lower Columbia River (LCR) and its tributaries (Johnson et al. 1997). A combination of several factors (loss & degradation of spawning and rearing habitats, changes to estuary ecology and habitat, altered mainstem and tributary hydrology, and harvest) resulted in a significant decline in chum salmon abundance beginning in the 1940s. The decline continued through the 1950s even after the harvest pressure was removed. In 1999, LCR chum salmon populations were listed as threatened under the auspices of the Endangered Species Act. Of the 17 historic LCR chum salmon populations, 90% are considered extirpated or nearly so. The Lewis population of chum salmon falls into the “nearly so” group. This population is at high risk as a result of low population size, low productivity due to loss of preferred/ needed spawning habitat, low diversity, and limited temporal and spatial distribution.

Recent adult returns of LCR chum salmon to the Lewis Basin are estimated to be less than 25-50 adults annually. This compares to estimated historical return sizes between 120,000 and 300,000 adults (LCFRB North Fork Lewis Subbasin Plan, 2010). The Lewis, Cowlitz and Sandy chum salmon populations are identified as the primary recovery populations within the Cascade strata of the LCR chum salmon ESU (NMFS 2013). Recovery plan goals include increasing the Lewis basin population viability from low (current state) to high, decreasing population risk from high (current state) to low, and reaching a target adult abundance level of 1,300 annually. De-listing requires at least two primary populations within each of the ESUs strata be “recovered”. Due to the low smolt-to-adult survival rates that LCR chum salmon experience, significant increases in freshwater productivity in this population will be necessary to achieve recovery plan goals.

Spawning channels have proven to be an effective tool to increase freshwater productivity (egg-to-fry survival rate) of chum salmon populations. Egg-to-fry survival rates in similarly constructed chum salmon spawning channels in the LCR have documented average egg-to-fry survival rates in the 50-55% range (Hillson and Ronne, 2016) compared to similarly estimated egg-to-fry survival rates from run-of-the-river spawners which can vary from near zero to 22% depending on the year (Salo 1991). Adults who utilize the spawning channel will realize a significant boost in productivity compared to adults spawning in the mainstem Lewis River.

4. Background

Provide information related to how this project fits into greater watershed objectives and any previously collected information at the project site (e.g. fish surveys, habitat delineation, etc.)

Section 3.2.4 (page 3-31) of the LCR salmon recovery plan states "Chum habitats have been reduced by 75% or more for the majority of the populations by changes or loss of low elevation reaches and off-channel areas due to channel stabilization, loss of floodplain connectivity and function, and sedimentation due to land use activities

throughout the entire watershed." (LCFRB 2010). This statement is especially true in the areas of the Lewis River basin that chum salmon historically utilized. Additionally, there is a hydropower/flow regulation component on the North Fork Lewis River further reducing the likelihood of natural habitat processes creating the productive side- and off-channel spawning habitat types that chum salmon need within the basin.

This project is in alignment with WDFWs regional chum salmon recovery plan objectives which are to 1) protect, restore, or create protected high quality off-main channel spawning habitats to increase fresh-water productivity (egg-to-fry survival), 2) supplement existing populations using a genetically appropriate donor stock to jumpstart usage of the new habitat and begin local adaptation of donor stock, 3) monitor adult and juvenile outmigrant monitoring at the spawning channel to estimate egg-to-fry survival rates by marking all fish produced via Parental Based Tagging (PBT; Anderson and Garza 2005) so that channel-origin adults can be identified, and 4) adaptively manage the project by using results of prior chum salmon monitoring activities within, and from outside, the basin to inform future decisions.

The Eagle Island chum salmon spawning channel (spawning channel) project has a long history. In 2010, a scoping project, funded by the Bonneville Power Administration (BPA) through the LCR chum salmon BiOp project ([2008-710-00](#)), was initiated to identify potential chum salmon spawning channel sites within the East Fork Lewis and North Fork Lewis river basins. Over the course of several years, multiple sites in both basins were monitored and evaluated. At the end of this process, it was determined that the Eagle Island site had the highest potential for a successful spawning channel ([Lewis Basin Groundwater Investigations and Spawning Channel Design](#) chapter). A mixture of funding sources (BPA, the Odessa Water Withdrawal mitigation fund, and WA State) have been used over the last four to five years to complete the spawning channel project up to the construction phase. We have final designs and all the necessary State, local, and Federal construction permits including ESA coverage and a completed cultural resources review (106 permit) in hand. A copy of the completed design report and permit drawings are included in our application package. In 2018, we applied for and received a \$100K grant through the LCFRBs Salmon Funding Recovery Board (SFRB) ([project ID 18-1413](#)) to use towards construction of the spawning channel. In the fall of 2018, the access road to the site was improved and approximately \$450K of construction materials (rock, spawning gravel, and logs), purchased through BPA project 2008-710-00, were moved on-site and the out-of-water section of the spawning channels alignment was cleared. Our plan, if all the necessary funding can be secured, is to complete construction of the spawning channel in the late spring and summer of 2021. As of the date that this proposal was submitted, the intent is to use staff from WDFWs Construction and Asset Management Program (CAMP) to accomplish the construction of the spawning channel.

5. Project Objective(s)

State the objectives of your Full Proposal including how the project is consistent with Aquatics Fund objectives and priorities, and recovery plans. Clearly describe the

biological benefits and expected outcome of your project. Describe the technical basis for the objectives including the identification of any supporting technical references. Identify biological metrics to help quantify the benefit of the project. Describe effects to other resource areas such as recreation and wildlife.

The overall goal of the Eagle Island spawning channel project is to create protected high quality off-main channel spawning habitat that can support at least 500 spawner pairs and be expected to reliably provide egg-to-fry survival rates of ~50% or greater annually. Highly productive chum salmon spawning and incubation habitat is critical for the recovery of this species within the Lewis Basin due to the low smolt-to-adult survival rates that LCR chum salmon experience. As a result of the increased productivity within the population, abundance is expected to increase thereby increasing diversity and species spatial and temporal distribution, which will reduce the extinction risk to the population. A long-term goal of the WDFWs regional chum salmon recovery strategy is to use a healthy and stable Lewis population as a donor stock for reintroduction/enhancement programs in other Cascade strata populations.

This project is consistent with the Aquatic Fund objectives and priorities to consider when reviewing and funding projects detailed in Section 3 of the Aquatic Funds – Strategic Plan and Administrative Procedures (2005). Specifically, this project will (1) benefit fish recovery throughout the North Fork Lewis River, with priority to ESA-listed species, (2) support the reintroduction of anadromous fish throughout the basin, and (3) enhance fish habitat in the Lewis River Basin, with priority given to the NF Lewis River. As mentioned above in the Background section above, this project is in alignment with both the overall LCR salmon recovery plan and WDFWs LCR chum salmon recovery strategy.

The Aquatics Fund Subgroup to the ACC has completed a Lewis River Aquatic Fund Priority Reaches (Priority Reaches) document which provides priority rankings for stream reaches within the Lewis River watershed. The Priority Reaches document is aligned with the LCFRB Interactive map which is found on their website at www.lowercolumbiasalmonrecovery.org/mappage. The interactive maps provide a wealth of information that should help project proponents in selecting areas to focus their habitat improvement efforts. For consideration of funding the proponent must demonstrate that they have reviewed both the Priority Reaches and the LCFRB Interactive map and selected appropriate projects/reaches from those two tools. Additionally, proponent must show how proposed project is consistent with fund objectives and priorities. Projects proposed in reaches other than those identified in the Priority Reaches document or high priority reaches in the LCFRB habitat strategy (Tier 1 and Tier 2) need a clear explanation of why they still support Lewis River Aquatic Fund goals.

The project is located inside the geographic scope of the Aquatic Fund boundary (Figure 1, Aquatic Funds – Strategic Plan and Administrative Procedures, 2005). While outside (between) reaches identified in the Lewis River Aquatic Fund Priority Reaches document, the Eagle Island chum spawning channel project is located in a reach (Lewis

4B) of the North Fork Lewis River considered high priority (Tier 1) in the Lower Columbia Fish Recovery Board's (LCFRB) habitat strategy ([SalmonPort](#) web site).

6. Tasks

State the specific actions which must be taken to achieve the project objectives. [NOTE: if the project will cause any latent, dangerous condition (e.g. submerged wooden structures in a waterway used by boaters and/or tubers) include installation of permanent warning signs in the project tasks.]

This project is essentially "shovel ready". The three remaining tasks are 1) securing the remaining funds needed to complete the spawning channel construction, 2) the construction phase itself, and 3) completing reporting requirements of funding entities. There will be post construction monitoring to document usage and performance of the spawning channel. However, at this time, ACC funds are not being requested for post construction monitoring and evaluation activities.

7. Methods

Describe methods to be used, by including the following:

- Preliminary Design including existing site plan with bankfull width indicated, plan view drawing overlaid with proposed actions of specific dimensions, and project profile and cross sections at important project locations showing water surface elevations relevant to the design including design flows. Structure design details should also be provided for instream projects involving large wood.

Final construction design drawings which include the relevant elements asked for above are included with this proposal.

- Identify sources of Best Management Practices (BMPs) and how they will protect resource values.

As a state agency, BMPs for WDFW have been defined by the Washington State Legislature through Washington Administrative Code (WAC). The WAC specific to habitat project BMPs and how they protect resource values are covered under Title 220, Chapter 220-660 and can be [found here](#).

- Describe how the restoration methods relate to specific fish habitat benefits and seasonal flow conditions, including expected short- and long-term functional habitat responses.

The specific fish habitat benefits this project will provide is ~18,200 square feet of groundwater fed high quality off-main channel spawning and incubation habitat for chum salmon. At optimal chum salmon spawner densities (2-2.5 square meters per female), this

channel has the capacity for ~700 pairs of spawners. It will provide protected and reliable high productivity spawning habitat for Lewis population natural-origin adults. The two in-stream areas of the project, the channel entrance and the log structure overlay on the infiltration gallery, were not designed to elicit functional habitat responses, therefore none are expected.

8. Specific Work Products

Identify specific deliverable results of the project. Project managers will be required to provide status updates with submission of project invoices.

We propose two deliverables for ACC funds, the first being completion of the spawning channel construction and the second being the project close-out site visit post construction and photo documentation submitted per items #9b and #14 respectively of this proposal form.

9. Project Duration

- a. Identify project duration. Note that duration of a project funded from Fiscal Year 2020 appropriations may extend beyond the end of the fiscal year.

Construction is expected to begin in the late spring/ summer of 2021 and end by October 2021. Construction will be phased with “out of water” work beginning first followed by the two in-water elements (channel entrance and infiltration gallery) during the in-water work window. Any remaining out of water work, clean up and revegetation will take place once the in-water work is completed.

- b. Provide a detailed project schedule to include:
 - o Initiation of project
 - o Completion date for each milestone or major task
 - o Project close-out site visit (with PacifiCorp, Cowlitz PUD, and ACC representatives)
 - o Monitoring & reporting on results

Late spring & summer of 2021:

Mobilize to site, install erosion and sediment controls, clear and convert existing vehicle trails into temporary roads for construction, place out of water floodplain wood, clear and excavate out of water channel alignment section, install pilings and log-toe components, install water level control elements, place spawning gravel. Prepare for in-water work

August 2021:

Place coffer dams, de-water work areas, excavate downstream entrance, install downstream entrance components, excavate for infiltration gallery placement, install infiltration gallery, backfill area and install LWD component of infiltration gallery, remove coffer dams.

August through September 2021:

Continue work on out of water elements as needed, general clean up and decommissioning of un-needed construction roads, de-mobilize from site.

October 2021:

Complete revegetation plan.

October or November 2021:

Conduct post project site visit with PacifiCorp, Cowlitz PUD, and ACC representatives, complete and submit photo documentation report.

Please note the schedule provided above makes the assumption that staff from WDFW's Construction and Asset Management Program will be doing the construction.

10. Permits and Authorizations

Identify any applicable permits and resource surveys required for project. Please include timeline for obtaining and any action taken to-date. Applicant will be responsible for securing all such necessary permits.

All required local, state, and federal construction and ESA permits have been secured. The project also has a completed cultural resources review (106 permit) in hand.

Obtain permission of all owners of land used for access to and completion of the project. **Landowner(s) must sign PacifiCorp's Release Agreement prior to finalization of a Funding Agreement with PacifiCorp (Attachment C).**

The project will occur on WDFW owned property. An ingress, egress and utilities easement will provide access to the project site. A signed Landowner Acknowledgment form is attached to this proposal.

11. Matching Funds and In-kind Contributions

If applicable, describe any matching funds and/or in-kind contributions that you have secured or have requested through other means. Matching funds are those funds contributed to the project from other funding sources. In-kind contributions may include donated labor, materials, or equipment. Please be specific in your description of contributions and use of volunteers (e.g. ACE construction is donating 8 hours of backhoe operation including operator).

Matching spent to date (scoping, groundwater monitoring, design, permits, and construction materials purchased to date)

- Cash – Bonneville Power Administration - ~\$575K (includes ~\$450K in purchased construction materials)
- Cash – Odessa Water Withdrawal mitigation fund - ~\$215K
- In-kind – WDFW Fish Management, Habitat and Engineering staff - ~\$100K

Available in hand

- Cash – LCFRB SFRB grant - \$100K

Pending

- Cash – \$525K – WDFW is seeking the remaining construction cost from other funding sources including the Bonneville Power Administration.

12. Peer Review of Proposed Project

It is encouraged that the Full Proposal be reviewed by an independent resource professional prior to submission for funding. Focus of such review should be on biological value, site selection and proposed methodology. Please note who completed the review and contact information. This does not have to be a third party review and can come from someone associated with the sponsoring organization. For large wood projects in the mainstems of the Lewis or Muddy River, a peer review is required.

WDFWs overall LCR chum salmon recovery program and this specific habitat project have both been through multiple reviews.

In 2010 and again in 2019, WDFWs BPA funded LCR chum recovery project underwent reviews by staff from the Northwest Power and Conservation Council (NPCC) and the Independent Scientific Review Panel (ISRP) as part of the NPCCs category review process. The project received positive reviews each time.

The chum salmon recovery strategy being proposed, construct a spawning channel to support other recovery efforts, is similar to another WDFW chum salmon reintroduction program being conducted in Duncan Creek. In 2009, the Duncan Creek program received a favorable review when it underwent a NPCC three-step review.

The spawning channel design generated under contract by Inter-Fluve was reviewed by staff from WDFWs Habitat Engineering unit in 2014. Additionally, in 2014 the spawning channel design was reviewed for fatal flaws by the Lower Columbia Fish Recovery Board's (LCFRB) Salmon Funding Recovery Board Technical Advisory Committee (SFRB TAC) as a condition of receiving funds from the Odessa Subarea Water Withdrawal Mitigation Fund. No fatal flaws were found in this review. In 2018, the project designs were reviewed and passed again by the LCFRB SFRB TAC as a condition of receiving a SFRB grant.

13. Budget

Provide a **detailed** budget for the project stages (Final design, Permitting, Construction, Signage, Monitoring/Reporting) by work task. Include:

Personnel costs

Labor and estimated hours for each project employee

Operating expenses

Supplies and materials

Mileage

Administrative overhead

Insurance expense, in accordance with Appendix A

If in-kind contributions have been acquired, please note contributions according to project stage within the budget.

An estimate for construction is attached to this proposal. If this proposal is chosen to be funded, the ACC grant will be one of at least three funding sources being used for construction. The budget was generated assuming WDFW CAMP staff would be doing the construction. However, it's possible that the work will instead be put out under a Public Works bid. Due to that possibility, each line item task cost is broken down into three sub-categories: Materials, Fees/Taxes, and Equipment/Work. These splits are a best guess but should be close and reflect labor and materials cost regardless of who does the work. The estimate includes some items that either will, or will not be, needed depending on who does the work, e.g. final design bid prep will not be needed and oversight cost will be reduced if CAMP does the work.

The attached estimate is a "worst case" budget. It does not include reductions for pre-purchased materials (logs, logs w/roots, and spawning gravel, ~\$450K worth). It is likely that some, possibly the majority, of logs intended to be pile driven will no longer be usable (dry now and will split when driven) and replacements will need to be purchased. The amount of indirect is likely over estimated. The Eagle Island spawning channel project is considered an improvement to WDFW owned land and as such, some of the materials purchased will be exempt from indirect. Also, the amount of indirect will change significantly if the construction work goes out under a Public Works bid.

14. Photo Documentation (*Per National Marine Fisheries Service's Biological Opinion for Relicensing of the Lewis River Hydroelectric Projects – August 27, 2007*):

Identify process or methodology project will include and provide "*photo documentation of habitat conditions at the project site before, during and after project completion*".

- a. "*Include general views and close-ups showing details of the project and project area, including pre- and post-construction*".
- b. "*Label each photo with date, time, project name, photographer's name, and documentation of the subject activity*".

Please provide schedule of when photo documentation will be provided to the ACC.

A Word document containing the required photos and accompanying notes will be provided to the ACC once construction has been completed. Barring unforeseen delays, we expect to be able to provide this deliverable in the fall of 2021.

15. Insurance. All qualifying applicants shall comply with PacifiCorp's insurance requirements set forth in Appendix A. The policy limits are deemed sufficient by PacifiCorp for project activities involving significant risk, including placement of large woody debris in navigable waterways, and are presumed to be sufficient for all activities likely to be funded under this Full Proposal Form. Should applicant's insurance program not meet these requirements, bid pricing should include any additional costs applicant would incur to comply with these requirements.

If this proposal is chosen to be funded, insurance coverage will need to be negotiated. WDFW is self-insured and our insurance liabilities and coverage are dictated by state law. I'm confident though that WDFWs and PacifiCorp's risk managers will be able to work out a mutually agreeable solution.

Appendix A
Insurance Requirements
(Risk Mgmt to evaluate risk by project and report needed
insurance limits to Lewis River Project Coordinator)

1. INSURANCE

Without limiting any liabilities or any other obligations of [CONTRACTOR], [CONTRACTOR] shall, prior to commencing the Project, secure and continuously carry with insurers having an A.M. Best Insurance Reports rating of A-:VII or better the following insurance coverage:

1.1 Workers' Compensation. [CONTRACTOR] shall comply with all applicable Workers' Compensation Laws and shall furnish proof thereof satisfactory to PacifiCorp prior to commencing the Project.

All Workers' Compensation policies shall contain provisions that the insurance companies will have no right of recovery or subrogation against PacifiCorp, its parent, divisions, affiliates, subsidiary companies, co-lessees, or co-venturers, agents, directors, officers, employees, servants, and insurers, it being the intention of the parties that the insurance as effected shall protect all parties.

1.2 Employers' Liability. Insurance with a minimum single limit of \$1,000,000 each accident, \$1,000,000 disease each employee, and \$1,000,000 disease policy limit.

1.3 Commercial General Liability. The most recently approved ISO policy, or its equivalent, written on an occurrence basis, with limits not less than \$1,000,000 per occurrence/ \$2,000,000 general aggregate (on a per location and/or per job basis) bodily injury (with no exclusions applicable to injuries sustained by volunteers working or participating in the Project) and property damage, including the following coverages:

- a. Premises and operations coverage
- b. Independent contractor's coverage
- c. Contractual liability
- d. Products and completed operations coverage
- e. Coverage for explosion, collapse, and underground property damage
- f. Broad form property damage liability
- g. Personal and advertising injury liability, with the contractual exclusion removed
- h. Sudden and accidental pollution liability, if appropriate
- i. Watercraft liability, either included or insured under a separate policy

1.4 Business Automobile Liability. The most recently approved ISO policy, or its equivalent, with a minimum single limit of \$1,000,000 each accident for bodily injury and property damage including sudden and accidental pollution liability, with respect to [CONTRACTOR]'s vehicles whether owned, hired or non-owned, assigned to or used in the performance of the Project.

1.5 Umbrella Liability. Insurance with a minimum limit of \$4,000,000 each occurrence/aggregate where applicable to be provided on a following form basis in excess of the coverages and limits required in Employers' Liability insurance, Commercial General Liability insurance and Business Automobile Liability insurance above. [CONTRACTOR] shall notify PacifiCorp, if at any time their minimum umbrella limit is not available during the term of this Agreement, and will purchase additional limits, if requested by PacifiCorp.

In addition to the requirements stated above any and all parties providing underground locate, engineering, design, or soil sample testing services including [CONTRACTOR], subcontractor and all other independent contractors shall be required to provide the followings insurance:

Professional Liability: [CONTRACTOR] (or its contractors) shall maintain Professional Liability insurance covering damages arising out of negligent acts, errors or omissions committed by [CONTRACTOR] (or its contractors) in the performance of this Agreement, with a liability limit of not less than \$1,000,000 each claim. [CONTRACTOR] (or its subcontractors of any tier) shall maintain this policy for a minimum of two (2) years after completion of the work or shall arrange for a two (2) year extended discovery (tail) provision if the policy is not renewed. The intent of this policy is to provide coverage for claims arising out of the performance of work or services contracted or permitted under this Agreement and caused by any error, omission for which the [CONTRACTOR] its subcontractor or other independent contractor is held liable.

Except for Workers' Compensation insurance, the policies required herein shall include provisions or endorsements naming PacifiCorp, its affiliates, officers, directors, agents, and employees as additional insureds.

To the extent of [CONTRACTOR]'s negligent acts or omission, all policies required by this Agreement shall include provisions that such insurance is primary insurance with respect to the interests of PacifiCorp and that any other insurance maintained by PacifiCorp is excess and not contributory insurance with the insurance required hereunder, provisions that the policy contain a cross liability or severability of interest clause or endorsement, and that [CONTRACTOR] shall notify PacifiCorp immediately upon receipt of notice of cancellation, and shall provide proof of replacement insurance prior to the effective date of cancellation. No required insurance policies, except Workers' Compensation, shall contain any provisions prohibiting waivers of subrogation. Unless prohibited by applicable law, all required insurance policies shall contain provisions that the insurer will have no right of recovery or subrogation against PacifiCorp, its parent, affiliates, subsidiary companies, co-lessees, agents, directors,

officers, employees, servants, and insurers, it being the intention of the Parties that the insurance as effected shall protect all parties.

A certificate in a form satisfactory to PacifiCorp certifying to the issuance of such insurance shall be furnished to PacifiCorp prior to commencement of the Project by [CONTRACTOR] or its volunteers or contractors. If requested, [CONTRACTOR] shall provide a copy of each insurance policy, certified as a true copy by an authorized representative of the issuing insurance company, to PacifiCorp.

[CONTRACTOR] shall require subcontractors who perform work at the Project to carry liability insurance (auto, commercial general liability and excess) workers' compensation/ employers' or stop gap liability and professional liability (as required) insurance commensurate with their respective scopes of work. [CONTRACTOR] shall remain responsible for any claims, lawsuits, losses and expenses including defense costs that exceed any of its subcontractors' insurance limits or for uninsured claims or losses.

PacifiCorp does not represent that the insurance coverage's specified herein (whether in scope of coverage or amounts of coverage) are adequate to protect the obligations [CONTRACTOR], and [CONTRACTOR] shall be solely responsible for any deficiencies thereof.



Washington
Department of
**FISH and
WILDLIFE**



proud past, promising future

CLARK COUNTY
WASHINGTON

ENGINEERING CASE _____
HABITAT CASE _____
PLANNING LAND USE CASE _____
WETLAND CASE _____

Signature	Clark County Fire Marshal	Date
Signature	Clark County Environmental Services Resource and Enhancement Permitting	Date
Signature	Clark County Transportation-Concurrency	Date
Signature	Clark County Transportation-Signal	Date
Signature	Clark County Transportation-Signing and Striping	Date
Signature	Clark County Development Engineering Final Site Plan	Date
Signature	Clark County Development Engineering	Date

A	N/A	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stormwater & Erosion Control CCC 40.380
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Stormwater & Erosion Control CCC 40.385
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Transportation & Circulation CCC 40.350
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Within Right-of-Way Landscaping Review
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Utility Permits CCC 13.12A & 12.20A
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Clark County Signing & Striping
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Clark County Traffic Signals
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Road Modifications CCC 40.550.010
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Critical Aquifer Recharge Areas CCC 40.410
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Geologic Hazard Areas CCC 40.430
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Flood Hazard Areas CCC 40.420
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Sewer and Water Plans
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Clark County M & O Pavement Deflection Testing
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Private Stormwater Covenant
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Grading, Excavation, Fill and Stockpile CCC 14.07

RECOMMENDED for APPROVAL

Engineering Team Leader

APPROVED for CONSTRUCTION

Clark County Engineer

Plans Approved for Construction by the County does not in any way relieve the applicant of responsibility to meet all requirements of the County or obligation to protect life, health and property. Plans have been reviewed and approved for compliance with Clark County Code and adopted regulations. Plans shall be revised or supplemented at any time it is determined that the full requirements of the County have not been met.

Rev. 05/14/12

LEWIS RIVER - EAGLE ISLAND
CHUM SPAWNING CHANNEL
WOODLAND, WASHINGTON



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

LEWIS RIVER - EAGLE ISLAND CHUM SPAWNING CHANNEL DESIGN



proud past, promising future

CLARK COUNTY
WASHINGTON

DESIGN PROFESSIONAL SHALL COMPLETE ALL LINES:

PROJECT QUANTITIES

N/A = NOT APPLICABLE ✓ = APPLICABLE

GRADING:

Onsite Excavation (Cut) Volume (Cubic Yards)	9130 CY
Onsite Fill Volume (Cubic Yards)	2179 CY
Exported Volume (Cubic Yards)	0
Imported Volume (Cubic Yards)	1387 CY

DISTURBED AREA:

Disturbed Area (Square Feet)	205,522 ft ²
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FLOW RESTORATION LAND COVER OBLIGATION (TO 0.1 ACRE):

(FOR ONSITE AREAS ONLY AND WHEN MR #7 IS TRIGGERED)

Total Project Area (Acres)	N/A
Pre-Development Effective Impervious Area Obligation (Acres)	N/A
Pre-Development Lawn/Landscape Obligation (Acres)	N/A
Pre-Development Pasture Obligation (Acres)	N/A

PUBLIC IMPROVEMENTS

<input type="checkbox"/>	Transportation (Arterial & Collector)			
	Sidewalk	Lineal	Feet	<u>N/A</u>
	Curb	Lineal	Feet	<u>N/A</u>
	Street	Lineal	Feet	<u>N/A</u>
<input type="checkbox"/>	Transportation (Other)			
	Sidewalk	Lineal	Feet	<u>N/A</u>
	Curb	Lineal	Feet	<u>N/A</u>
	Street	Lineal	Feet	<u>N/A</u>

☐ Stormwater

Facility Type N/A

PRIVATE IMPROVEMENTS

<input type="checkbox"/> Transportation	Sidewalk	Lineal	Feet	N/A
	Curb	Lineal	Feet	N/A
	Street	Lineal	Feet	N/A

☐ Stormwater

Facility Type N/A

SHEET INDEX

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- 3 Erosion Control Notes
- 4 Erosion Control Details
- 5 Summary of Quantities and Material Specifications
- 6 Existing Conditions, Ownership, and Survey Control
- 7 Preliminary Development Plan (Access, Staging & Erosion Control)
- 8 Erosion and Sedimentation Control Typical Details
- 9 Sheet Index and Proposed Conditions Plan & Profile
- 10 Proposed Conditions STA 0+10 to 3+25
- 11 Proposed Conditions STA 3+50 to 10+25
- 12 Proposed Conditions STA 10+25 to 13+70
- 13 Grading Cross-Sections STA 1+00 to 13+00
- 14 Control Weir Cross Sections
- 15 Typical Details
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EXPIRES 8/25/2016

COVER, SHEET INDEX,
AND VICINITY MAP

SHEET
1 OF 20

EXISTING DATA

GENERAL TOPOGRAPHIC INFORMATION IS PROVIDED FROM LIDAR (US ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT, 2009) AND SPECIFIC PROJECT AREA SURVEY PERFORMED BY INTER-FLUVE, INC.

SOILS

LEWIS RIVER ALLUVIUM.

UTILITIES

THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR HAVING UTILITIES LOCATED PRIOR TO CONSTRUCTION ACTIVITIES.

THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE AFFECTED UTILITY SERVICE TO REPORT ANY DAMAGED OR DESTROYED UTILITIES. THE CONTRACTOR SHALL PROVIDE EQUIPMENT OR LABOR TO AID THE AFFECTED UTILITY SERVICE IN REPAIRING DAMAGED OR DESTROYED UTILITIES AT NO COST TO THE OWNER.

WORK AREA CONDITION

THE CONTRACTOR SHALL KEEP THE WORK AREAS IN A NEAT AND SIGHTLY CONDITION FREE OF DEBRIS AND LITTER FOR THE DURATION OF THE PROJECT.

ALL EQUIPMENT, MATERIALS AND PERSONNEL SHALL REMAIN WITHIN THE LIMITS OF DISTURBANCE.

SWPPP

A CONSTRUCTION STORMWATER GENERAL PERMIT IS REQUIRED FOR THE PROJECT SITE (GREATER THAN 1 ACRE OF DISTURBANCE).

IN ACCORDANCE WITH THE GENERAL PERMIT, CONTRACTOR IS REQUIRED TO DEVELOP A STORMWATER POLLUTION PREVENTION (SWPPP) PLAN.

PRESERVE VEGETATION/MARK CLEARING LIMITS

BEFORE BEGINNING CLEARING ACTIVITIES, CLEARLY MARK ALL CLEARING LIMITS, WATERWAYS AND DRAINAGES NOT TO BE DISTURBED, SENSITIVE AREAS, AND THEIR BUFFERS, AND TREES THAT ARE TO BE PRESERVED WITHIN THE CONSTRUCTION AREA.

TREES MARKED FOR PRESERVATION SHALL NOT BE DEBARKED OR DAMAGED DURING CLEARING ACTIVITIES.

THE DUFF LAYER, NATIVE TOP SOIL, AND NATURAL VEGETATION SHALL BE RETAINED IN AN UNDISTURBED STATE TO THE MAXIMUM EXTENT PRACTICABLE.

TREE SALVAGE

ALL TREES AND WOODY VEGETATION REMOVED FROM CLEARING AND GRUBBING SHALL BE SALVAGED AND STOCKPILED FOR USE IN FLOODPLAIN ROUGHNESS AND RIVERBANK LOG STRUCTURE, SUBJECT TO APPROVAL BY ENGINEER. CONTRACTOR IS RESPONSIBLE FOR REMOVING ALL SALVAGED CLEARING AND GRUBBING DEBRIS FROM THE SITE AT END OF THE PROJECT UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

ESTABLISH CONSTRUCTION ACCESS

THE CONTRACTOR SHALL ENTER THE SITE FROM NW HAYES ROAD. ACCESS AND EXIT SHALL BE LIMITED TO ONE ROUTE.

CONTRACTOR SHALL ESTABLISH ACCESS INCLUDING TEMPORARY REMOVAL AND REPLACEMENT OF GATES, TRIMMING AND REMOVAL OF TREES, AND MAINTENANCE OF ACCESS ROADS IN ACCORDANCE WITH LANDOWNER ACCESS AGREEMENTS.

ACCESS POINT SHALL BE STABILIZED WITH A PAD OF QUARRY SPALLS, CRUSHED ROCK, OR OTHER EQUIVALENT BMP TO MINIMIZE TRACKING OF SEDIMENT ONTO PUBLIC ROADS.

LOCATE WHEEL WASH OR TIRE BATHS ON SITE, IF THE STABILIZED CONSTRUCTION ENTRANCE IS NOT EFFECTIVE IN PREVENTING TRACKING OF SEDIMENT ONTO ROADS.

THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING ANY REQUIRED TRAFFIC CONTROL INCLUDING, BUT NOT LIMITED TO, SIGNAGE AND FLAGGERS.

ALL SAPLINGS AND TREES TO BE TRANSPLANTED OR REMOVED ALONG THE ACCESS ROUTE SHALL BE APPROVED BY THE ENGINEER AND CLEARLY MARKED.

PUBLIC RIGHTS-OF-WAY SHALL BE KEPT IN A CLEAN AND SERVICEABLE CONDITION AT ALL TIMES. IN THE EVENT MATERIALS ARE INADVERTENTLY DEPOSITED ON ROADWAYS THE MATERIAL SHALL BE PROMPTLY REMOVED. MATERIALS ARE TO BE SWEEPED AND REMOVED PRIOR TO ANY STREET FLUSHING.

INSTALL EROSION AND SEDIMENT CONTROLS

THE CONTRACTOR IS ADVISED THAT THE PROJECT AREA DRAINS TO A SALMON BEARING STREAM AND/OR STATE WATERS AND THAT THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING THE RECEIVING WATERS FROM DELETERIOUS EFFECTS OF CONSTRUCTION.

THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING THE EROSION AND SEDIMENT CONTROL MEASURES SHOWN OR DESCRIBED IN THE CONTRACT DOCUMENTS AND ANY ADDITIONAL MEASURES THAT MAY BE REQUIRED BY THE CONTRACTOR'S MEANS AND METHODS OF CONSTRUCTION TO PREVENT VIOLATION OF SURFACE WATER QUALITY, GROUND WATER QUALITY, OR SEDIMENT MANAGEMENT STANDARDS.

LOCATE BMPS INTENDED TO TRAP SEDIMENT ON-SITE IN A MANNER TO AVOID INTERFERENCE WITH THE MOVEMENT OF JUVENILE SALMONIDS.

STABILIZE SOILS

SOILS SHALL BE STABILIZED BEFORE A WORK SHUTDOWN, HOLIDAY OR WEEKEND IF NEEDED BASED ON THE WEATHER FORECAST.

SOIL COMPACTION SHALL BE MINIMIZED, UNLESS INFEASIBLE, TO PRESERVE TOPSOIL.

CONTROL POLLUTANTS

CHEMICAL WASTES SHALL BE STORED AND DISPOSED OF IN A MANNER APPROVED BY REGULATORY AGENCIES AND AS IDENTIFIED IN THE SWPPP.

ALL POLLUTANT DISCHARGES OTHER THAN SEDIMENT THAT OCCUR ON SITE DURING CONSTRUCTION SHALL BE HANDLED AND DISPOSED OF IN A MANNER THAT DOES NOT CAUSE CONTAMINATION OF STORMWATER, GROUNDWATER, OR SOILS TO REMAIN ON SITE.

THE USE OF LIME, FLY ASH, OR OTHER SOIL AMENDMENTS THAT COULD ALTER THE PH OF DISCHARGE WATERS IS PROHIBITED.

CONTROL DEWATERING

PROJECT AREA WILL BE ISOLATED FROM THE LEWIS RIVER BY LEAVING IN PLACE AN EARTHEN BERM AT THE DOWNSTREAM END OF THE CONSTRUCTED CHANNEL.

PRIOR TO REMOVAL OF THE EARTHEN BERM, WORK AREA SHALL BE ISOLATED BY A COFFERDAM INSTALLED DOWNSTREAM OF CHANNEL OUTLET.

PUMPING SHALL BE PERFORMED TO KEEP WORK AREA DEWATERED TO THE EXTENT NECESSARY TO CONSTRUCT THE PROJECT.

HIGHLY TURBID OR CONTAMINATED DEWATERING WATER FROM CONSTRUCTION EQUIPMENT OPERATION SHALL BE PREVENTED FROM DELIVERING SEDIMENT TO THE RIVER. DISPOSAL OPTIONS FOR DEWATERING DISCHARGE INCLUDE:

1. SEDIMENT-LADEN WATER MAY BE PUMPED TO AN UPLAND AREA AND ALLOWED TO SHEET FLOW OVER UNDISTURBED GROUND THROUGH EXISTING VEGETATION TO INFILTRATE INTO THE GROUND. IF NECESSARY TO PREVENT EROSION, THE DEWATERING PIPE OUTLET SHALL BE STABILIZED.

2. USE OF AN APPROPRIATELY SIZED AND MAINTAINED SEDIMENTATION BAG (DIRTBAG) OR OTHER SEDIMENTATION FACILITY WITH OUTFALL TO A DITCH OR SWALE FOR SMALL VOLUMES OF LOCALIZED DEWATERING.

INSPECTIONS, MONITORING, MAINTENANCE, AND REPAIR

SITE INSPECTIONS AND MONITORING SHALL BE CONDUCTED IN ACCORDANCE WITH THE CONSTRUCTION STORMWATER GENERAL PERMIT.

EROSION CONTROL
INSPECTION REQUIRED
CALL 397-2375 EXT. 2499
BEFORE YOU BEGIN ANY SITEWORK



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CHUM SPAWNING CHANNEL
WOODLAND, WASHINGTON



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Hood River, OR 97031
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GENERAL NOTES

SHEET

2 OF 20

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Approved Construction Permit
JUL 21 2016
Page 2 of 99

NO.	BY	DATE	REVISION DESCRIPTION


MJ,DF	MM,GJ	GJ
DRAWN	DESIGNED	CHECKED
MM	7/07/16	11-02-07
APPROVED	DATE	PROJECT

STANDARD NOTES FOR EROSION CONTROL PLAN

1. THE CONTRACTOR SHALL INSTALL AND MAINTAIN BMP'S AS SHOWN AND PERFORM ALL ACTIONS NECESSARY TO PREVENT EROSION, AND CONTROL SEDIMENT FROM LEAVING THE CONSTRUCTION SITE. CONTRACTOR SHALL COMPLY WITH CLARK COUNTY CODE CHAPTER 40.385.
2. ALL EROSION CONTROL MEASURES SHALL BE IN-PLACE AND IN WORKING CONDITION PRIOR TO DISTURBING AND EXPOSING ANY SOIL SURFACES (I.E. SILT FENCE, CONSTRUCTION ENTRANCE, SEDIMENTATION BARRIERS, SEDIMENTATION TRAPS).
3. ALL EROSION PREVENTION AND CONTROL BMP'S SHALL BE MAINTAINED AND REPAIRED AS NEEDED TO INSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION. NEEDED REPAIRS SHALL BE MADE AS SOON AS PRACTICABLE. THEY ARE TO REMAIN IN PLACE AND OPERATIONAL DURING ALL PHASES OF CONSTRUCTION. CONSTRUCTION ACTIVITIES SHALL NOT CONTINUE OR RESUME UNTIL REPAIRS TO EROSION CONTROL FACILITIES ARE MADE AND THE FACILITIES ARE FUNCTIONAL. ANY SEDIMENT LEAVING THE SITE OR DISCHARGING TO A SENSITIVE AREA SHALL BE STOPPED AND CONTROLLED IMMEDIATELY. CONTAMINATED AREAS SHALL BE CLEANED AND RESTORED.
4. CLEARING LIMITS AND WORK AREA LIMITS SHALL BE DELINEATED AND MARKED. DO NOT DISTURB MORE AREA THAN NEEDED FOR CONSTRUCTION REQUIREMENTS.
5. ALL SENSITIVE OR CRITICAL AREAS (WETLANDS, STEEP SLOPES, NATURAL WATERWAYS), AND BUFFERS SHALL ALL BE CLEARLY DELINEATED AND CLEARLY MARKED, AND PROTECTED FROM SEDIMENT DEPOSITION.
6. SEDIMENT LADEN RUNOFF SHALL BE PREVENTED FROM ENTERING ALL EXISTING STORM WATER CATCH BASINS, INLETS AND PERVIOUS DRAINAGE SYSTEMS AFFECTED BY CONSTRUCTION.
7. NO EXPOSED, BARE SOILS SHALL REMAIN UNSTABILIZED FOR MORE THAN TWO DAYS DURING THE PERIOD OCTOBER 1 THRU APRIL 30 OR FOR MORE THAN SEVEN DAYS DURING THE PERIOD OF MAY 1 THROUGH SEPTEMBER 30. ALL DISTURBED SOIL SURFACES SHALL BE STABILIZED BY A SUITABLE APPLICATION OF "BEST MANAGEMENT PRACTICES".
8. WHERE FEASIBLE, NO MORE THAN 500 FEET OF TRENCH SHALL BE OPEN AT ONE TIME. EXCAVATED MATERIAL SHALL BE PLACED ON THE UP-HILL SIDE OF TRENCHES PROVIDED IT DOES NOT CONFLICT WITH SAFETY REQUIREMENTS.
9. DEWATERING DEVICES SHALL DISCHARGE INTO A SEDIMENT TRAP OR SEDIMENT POND. NO DISCHARGE SHALL BE MADE TO A PAVED STREET OR STORMWATER COLLECTION SYSTEM WITHOUT APPROVAL AND REMOVING SEDIMENT.
10. CUT AND FILL SLOPES SHALL BE CONSTRUCTED IN A MANNER THAT WILL MINIMIZE EROSION. EROSION SHALL BE CONTROLLED AND PREVENTED BY SUCH MEASURES AS ROUGHENING THE SURFACE, INSTALLATION OF INTERCEPTOR DITCHES, TERRACING, COVERING WITH MATTING, MULCH OR PLASTIC SHEETING. RUNOFF SHALL BE PREVENTED FROM ENTERING A SLOPE AND FROM UNDERCUTTING THE BASE OF SLOPES.
11. ANY SOIL OR DEBRIS TRANSPORTED ONTO ROADWAYS AND SIDEWALKS SHALL BE REMOVED. DEPOSITS SHALL BE COMPLETELY REMOVED BY SHOVELING AND/OR SWEEPING. WASHING SHALL NOT BE UTILIZED UNLESS SPECIFICALLY APPROVED IN WRITING BY THE COUNTY.
12. ALL PERMANENT INFILTRATION SYSTEMS SHALL BE ISOLATED AND PROTECTED FROM SEDIMENT LADEN RUNOFF ENTERING TO AVOID RISK OF REDUCING THE ABILITY OF THE SYSTEMS TO INFILTRATE. ISOLATION AND PROTECTION SHALL NOT BE REMOVED UNTIL THE DRAINAGE AREA TRIBUTARY TO THE SYSTEM IS COMPLETELY STABILIZED.
13. ALL CONVEYANCE CHANNELS, BOTH TEMPORARY AND PERMANENT SHALL BE STABILIZED TO PREVENT EROSION OF THE CHANNEL. STABILIZATION SHALL EXTEND TO AREAS AT OUTLETS AND DOWNSTREAM REACHES VULNERABLE TO EROSION RESULTING FROM FLOW DISCHARGING FROM THE CHANNEL.
14. IF BMP'S SHOWN ARE UTILIZED BUT ARE INSUFFICIENT TO PREVENT SEDIMENT FROM REACHING WATER BODIES, ADJACENT PROPERTIES, OR PUBLIC RIGHTS-OF-WAY; ADDITIONAL BMP'S SHALL BE IMPLEMENTED IMMEDIATELY TO PREVENT FURTHER ENCROACHMENT OF SEDIMENT.

DWG: ECN.DWG

SHEET 1 OF 2



Department of
Public Works
CLARK COUNTY
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STANDARD NOTES FOR
EROSION CONTROL PLAN
APPROVED
COUNTY ENGINEER
01/30/15
DATE


STANDARD
ECN1
DETAIL
DESIGNED
DRAWN
DATE 01/30/15

STANDARD NOTES FOR EROSION CONTROL PLAN (CONTINUED)

15. STABILIZED AREAS SHALL BE PROVIDED FOR EMPLOYEE PARKING AND STORAGE OF CONSTRUCTION MATERIALS. ERODIBLE STOCKPILES OF EARTHEN MATERIALS, SUCH AS TOPSOIL, SILTY AND CLAYEY SOILS; AND LANDSCAPE MATERIALS, SHALL BE COVERED WHEN NOT BEING INCORPORATED IN THE WORK. EROSION CONTROL BMP'S SHALL BE UTILIZED AS NECESSARY TO PREVENT SEDIMENT LADEN RUNOFF FROM LEAVING OR SEDIMENT BEING TRANSPORTED FROM THESE AREAS FROM VEHICLE ACTIVITY.
16. ALL POLLUTANTS OTHER THAN SEDIMENT THAT OCCUR DURING CONSTRUCTION SHALL BE HANDLED AND DISPOSED OF IN A MANNER THAT DOES NOT CAUSE CONTAMINATION OF STORM WATER.
17. THE CONTRACTOR SHALL KEEP AN INSPECTION LOG OF THE CONDITION OF THE EROSION CONTROL FACILITIES. EROSION CONTROL FACILITIES SHALL BE INSPECTED AT LEAST WEEKLY AND AFTER EACH RAINFALL. THE INSPECTION LOG SHALL BE KEPT AT THE PROJECT SITE AT A DESIGNATED LOCATION AND SHALL BE AVAILABLE FOR REVIEW BY THE COUNTY. AN INDIVIDUAL THAT HAS SUCCESSFULLY COMPLETED THE COUNTY'S EROSION CONTROL CERTIFICATION COURSE SHALL PERFORM INSPECTIONS AND MAINTAIN THE LOG.
18. ALL TEMPORARY BMP'S SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION IS ACHIEVED. TRAPPED SEDIMENT SHALL BE DEPOSITED AND STABILIZED ON SITE. AREAS DISTURBED RESULTING FROM REMOVAL SHALL BE PERMANENTLY STABILIZED.
19. CONSTRUCTION SHALL NOT BE CONSIDERED COMPLETE AND ACCEPTABLE UNTIL ALL DISTURBED SOIL SURFACES HAVE BEEN PROTECTED FROM EROSION WITH PERMANENT LANDSCAPING, COVERING WITH IMPERVIOUS SURFACES, RESTORED TO ORIGINAL UNDISTURBED CONDITION OR PERMANENTLY STABILIZED.
20. VEGETATED STABILIZATION AND LANDSCAPING SHALL BE FERTILIZED, WATERED AND MAINTAINED TO INSURE THAT GROWTH OF VEGETATION IS ESTABLISHED AND SUSTAINED.
21. DURING DRY WEATHER CONSTRUCTION PERIODS THE CONTRACTOR SHALL PROVIDE PROJECT-SPECIFIC DUST CONTROL MEASURES THAT MAY INCLUDE: SEEDING, MULCHING, MATTING, WATER, TACKIFIER, OR CHEMICAL SOIL STABILIZERS. THE CONTRACTOR SHALL MAINTAIN THE DUST CONTROL MEASURES THROUGH DRY WEATHER PERIODS UNTIL ALL DISTURBED AREAS HAVE BEEN STABILIZED. IMMEDIATELY RE-STABILIZE AREAS DISTURBED BY CONTRACTOR'S OPERATIONS OR OTHER ACTIVITIES (WIND, WATER, VANDALISM, ETC.).
22. ENTRY ONTO THE CONSTRUCTION SITE SHALL BE RESTRICTED TO A SINGLE APPROVED ENTRANCE AS SHOWN ON THE APPROVED PLAN.
23. MAINTENANCE AND REPAIR OF HEAVY EQUIPMENT AND VEHICLES WHICH INVOLVE POTENTIAL CONTAMINANTS (OIL, SOLVENTS, HYDRAULIC FLUID, ETC.) MUST BE CONDUCTED IN A MANNER WHICH PREVENTS CONTAMINATION OF SOILS, SURFACE WATER AND GROUND WATER. TARPS, DRIP PANS, OR OTHER APPROPRIATE MEASURES SHALL BE USED AS NECESSARY.
24. STRIPPING, TOPSOIL, AND UNSUITABLE MATERIAL STOCKPILES SHALL BE HYDROSEEDING WITH "REGREEN WHEAT X WHEAT GRASS HYBRID" BY HOBBS AND HOBKINS (OR APPROVED EQUAL). MAINTENANCE OF STOCKPILE AREAS AND REAPPLICATION OF HYDROSEED COVERING SHALL BE REQUIRED IF BARE SOIL IS PRESENT. DURING WINTER AND WET WEATHER CONDITIONS, STOCKPILES SHALL BE COVERED WITH PLASTIC SHEETING PER DETAIL E-16.
25. SIGNIFICANT VARIATION AND DEGREE OF EROSION CONTROL EFFORT WILL BE DICTATED BY WEATHER CONDITIONS. THE DEVELOPER AND CONTRACTOR SHOULD BE PREPARED TO PROVIDE EXTRA EROSION CONTROL PROVISIONS AND EFFORT DURING WINTER AND WET WEATHER CONDITIONS BEYOND THAT NORMALLY REQUIRED DURING SUMMER AND DRY WEATHER CONDITIONS. FINE GRAINED AND UNCONSOLIDATED SOILS ON SLOPING SITES MAY BECOME UNSTABLE WHEN SUBJECT TO EXCESSIVE MOISTURE.

DWG: ECN.DWG

SHEET 2 OF 2



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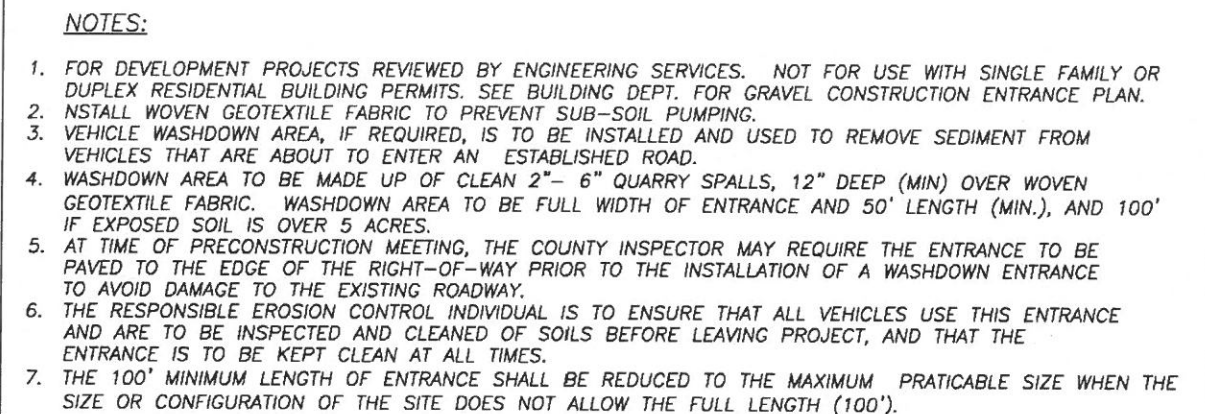
STANDARD NOTES FOR
EROSION CONTROL PLAN (CONTINUED)
APPROVED
COUNTY ENGINEER
01/30/15
DATE

STANDARD
ECN2
DETAIL
DESIGNED
DRAWN
DATE 01/30/15

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EROSION CONTROL
NOTES



DWG: E1.DWG



Peter Capen APPROVED
COUNTY ENGINEER

STANDARD
E1
DETAIL
DESIGNED
DRAWN
DATE 05/23/08

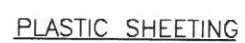
<u>MJ,DF</u>	<u>MM,GJ</u>	<u>GJ</u>
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<u>MM</u>	<u>7/07/16</u>	<u>11-02-07</u>
APPROVED	DATE	PROJECT



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EROSION CONTROL DETAILS

SHEET
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1. PLASTIC SHEETING IS USED TO PROVIDE IMMEDIATE PROTECTION TO SLOPES AND STOCKPILES.
2. DO NOT USE PLASTIC COVERING UPSLOPE OF AREAS SUCH AS STEEP AND/OR UNSTABLE SLOPES THAT MIGHT BE ADVERSELY AFFECTED BY CONCENTRATED RUNOFF.
3. WHEN POSSIBLE, INSTALL AN INTERCEPTER DIKE AT THE TOP OF THE PLASTIC TO DIVERT FLOWS AWAY FROM THE PLASTIC.
4. TOE-IN THE TOP OF THE SHEETING IN A 6"x6" TRENCH BACKFILLED WITH COMPACTED NATIVE MATERIAL.
5. INSTALL A GRAVEL BERM, RIPRAP, OR OTHER SUITABLE PROTECTION AT THE TOP OF THE SLOPE IN ORDER TO DISSIPATE RUNOFF VELOCITY.
6. ANCHOR THE PLASTIC USING SANDBAGS OR OTHER SUITABLE TETHERED ANCHOR SYSTEM SPACED ON A 10' GRID SPACING IN ALL DIRECTIONS.
7. OVERLAP SEAMS 1-2', TAPE, ROLL AND STAKE THE SEAMS AND THEN WEIGH DOWN THE ENTIRE LENGTH.
8. BARRIER IS REQUIRED @ TOE OF STOCK PILE.
9. REPLACE TORN SHEETS AND REPAIR OPEN SEAMS. COMPLETELY REMOVE AND REPLACE PLASTIC WHEN IT BEGINS TO DETERIORATE.

DWG: E16.DWG



Peter Capen APPROVED
COUNTY ENGINEER

STANDARD
E16
DETAIL
DESIGNED
DRAWN
DATE 05/03/11

SUMMARY OF QUANTITIES				
		Qty		
Chum Channel		Total	Above OHW	Below OHW
	Excavation to subgrade	8174 CY	8144 CY	30 CY
	Timber piles (furnished, delivered, installed)*	196	194	2
	Toe logs (furnished, delivered, installed)	8500 LF	8482 LF	2 LF
	Rock for Erosion Control and Scour Protection, Class A (entry pool)	26 CY	26 CY	0 CY
	Spawning gravel mix	1205 CY	1176 CY	29 CY
	8' Sheet pile for control weirs	60 LF	60 LF	0 LF
	Rock for Erosion Control and Scour Protection, Class A (control weirs)	21 CY	21 CY	0 CY
	Steel 'C'-Channel for adult fish screen mounting slots	36 LF	36 LF	0 LF
	Backfill behind log walls (native material)	1581 CY	1580 CY	1 CY
	Surplus native fill material (to be disposed of onsite, above floodplain)	6015 CY	0 CY	0 CY
	Chum Channel Net Cut(-) / Fill (+)	-5341 CY	-5341 CY	0 CY
* Actual number of piles depends on layout of bank toe logs. Minimum numbers could be derived by dividing linear feet of channel banks by average log length without regard to variations in log length that may be necessary to accommodate channel curvature effectively. The numbers presented in this table are based on the layout shown in the drawings. Contractor may alter log orientation to fit channel curvature more efficiently, but should anticipate needing to cut some logs to appropriate lengths, and estimate two piles per log.				
Flow Supplementation System		Total	Above OHW	Below OHW
	Infiltration Gallery			
	Excavation of riverbank to subgrade	956 CY	902 CY	54 CY
	Rock for Erosion Control and Scour Protection, Class A	74 CY	24 CY	50 CY
	16" PVC well screen pipe	160 LF	0 LF	160 LF
	16" PVC pipe caps	2	2	0
	24" HDPE-S tee	1	1	0
	24"x18" HDPE-S eccentric reducers	2	2	0
	18" Marmac Dissimilar Pipe Couplers	2	2	0
	Drain rock (or spawning gravel mix)	61 CY	61 CY	0 CY
	Conveyance Pipe			
	24" HDPE-S conveyance and riser pipe	180 LF	180 LF	0 LF
	24" HDPE-S tee	1	1	0
	24" HDPE-S riser lid	1	1	0
	24" canal gate (Waterman C-20 or equivalent)	1	1	0
	24" trash rack	1	1	0
	Conveyance pipe trenching and backfill	160 LF	160 LF	0 LF
	Riverbank Log Structure			
	Logs w/ roots (furnished, delivered, installed)	18	12	6
	Timber piles (furnished, delivered, installed)	40	38	2
	Logs (furnished, delivered, installed)	21	14	7
	Backfill around and over logs with native material	598 CY	598 CY	0 CY
	Surplus native fill material (to be disposed of onsite, above floodplain)	352 CY	0 CY	0 CY
	Flow Supplementation System Net Cut(-) / Fill (+)	-223 CY	-219 CY	-4 CY
Floodplain Wood				
	Logs w/ roots (furnished, delivered, installed)	18	18	0
	Timber piles (furnished, delivered, installed)	48	48	0
	Logs (furnished, delivered, installed)	30	30	0
Total Project Net Cut(-) / Fill (+)		-5564 CY	-5560 CY	-4 CY

CONTRACTOR SHALL SUBMIT STAMPED DRAWINGS FOR SHEETPILE CONTROL WEIRS.

TIMBER PILES SHALL HAVE DIAMETER RANGING 12-15" AT SCALED END.

FLOODPLAIN WOOD SHALL HAVE MINIMUM LENGTH OF 30' AND DIAMETERS RANGING 18-24" AT SCALED END. LOGS WITH ROOTS SHALL HAVE ROOT FAN DIAMETER EXCEEDING 5' AND DIAMETER AT BREAST HEIGHT (DBH) GREATER THAN 18".

CABLE AND HARDWARE FOR LOG TO LOG AND LOG TO PILE CONNECTIONS TO BE USED IN BANK TOE, FLOODPLAIN WOOD, AND RIVER BANK LOG STRUCTURE ARE INCIDENTAL.

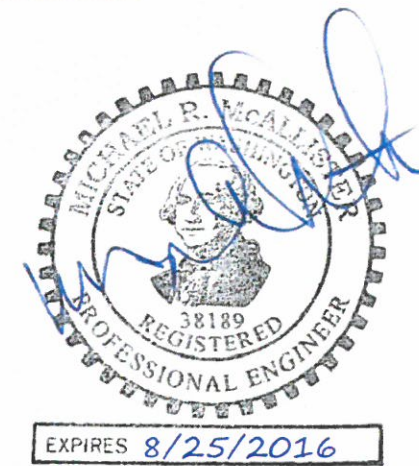
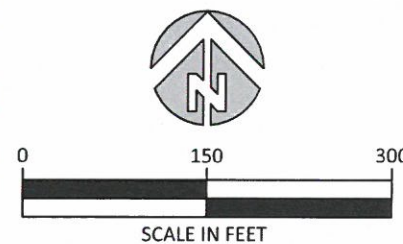
SPAWNING GRAVEL SHALL BE A CLEAN, FREE-DRAINING, ROUND RIVER ROCK NATURALLY OCCURRING. MATERIAL SHALL COME FROM A RECOGNIZED AND ESTABLISHED BORROW SITE. THE MATERIAL SHALL BE FREE OF ALL OBJECTIONABLE COATING. MATERIAL SHALL BE GRADED ACCORDING TO THE FOLLOWING TABLE:

CLASS A RIPRAP SHALL BE PER 9-13.4 - ROCK FOR EROSION CONTROL AND SCOUR PROTECTION, CLASS A, GRADED ACCORDING TO THE FOLLOWING TABLE:

DRAIN ROCK SHALL CONFORM TO WSDOT SPECIFICATION 9-03.12(5) - GRAVEL BACKFILL FOR DRYWELLS, GRADED ACCORDING TO THE FOLLOWING TABLE (WSDOT SPECIFICATION 9-03.12(4)):



SITE PLAN



NOTES:

1. EXISTING FLOW PATHS WILL NOT BE ALTERED BY PROJECT. EXISTING AND PROPOSED WILL BE THE SAME EXCEPT FOR EXISTING CAPTURED FLOWS. DURING CONSTRUCTION, THEY WILL BE TREATED IN THE AREA AND RELEASED TO THE RIVER. FOLLOWING CONSTRUCTION, CONTAINED FLOW WILL FREELY DRAIN TO THE RIVER.
2. TEMPORARY ROADS WILL BE ABANDONED FOLLOWING CONSTRUCTION. TEMPORARY ROAD FILL PLACEMENT: A MAXIMUM OF 2,000 LF OF 10-12' WIDE ROAD MAY BE ROCKED IF SOIL CONDITIONS/WEATHER DICTATES NECESSARY. UPLAND CONSTRUCTION IS NOT PLANNED TO BEGIN UNTIL THE SITE HAS DRIED OUT (ESTIMATE MAY) TO MINIMIZE ENVIRONMENTAL IMPACTS AND WATER MANAGEMENT/TREATMENT COSTS AND EFFORTS. IN-WATER WORK WILL NOT HAPPEN UNTIL PERMIT WINDOWS (ESTIMATE JULY). IN THE EVENT THAT ANY ROCK IS NEEDED, THE ROAD WILL BE SPOT ROCKED TO FIRM UP SOFT SPOTS. IF THE ENTIRE ROAD WAS TO BE ROCKED, THIS WOULD BE A TOTAL OF 500 CY OF 2-1/2" MINUS (2,000 LF x 12' WIDE x 0.5' DEEP / 27 x 1.15 COMPACTION FACTOR). IT IS HIGHLY UNLIKELY THIS WILL HAPPEN BASED ON SITE OBSERVATIONS. IT IS MORE PROBABLE THAT SOME AREAS (20-50' LONG) MAY RECEIVE MORE THAN 6" OF ROCK ON THEM. ALL TEMPORARY ROCK FILL WILL BE REMOVED AT THE CONCLUSION OF THE WORK BACK DOWN TO EXISTING SOILS TO ENCOURAGE REVEGETATION AND PRESERVE NATURAL DRAINAGE PATHS, AND MINIMIZE IMPERMEABLE SURFACE AREA.
3. ADDITIONALLY, THE EXCAVATED CHANNEL WILL BE USED AS A TEMPORARY ROADWAY.
4. PLANNED ROAD FILL PERMANENT: THE STAGING AREA WILL RECEIVE 6" OF 2-1/2" MINUS GRAVEL TO FACILITATE STAGING OF MATERIALS IN THE SPRING. ESTIMATED QUANTITY 300CY.
5. CHANNEL IS TO BE CONSTRUCTED IN RELIC CHANNEL OF LEWIS RIVER (CIRCA 1950s). THERE ARE NATURAL LEVEES ON BOTH ENDS OF OF THE CHANNEL CURRENTLY. THE DOWNSTREAM (A) LEVEE WILL BE BREACHED. THE UPSTREAM END (B) WILL BE REBUILT.

LEGEND

- OHW — ORDINARY HIGH WATER
- - - EXISTING CONTOURS (1FT INTERVALS)
- PROPOSED CONTOURS (1FT INTERVALS)
- - - PROPERTY LINES
- - - EDGE OF EXISTING FLOODPLAIN
- - - LIMITS OF DISTURBANCE
- [Pink Hatched Box] WETLAND - PALUSTRINE FORESTED (43,356 SQUARE FEET)
- [Blue Hatched Box] IMPACTED WETLAND (3882 SF, 288 CY)
- [Green Box] POTENTIAL VEGETATIVE FILTRATION ZONE
- [Red Hatched Box] TEMPORARY STAGING / STOCKPILE AREA
- [Yellow Dashed Line] TEMPORARY COFFERDAM
- [Square with X] SILT FENCE
- [Red Dashed Line] CLEARED, EXISTING VEHICLE TRAILS TO BE USED AS TEMPORARY ROADS (SEE NOTE 4)
- [Blue Dashed Line] PROPOSED PERMANENT ACCESS ROAD AND PARKING AREA (SEE NOTE 3)
- - - THRESHOLD DRAINAGE AREA (TDA) BOUNDARY
- - - TDA FLOW PATH

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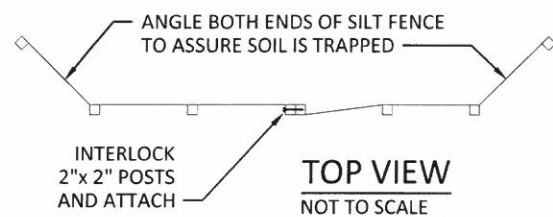
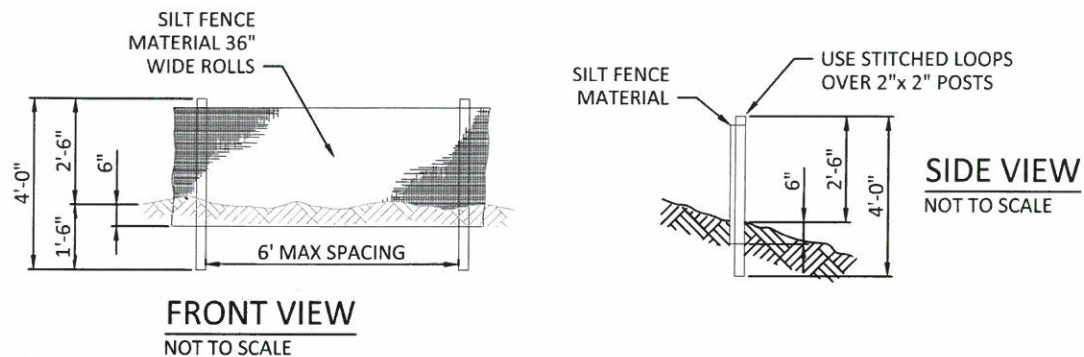
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PRELIMINARY DEVELOPMENT
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EROSION CONTROL)

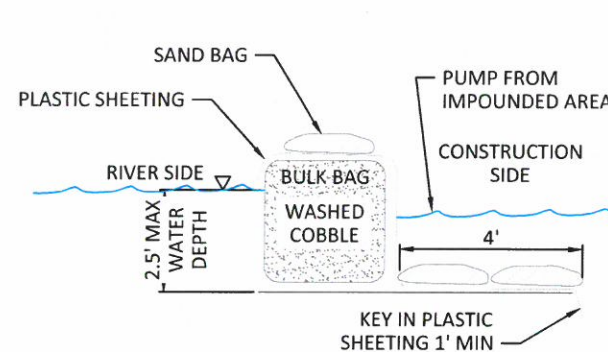
SHEET
7 OF 20



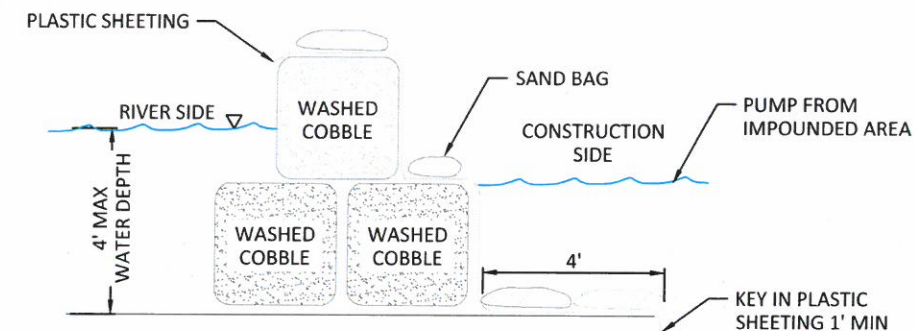
TYPICAL SILT FENCE DETAIL
NOT TO SCALE

SILT FENCES:

1. THE SILT FENCE SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, SILT FENCE SHALL BE SPICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM 6 INCH OVERLAP, AND BOTH ENDS SECURELY FASTENED TO THE POST. ALTERNATIVELY, OVERLAP AND INTERLOCK TWO POSTS WITH ATTACHED FABRIC AS REQUIRED TO MEET APPLICABLE REGULATIONS.
2. THE SILT FENCE IS TO BE INSTALLED AT LOCATIONS SHOWN ON THE PLAN ALONG THE DOWNHILL PERIMETER OF CONSTRUCTION AREAS. THE FENCE POSTS SHALL BE SPACED A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 24 INCHES.
3. THE SILT FENCE SHALL HAVE A MINIMUM VERTICAL BURIAL OF 6 INCHES. ALL EXCAVATED MATERIAL FROM SILT FENCE INSTALLATION SHALL BE BACK-FILLED AND COMPACTED ALONG THE ENTIRE DISTURBED AREA.
4. STANDARD OR HEAVY DUTY SILT FENCE SHALL HAVE MANUFACTURED STITCHED LOOPS FOR 2 INCHES X 2 INCHES POST INSTALLATION.
5. SILT FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE, BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY PROTECTED AND STABILIZED, OR AS DIRECTED BY OWNER'S REPRESENTATIVE.



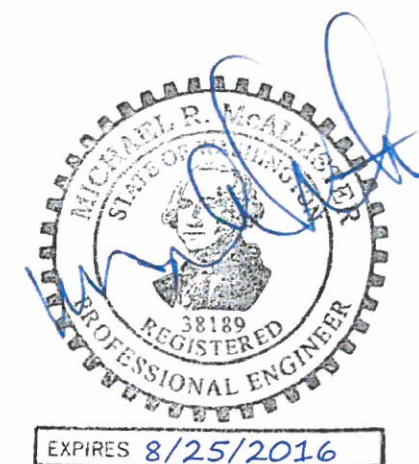
TEMPORARY COFFER DAM SECTION A-A'
NOT TO SCALE



COFFER DAM SECTION IN WATER DEPTHS GREATER THAN 2.5'
NOT TO SCALE

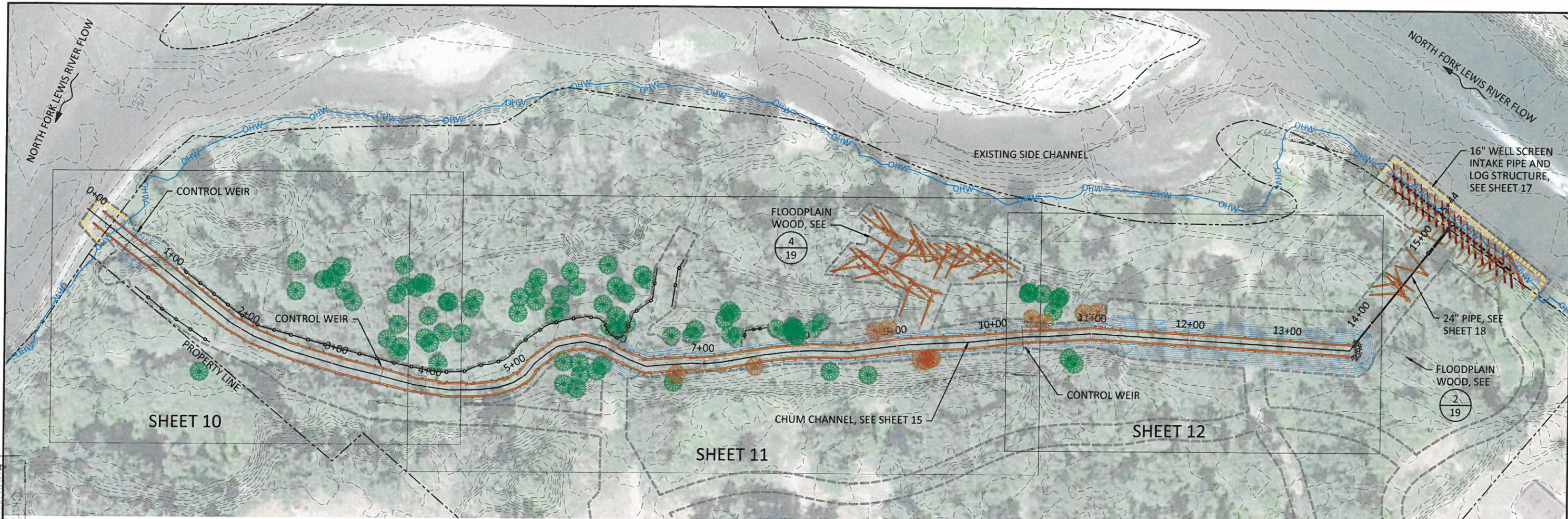
BULK BAG NOTES:

1. BULK BAG COFFERDAM SHALL BE CONSTRUCTED OF SEVERAL UNITS OF BULK BAGS FILLED WITH WASHED GRAVEL, AND ABUTTED SIDE BY SIDE TO CREATE A ROW THAT ISOLATES THE CONSTRUCTION SITE.
2. IF WATER DEPTH EXCEEDS 85% OF THE BULK BAG HEIGHT, AN ADDITIONAL TOP ROW OF BULK BAGS SHALL BE INSTALLED, SUPPORTED BY TWO BOTTOM ROWS OF BULK BAGS. BULK BAG COFFERDAM SHALL BE SEALED BY COVERING THE COFFERDAM WITH PLASTIC SHEETING HELD IN PLACE BY STANDARD SANDBAGS PLACED IN ROWS ON TOP OF COFFERDAM, AND AT TOE OF COFFERDAM.
3. THE PLASTIC SHEETING SHALL BE DRAPED ALONG THE CHANNEL BOTTOM ON BOTH SIDES OF THE COFFERDAM WITH OUTWARD EDGE OF SHEETING MINIMUM 4-Feet FROM TOE OF COFFERDAM. THE DRAPED PORTION OF PLASTIC SHEETING SHALL BE PINNED TO THE CHANNEL BED BY MINIMUM TWO ROWS OF STANDARD SANDBAGS.
4. THE CONSTRUCTION SIDE EDGE OF PLASTIC SHEETING SHALL BE TOED INTO THE CHANNEL BED MINIMUM 1-FT. TOEING IN THE OUTWARD EDGE OF PLASTIC SHEETING SHALL OCCUR AFTER THE COFFERDAM IS CLOSED TO PREVENT TURBIDITY RELEASE TO THE WATERWAY.
5. THE TERMINAL ENDS OF BULK BAG COFFERDAM, WHERE IT CONNECTS TO CHANNEL BANK OR HIGH GROUND, SHALL BE SEALED WITH PLASTIC SHEETING AND STANDARD SANDBAGS.
6. BULK BAGS SHALL BE CUBE-SHAPED POLYPROPYLENE WOVEN FABRIC BAGS WITH FULLY OPEN TOP, FLAT BOTTOM, FOUR LOOPS, MINIMUM 2-TON WEIGHT CAPACITY, MINIMUM 5:1 SAFETY FACTOR.
7. PLASTIC SHEETING SHALL BE MINIMUM 6-MIL THICKNESS. ROLL LENGTH SHALL BE LONG ENOUGH TO ENSURE THAT ENTIRE LENGTH OF COFFERDAM WILL BE COVERED WITHOUT A SEAM. MINIMUM 12-FT WIDE ROLL SHALL BE USED FOR SINGLE LAYER BULK BAG COFFERDAM. MINIMUM 16-FT WIDE ROLL SHALL BE USED FOR 2-LAYER STACKED BULK BAG COFFERDAM.
8. BULK BAG COFFERDAM SHALL BE COMPLETELY REMOVED AFTER CONSTRUCTION IS COMPLETED AND TURBIDITY HAS BEEN REMOVED.
9. MEASUREMENT AND PAYMENT FOR BULK BAG COFFERDAM, SAND BAGS, PLASTIC SHEETING, WASHED GRAVEL PLACEMENT, MAINTENANCE AND REMOVAL OF ALL MATERIALS SHALL BE INCIDENTAL TO THE LUMP SUM ALL INCLUSIVE COST FOR DIVERSION AND DEWATERING.
10. ALTERNATE COFFERDAM MATERIALS AND CONFIGURATIONS MAY BE ALLOWED BUT SHALL NOT BE IMPLEMENTED WITHOUT REVIEW AND APPROVAL BY THE OWNER'S REPRESENTATIVE. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS AND/OR VENDOR CUT SHEETS FOR SUBSTITUTIONS.



JUL 21 2016

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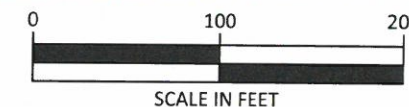


LEGEND

- OHW — ORDINARY HIGH WATER
- - - EXISTING CONTOURS (1FT INTERVALS)
- - - PROPOSED CONTOURS (1FT INTERVALS)
- - - PROPERTY LINES
- - - LIMITS OF DISTURBANCE
- - - TEMPORARY COFFERDAM
- EXISTING TREES TO REMAIN
- EXISTING TREES TO BE REMOVED

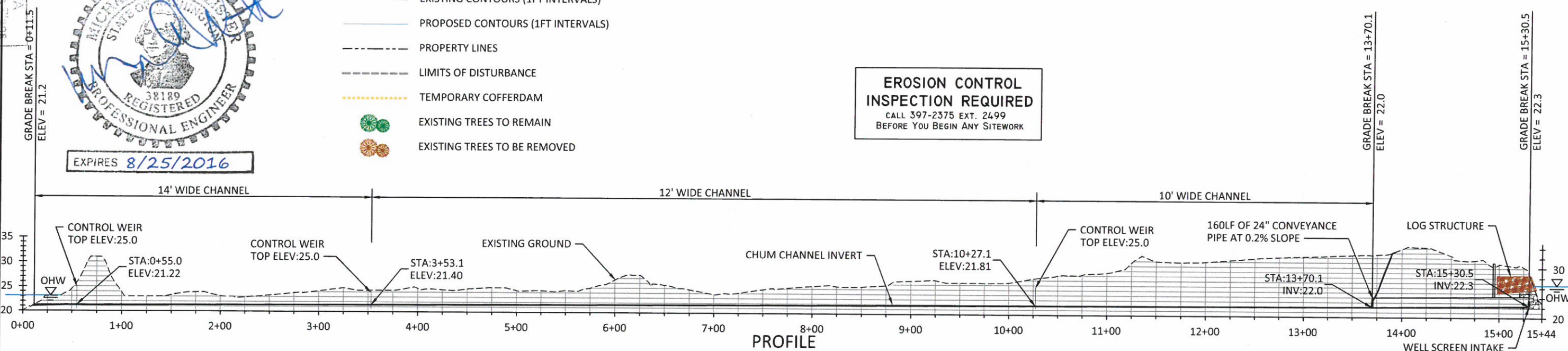
PLAN

TEN EXISTING TREES TO BE REMOVED AND SALVAGED. REMOVED TREES SHALL BE USED IN LOG STRUCTURE OR FLOODPLAIN WOOD AT LOCATIONS SPECIFIED BY OWNER.



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SHEET INDEX AND PROPOSED
CONDITIONS PLAN & PROFILE

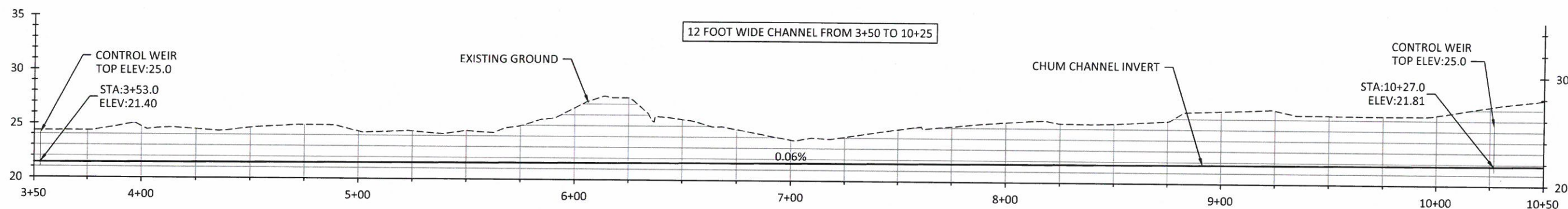
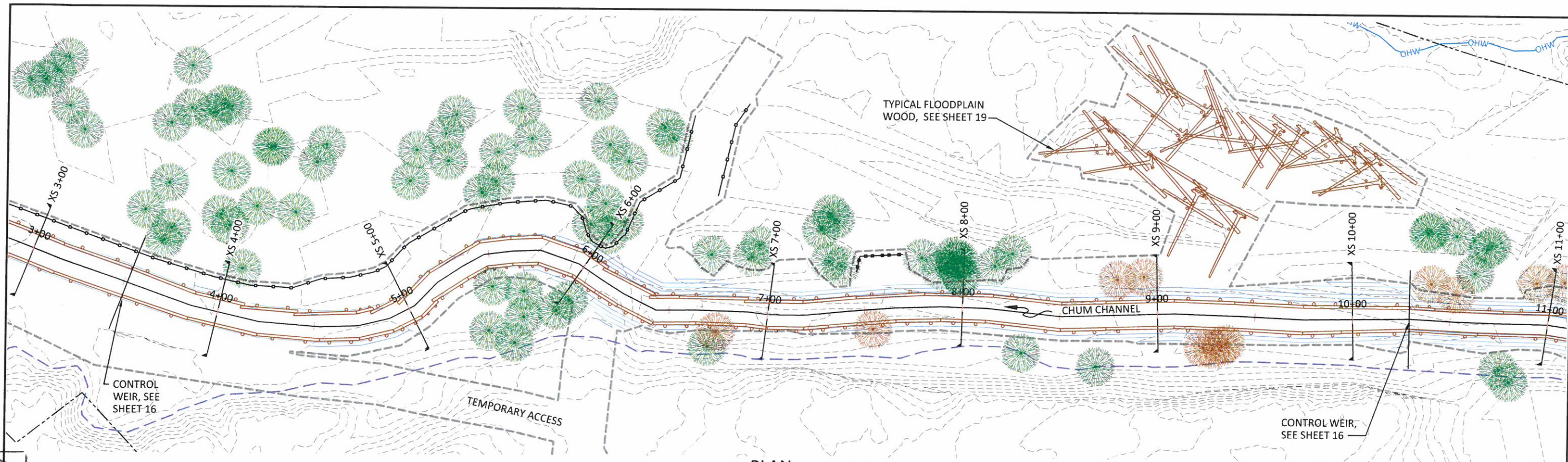
SHEET
9 OF 20

NO.	BY	DATE	REVISION DESCRIPTION

MJ,DF	MM,GJ	GJ
DRAWN	DESIGNED	CHECKED
MM	7/07/16	11-02-07
APPROVED	DATE	PROJECT

JUL 21 2016

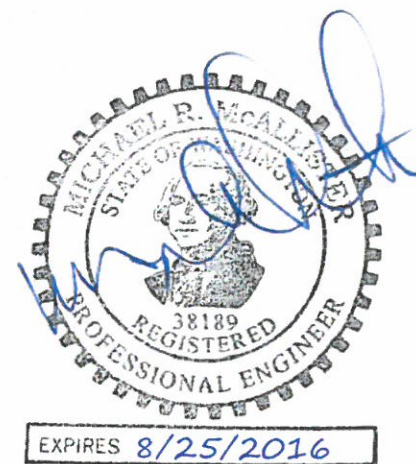
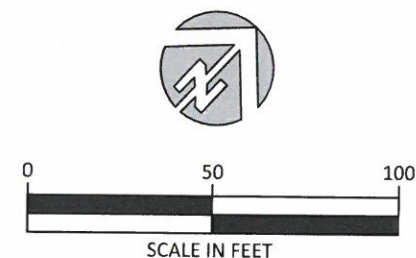
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Approved: Clark County, WA



LEGEND

- OHW — ORDINARY HIGH WATER
- - - EDGE OF EXISTING FLOODPLAIN
- - - EXISTING CONTOURS (1FT INTERVALS)
- - - PROPOSED CONTOURS (1FT INTERVALS)
- - - PROPERTY LINES
- - - LIMITS OF DISTURBANCE
- XS 3+00 — GRADING CROSS SECTIONS, SEE SHEET 13
- EXISTING TREES TO REMAIN
- EXISTING TREES TO BE REMOVED

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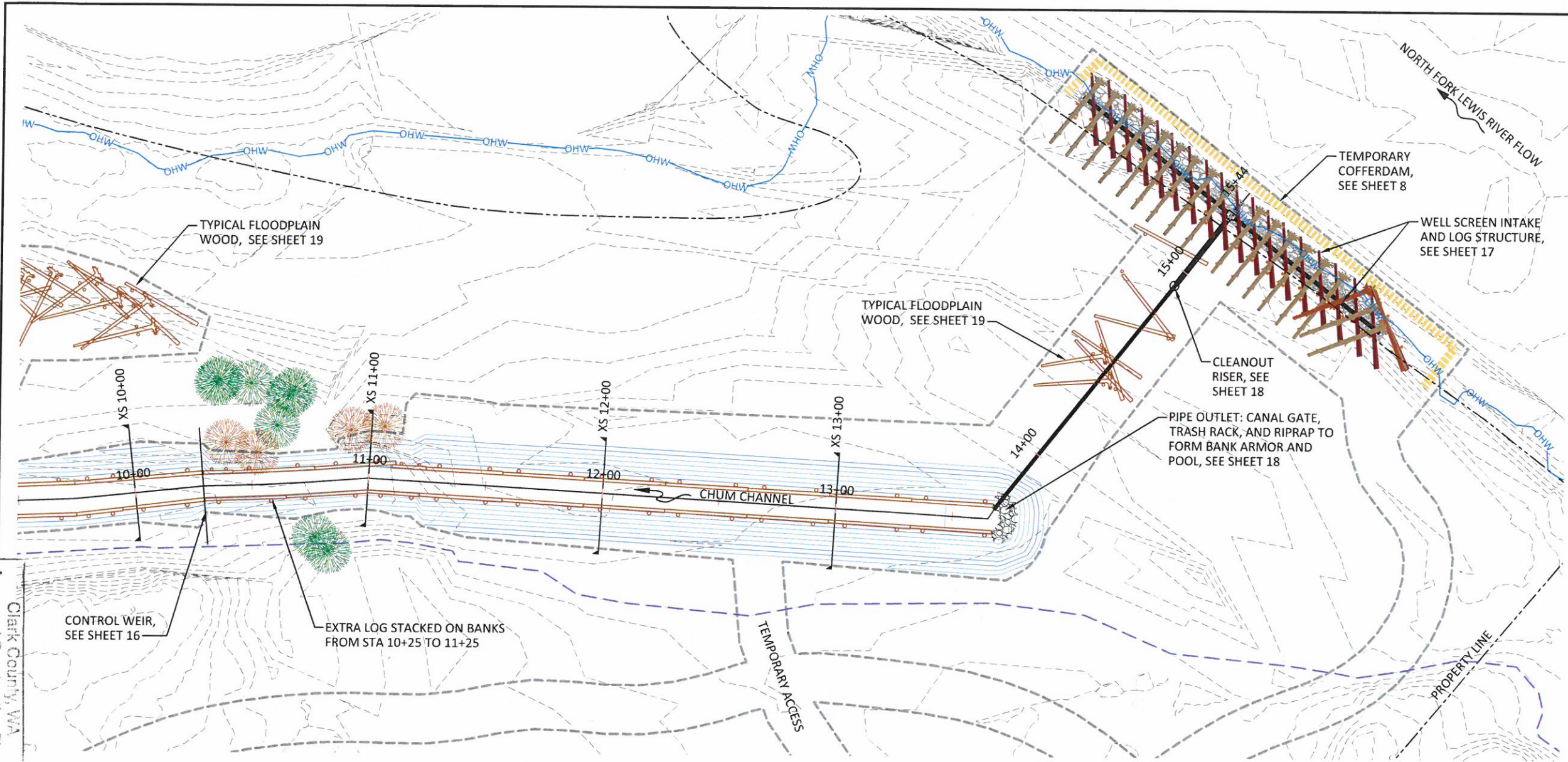
PROPOSED CONDITIONS
STA 3+50 TO 10+25

SHEET
11 OF 20

NO.	BY	DATE	REVISION DESCRIPTION

MJ,DF	MM,GJ	GJ
DRAWN	DESIGNED	CHECKED
MM	7/07/16	11-02-07
APPROVED	DATE	PROJECT

Approved Construction Drawing
Clark County WA
JUL 21 2016
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Page 12 of 20

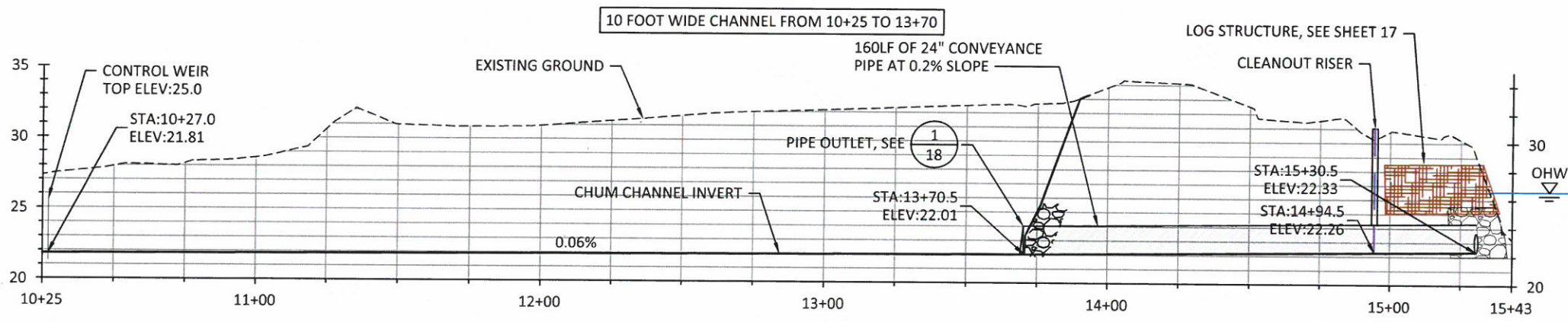


PLAN SEE SHEET 13 FOR GRADING CROSS SECTIONS.

LEGEND

- OHW — ORDINARY HIGH WATER
- - - EDGE OF EXISTING FLOODPLAIN
- - - EXISTING CONTOURS (1FT INTERVALS)
- - - PROPOSED CONTOURS (1FT INTERVALS)
- - - PROPERTY LINES
- - - LIMITS OF DISTURBANCE
- - - TEMPORARY COFFERDAM
- XS 3+00 GRADING CROSS SECTIONS, SEE SHEET 13
- EXISTING TREES TO REMAIN
- EXISTING TREES TO BE REMOVED

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PROFESSIONAL ENGINEER
MICHAEL R. McALLISTER
38189
REGISTERED
EXPIRES 8/25/2016

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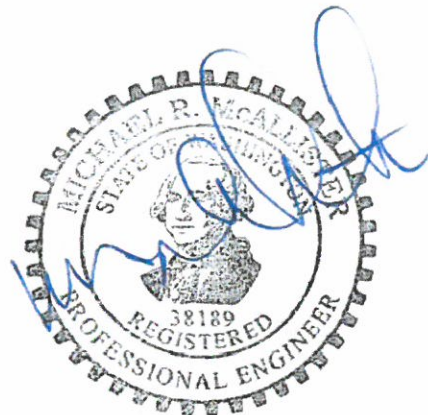
MJ,DF	MM,GJ	GJ
DRAWN	DESIGNED	CHECKED
MM	7/07/16	11-02-07
APPROVED	DATE	PROJECT

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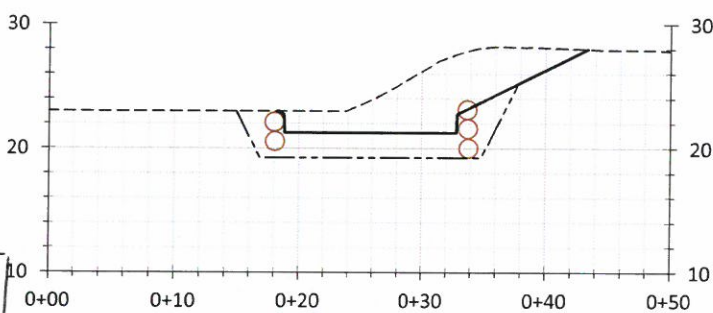
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PROPOSED CONDITIONS
STA 10+25 TO 13+70

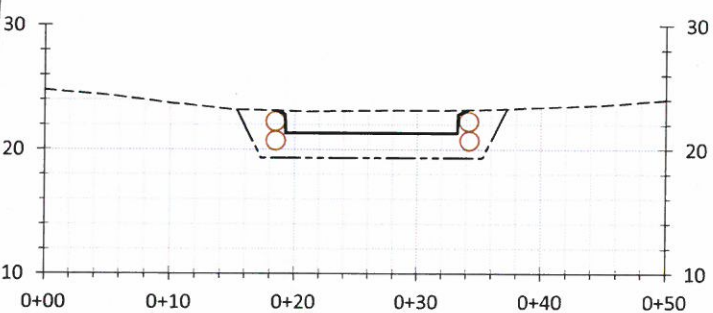
SHEET
12 OF 20



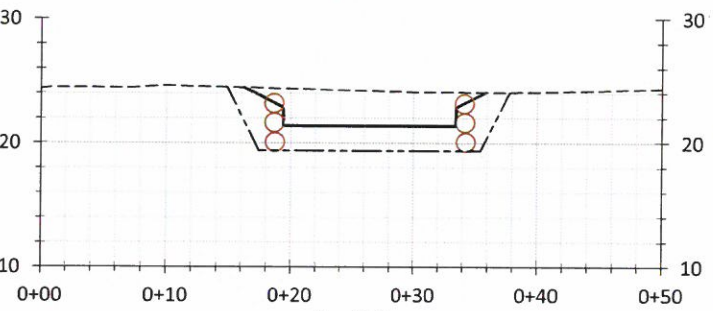
EXPIRES 8/25/2016



1+00

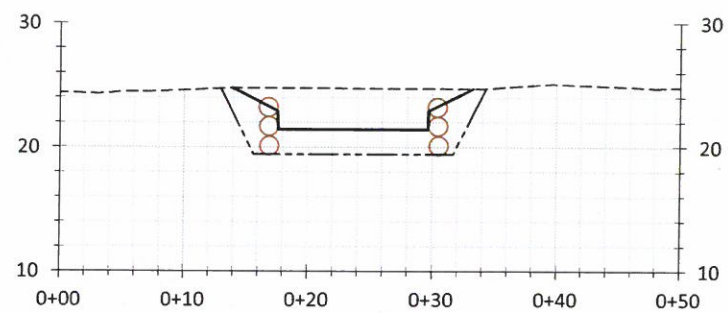


2+00

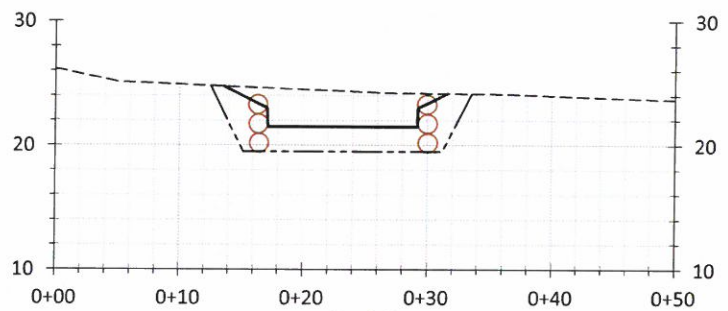


3+00

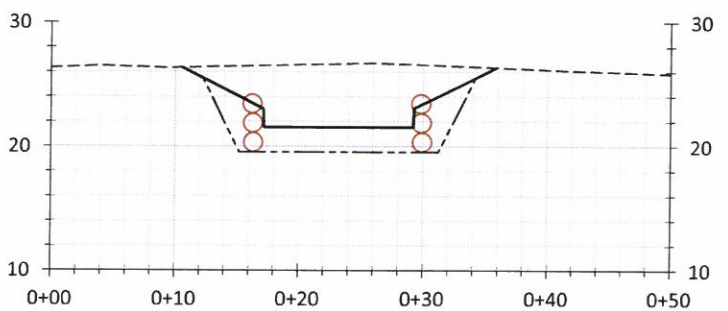
14 FOOT WIDE CHANNEL FROM 0+10 TO 3+25



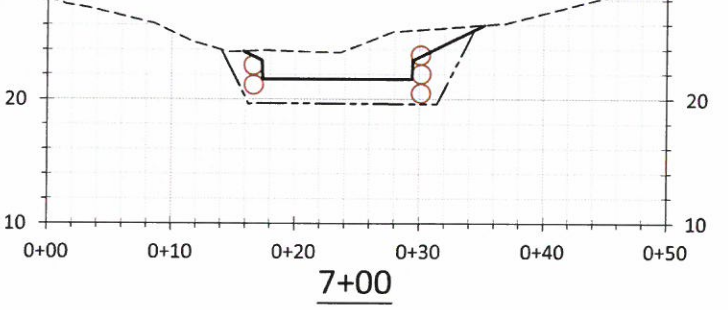
4+00



5+00



6+00

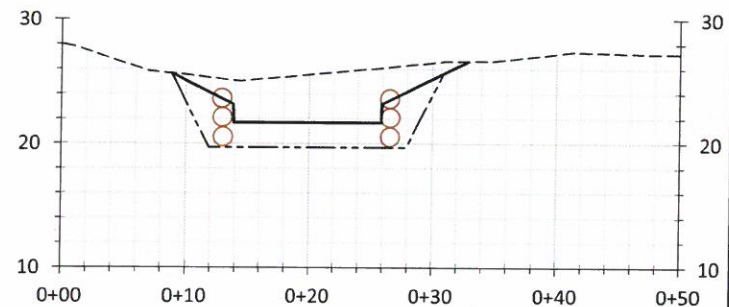
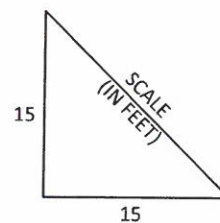


7+00

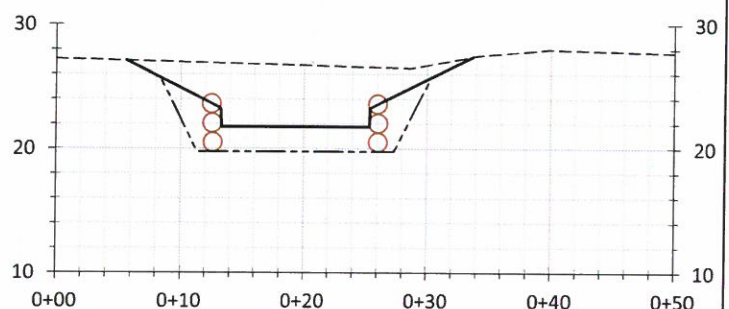
12 FOOT WIDE CHANNEL FROM 3+50 TO 10+25

LEGEND

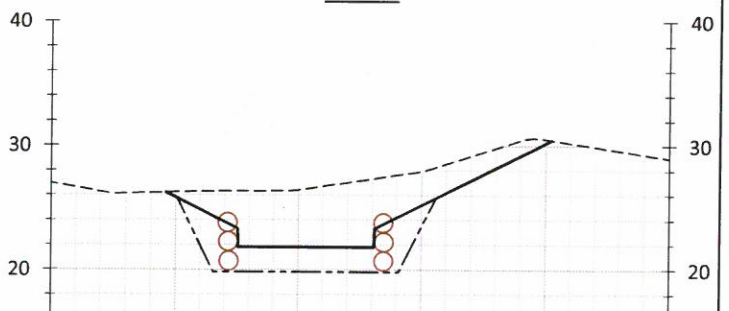
- EXISTING GROUND
- PROPOSED GROUND
- SUBGRADE



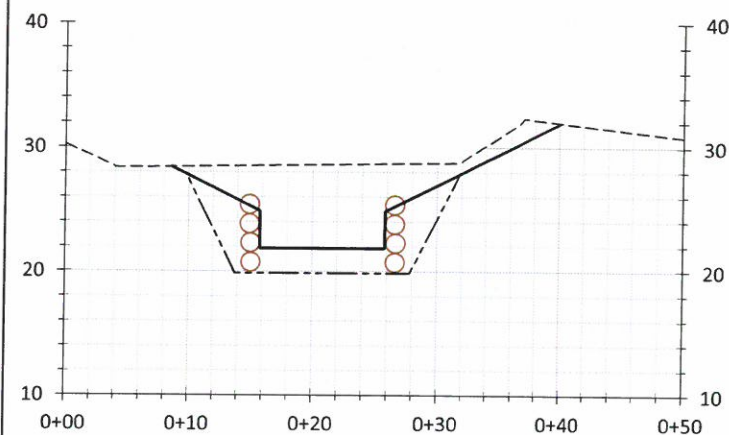
8+00



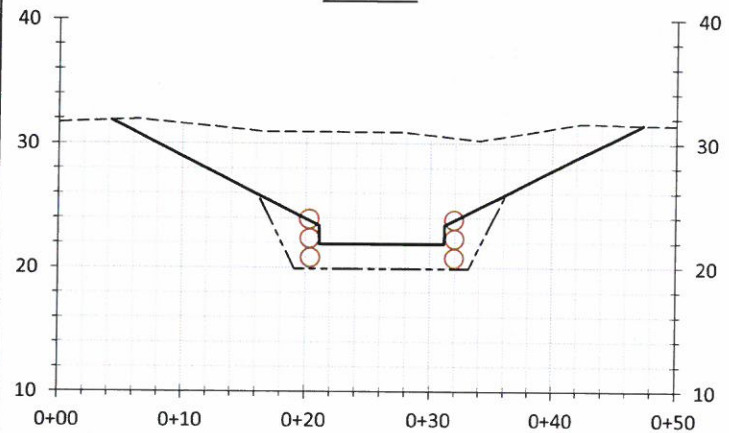
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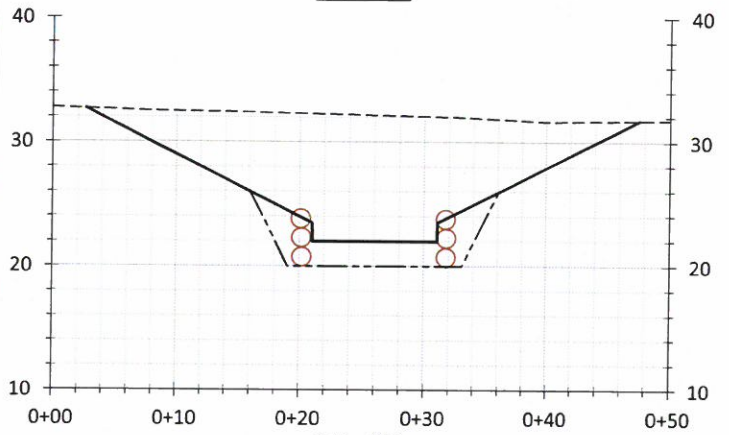
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11+00



12+00



13+00

10 FOOT WIDE CHANNEL FROM 10+25 TO 13+70

Clark County, WA
Approved Construction Plans

JUL 21 2016

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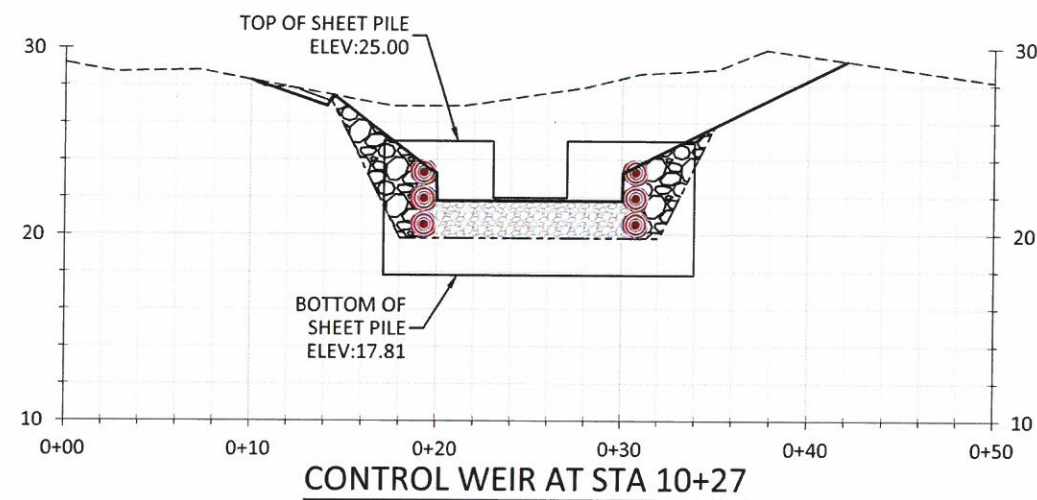
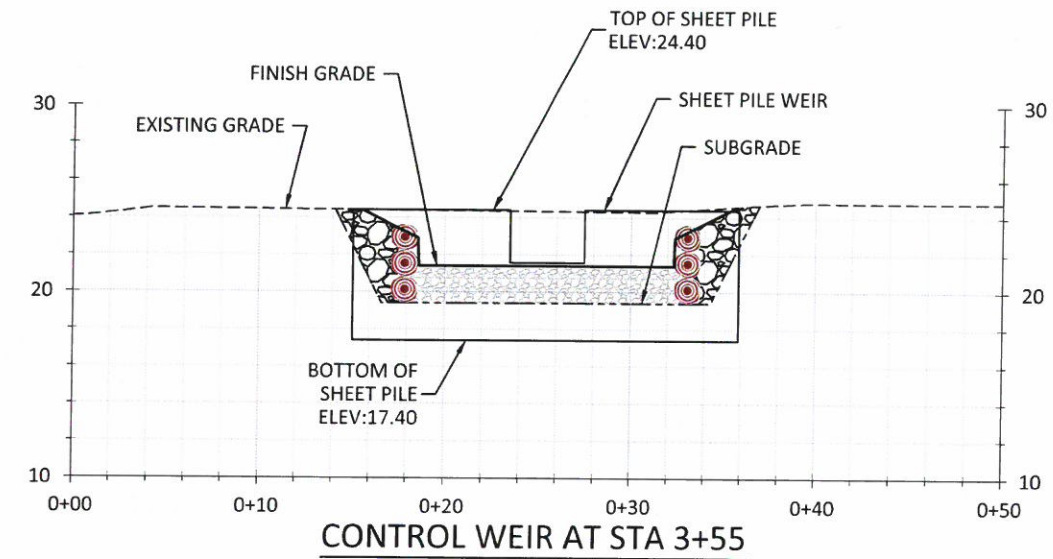
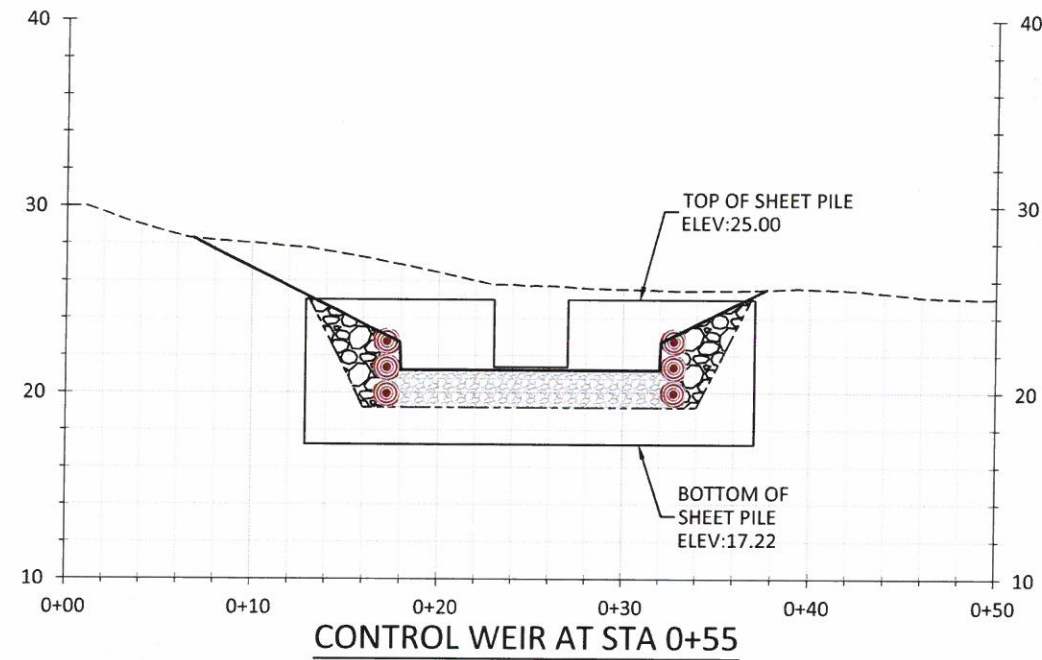
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GRADING CROSS-SECTIONS
STA 1+00 TO 13+00

SHEET
13 OF 20



LEGEND

TOE LOG

ROCK

SPAWNING GRAVEL

NOTE: SEE CONTROL WEIR DETAILS ON SHEET 16

A right-angled triangle is shown. The vertical side is labeled "SCALE: 1" = 10'", the horizontal side is labeled "SCALE: 1" = 10'", and the hypotenuse is labeled "1x VERTICAL EXAGGERATION".



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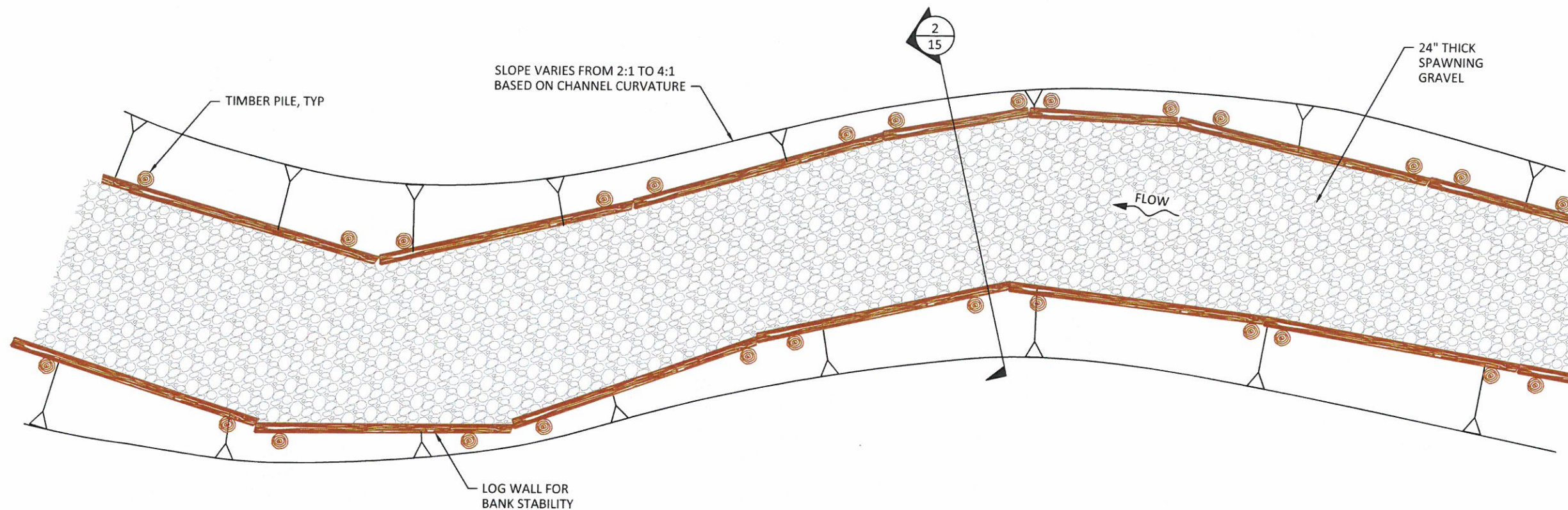
CONTROL WEIR CROSS SECTIONS

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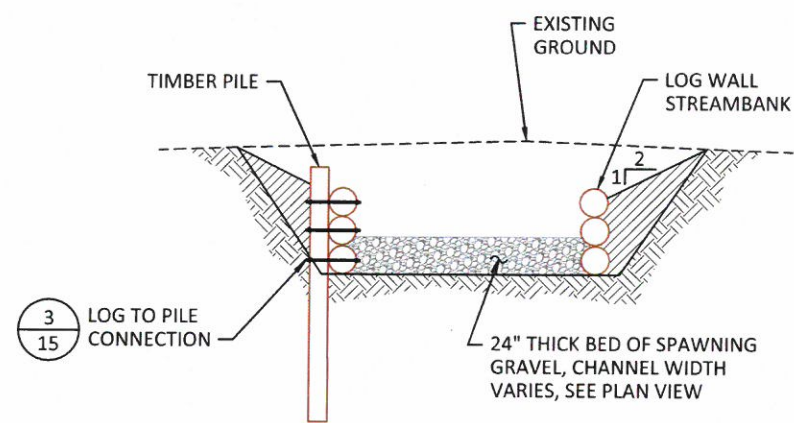
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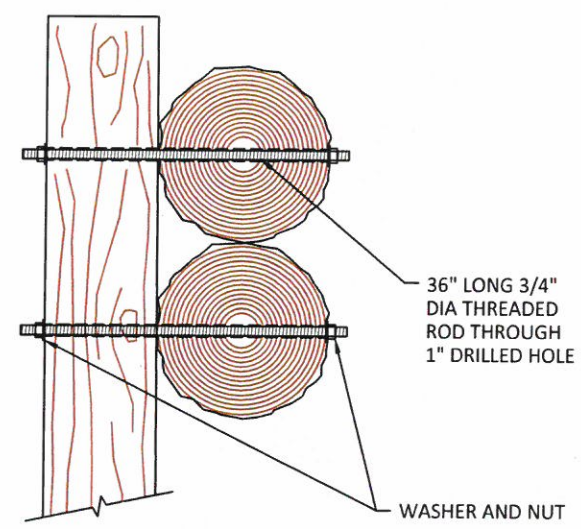
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15
TYPICAL PLAN
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2
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SECTION
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3
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LOG TO PILE CONNECTION
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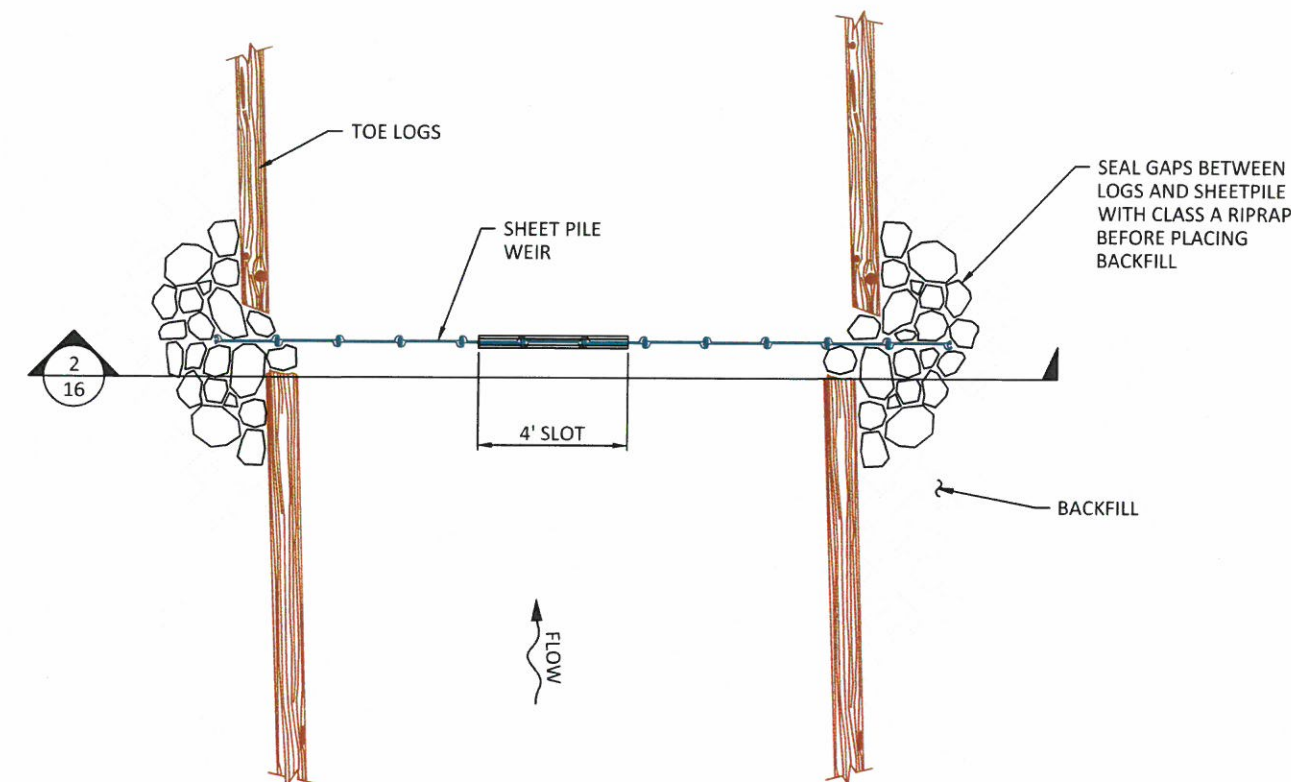
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15 OF 20

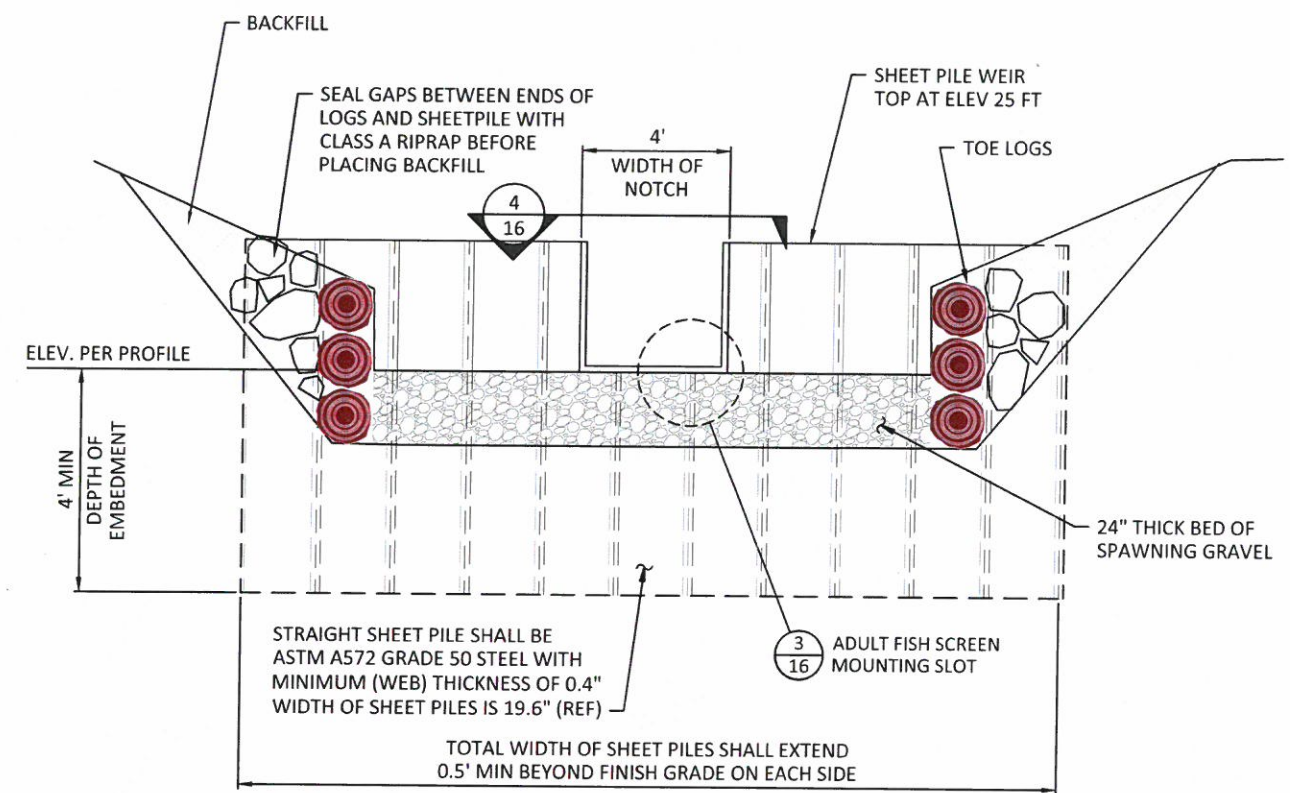
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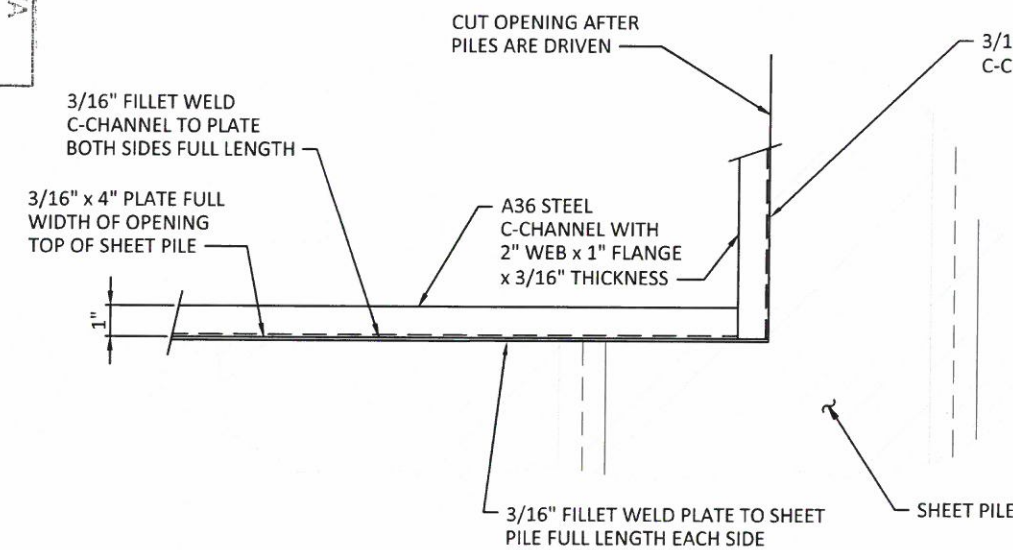
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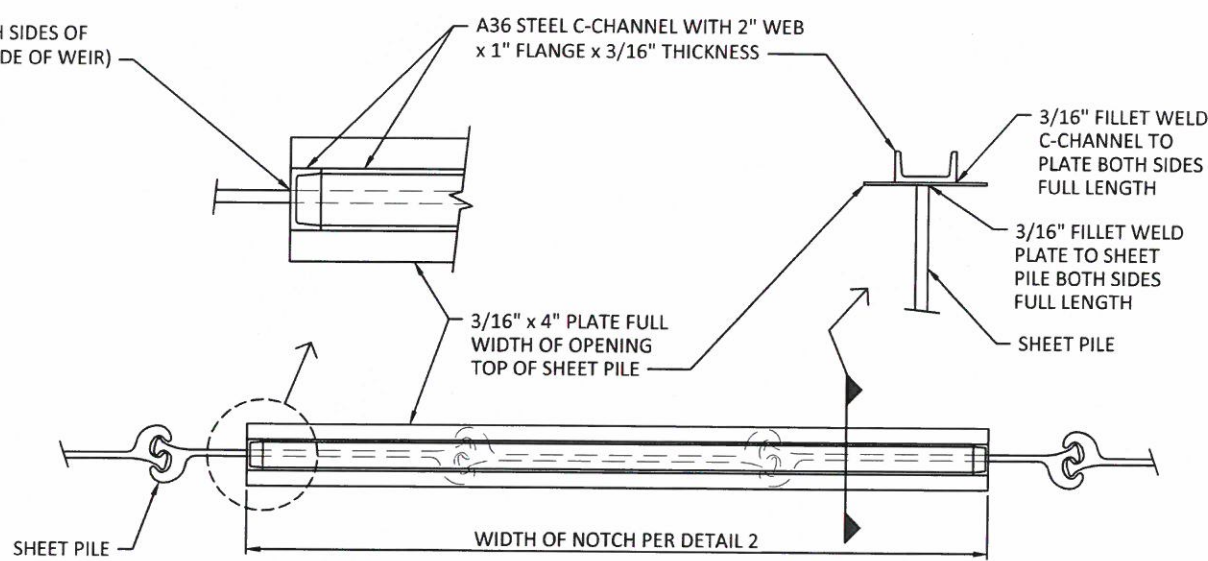
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4 PLAN AT BOTTOM OF FISH SCREEN SLOT
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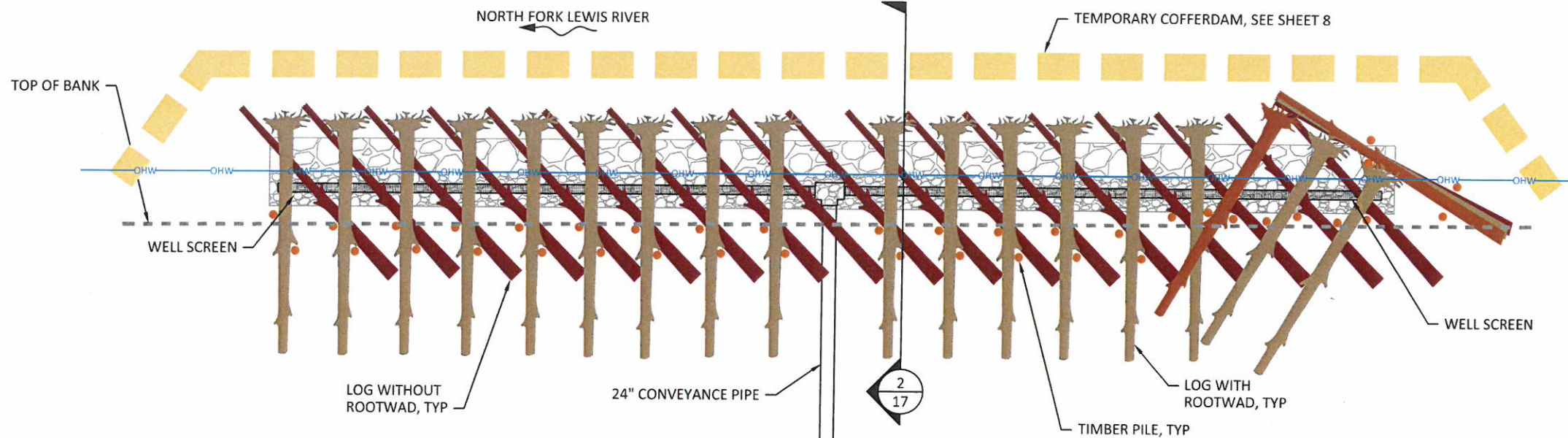
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CONTROL WEIR TYPICAL
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16 OF 20

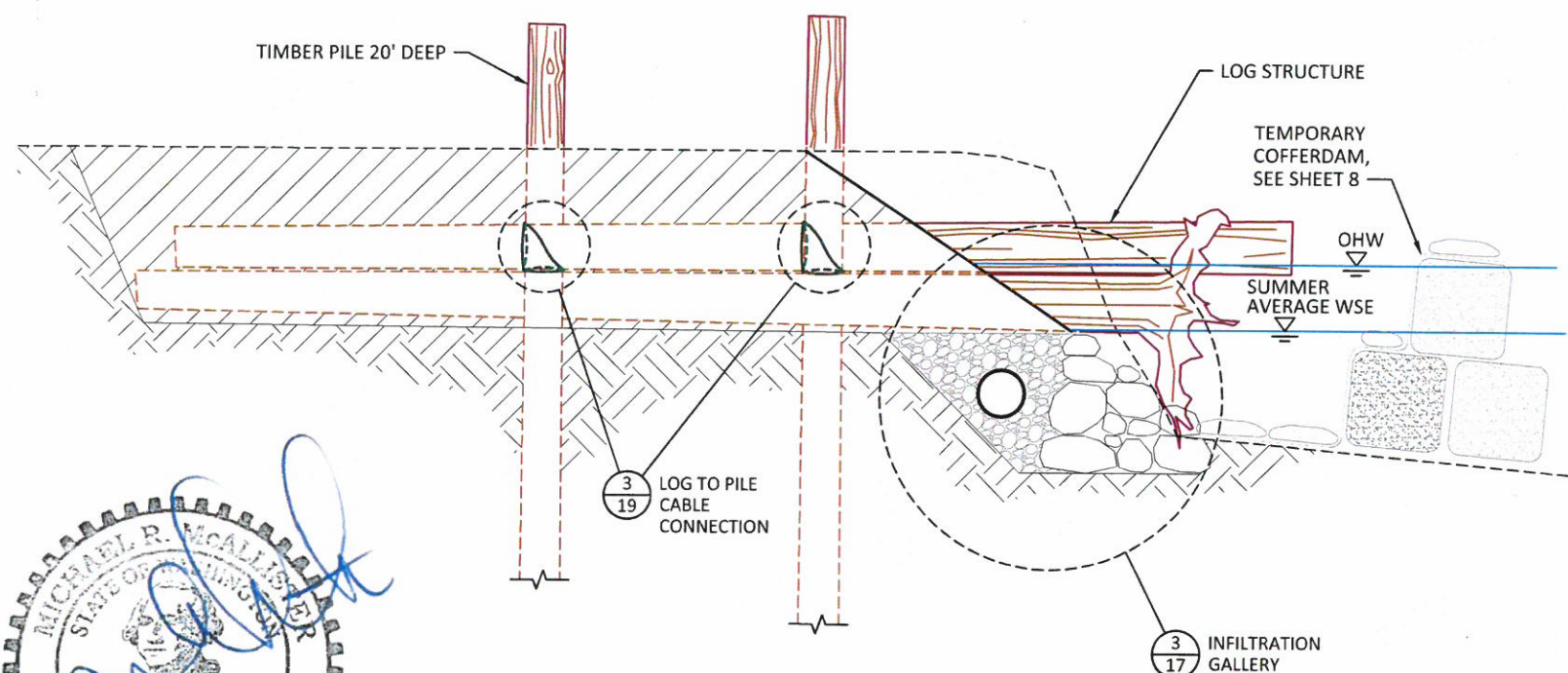


- LAYER 1
- LAYER 2
- LAYER 3
- VERTICAL SNAG

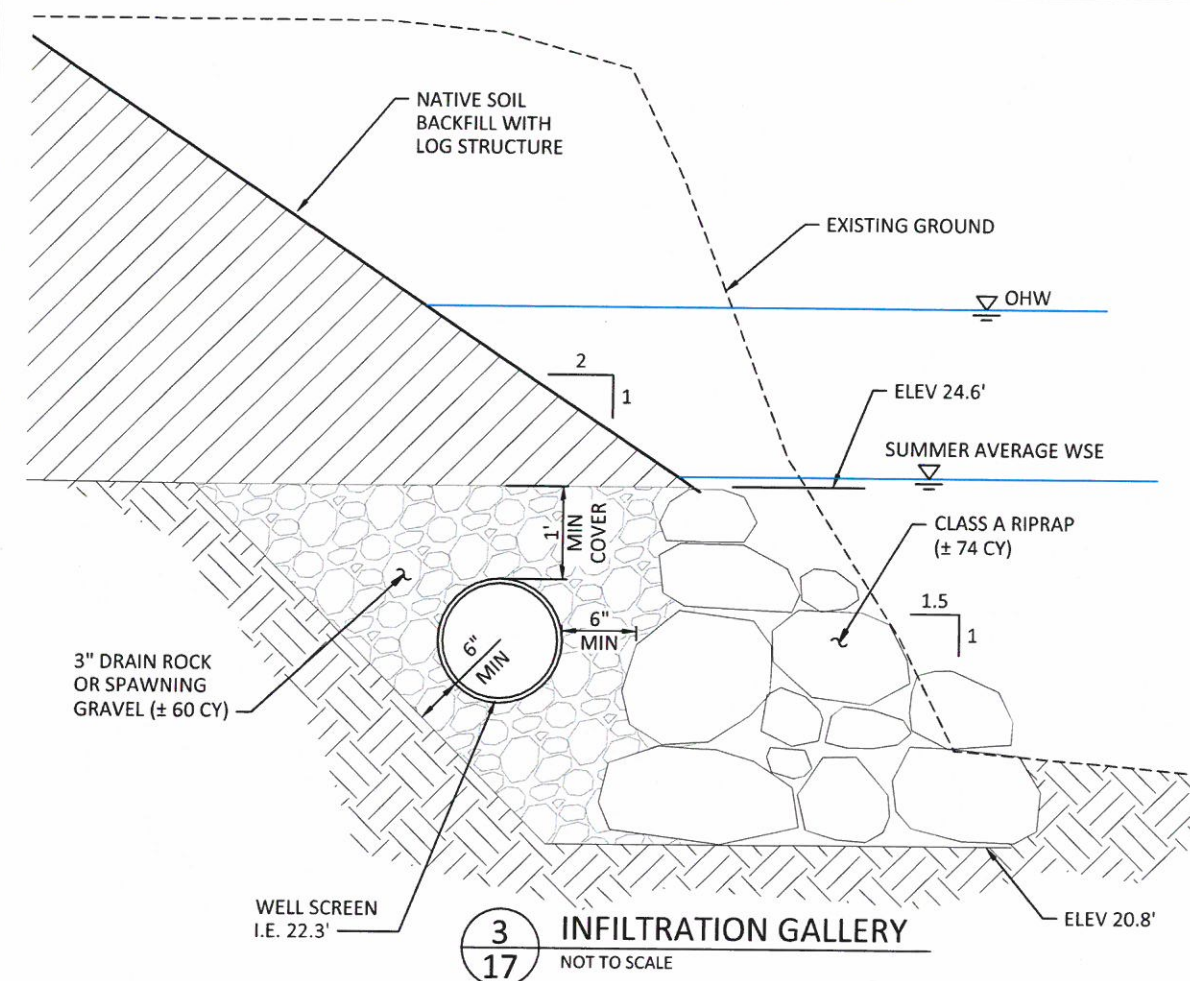
SEE $\frac{2}{18}$ FOR WELL
SCREEN, PIPE, FITTINGS,
AND APPURTENANCES.

**EROSION CONTROL
INSPECTION REQUIRED**
CALL 397-2375 EXT. 2499
BEFORE YOU BEGIN ANY SITEWORK

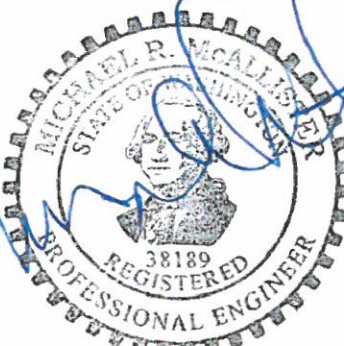
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17 PLAN - WELL SCREEN AND LOG STRUCTURE
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2
17 SECTION - WELL SCREEN AND LOG STRUCTURE
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3
17 INFILTRATION GALLERY
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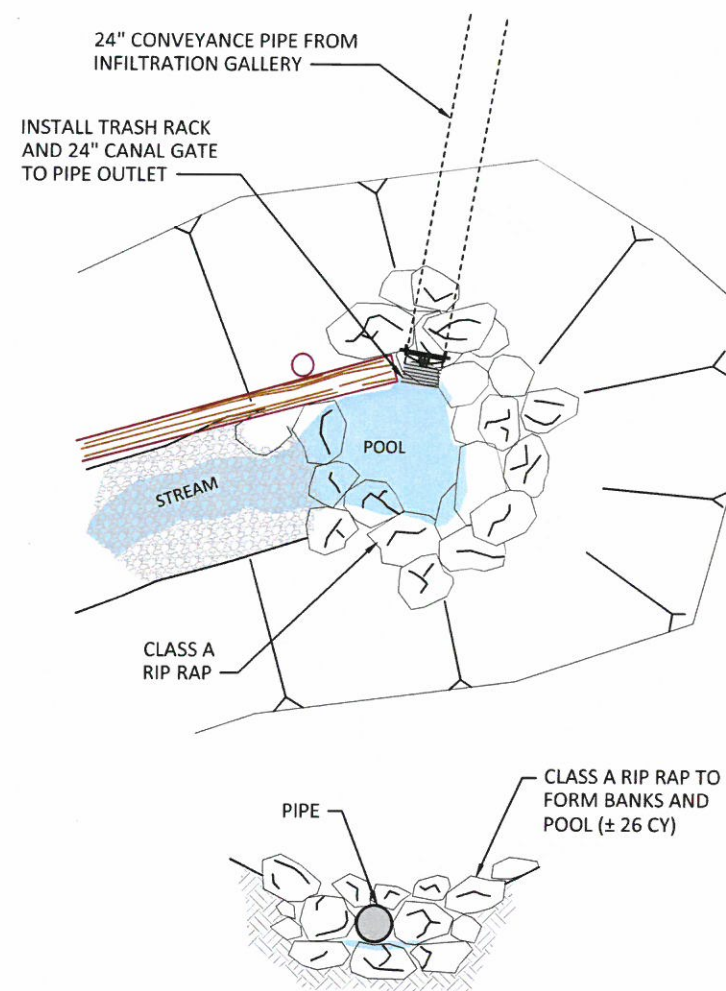
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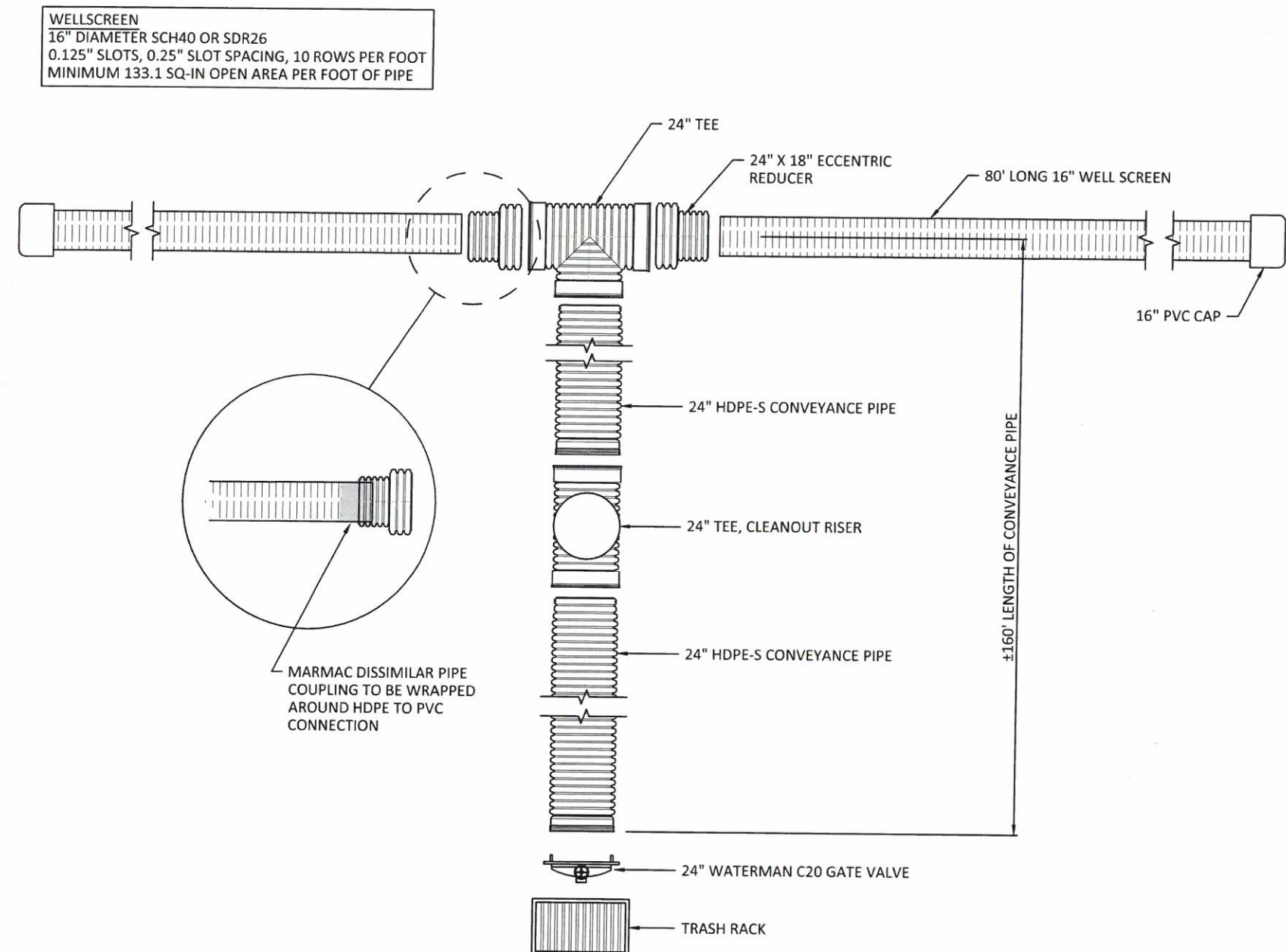
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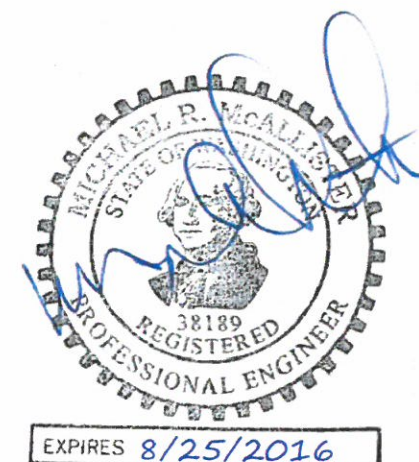
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1 PIPE OUTLET
18 NOT TO SCALE



2 WELL SCREEN PIPE AND FITTINGS
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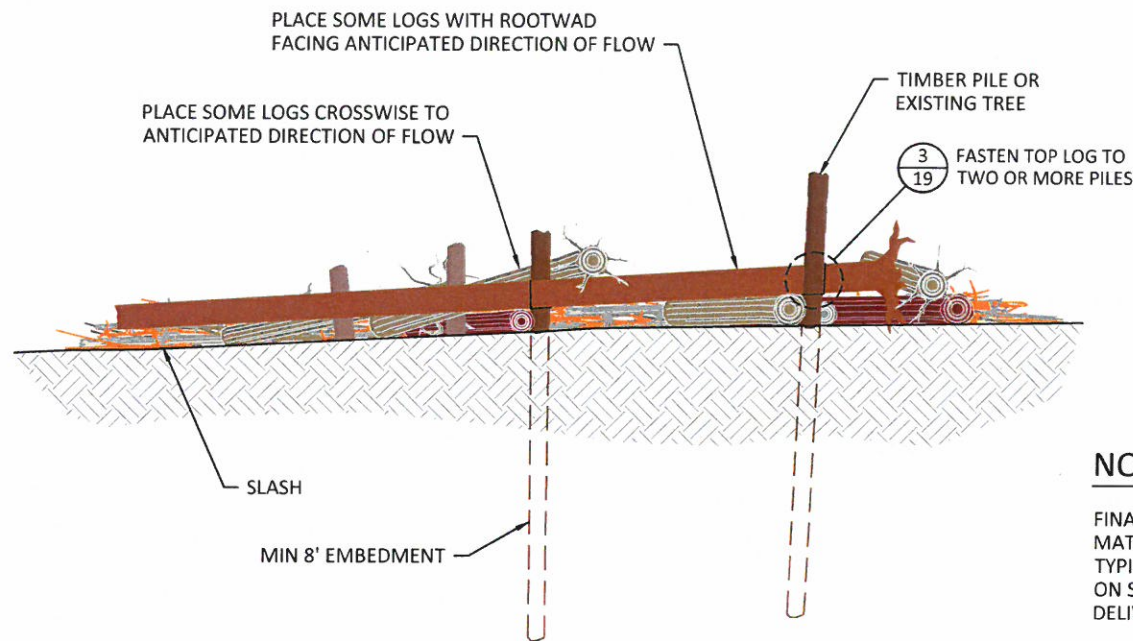
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TYPICAL DETAILS

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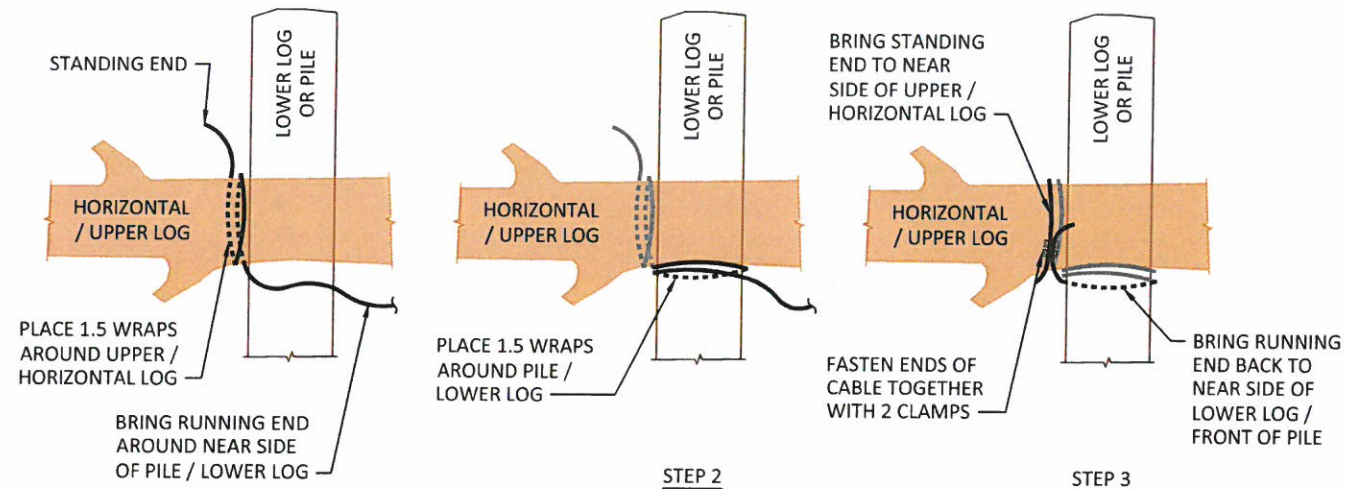


1
19 SECTION - TYPICAL FLOODPLAIN ROUGHNESS LWD
NOT TO SCALE

NOTES

FINAL ORIENTATION OF LOGS AND MATERIALS MAY VARY FROM TYPICAL DRAWINGS DEPENDING ON SIZE AND SHAPE OF MATERIAL DELIVERED OR SALVAGED.

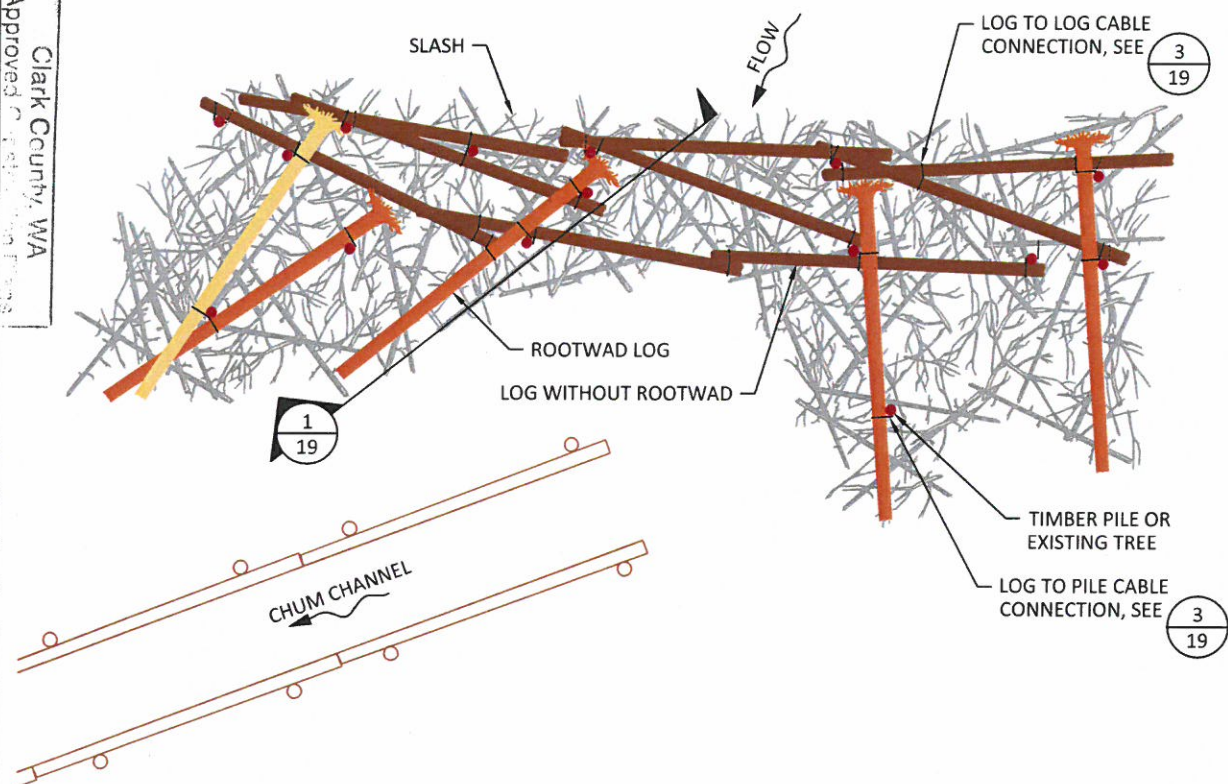
ALL REMOVED TREES AND WOODY VEGETATION SHALL BE SALVAGED AND STOCKPILED FOR USE AS FLOODPLAIN ROUGHNESS.



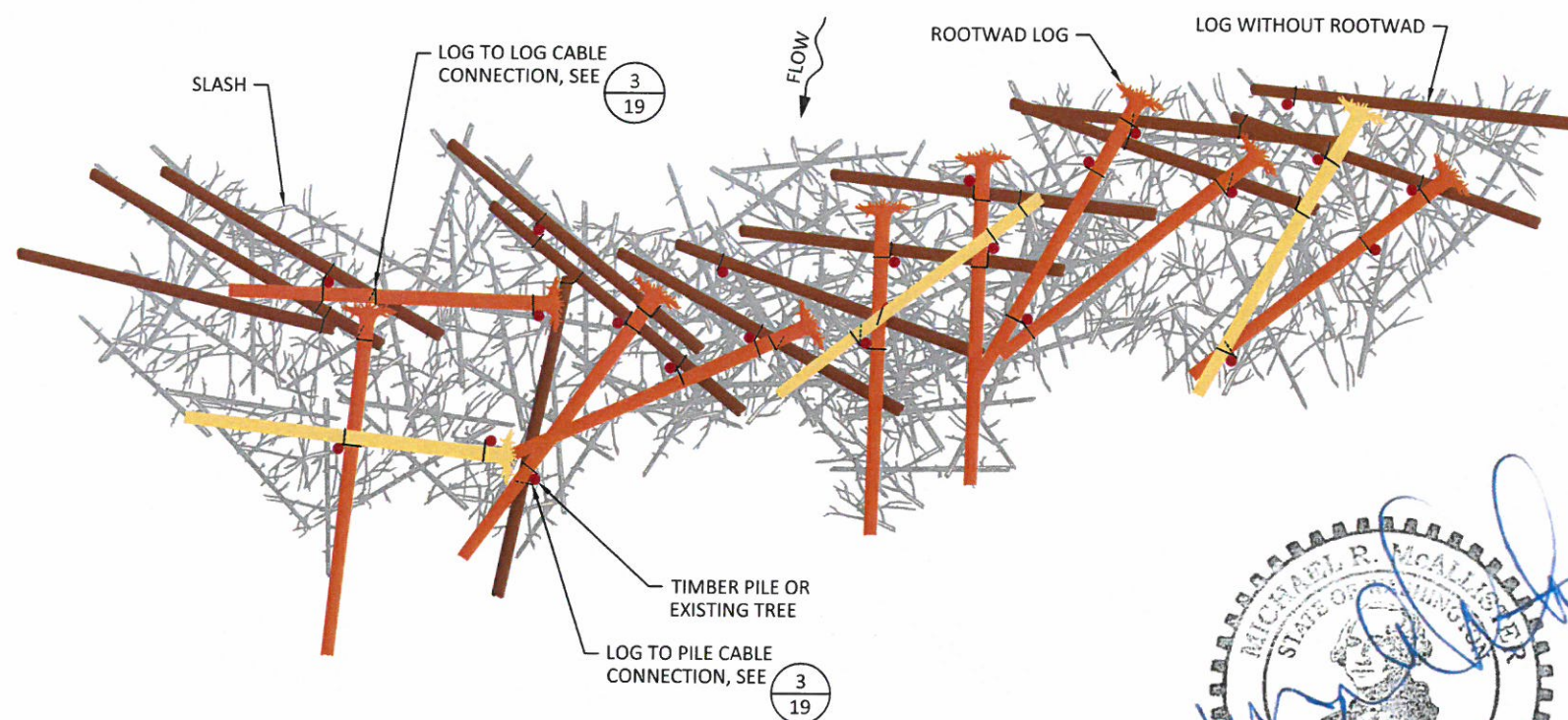
3
19 TYPICAL LOG CABLE CONNECTIONS
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NOTES

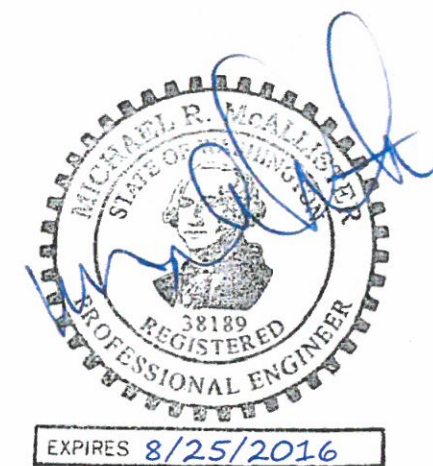
1. USE 3/8 INCH GALVANIZED CABLE.
2. CABLE SHALL BE SECURED BY 1.5 WRAPS AROUND LOG AND SECURE TAG END WITH 2 CABLE CLAMPS
3. THERE SHALL BE NO SLACK IN THE CABLE AFTER IT IS FASTENED.
4. ADJUST LENGTH OF STANDING AND RUNNING ENDS SO THAT CLAMPS ARE LOCATED NEAR THE BOTTOM OF THE UPPER OR HORIZONTAL LOG.



2
19 PLAN - FLOODPLAIN ROUGHNESS LWD
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4
19 PLAN - FLOODPLAIN ROUGHNESS LWD
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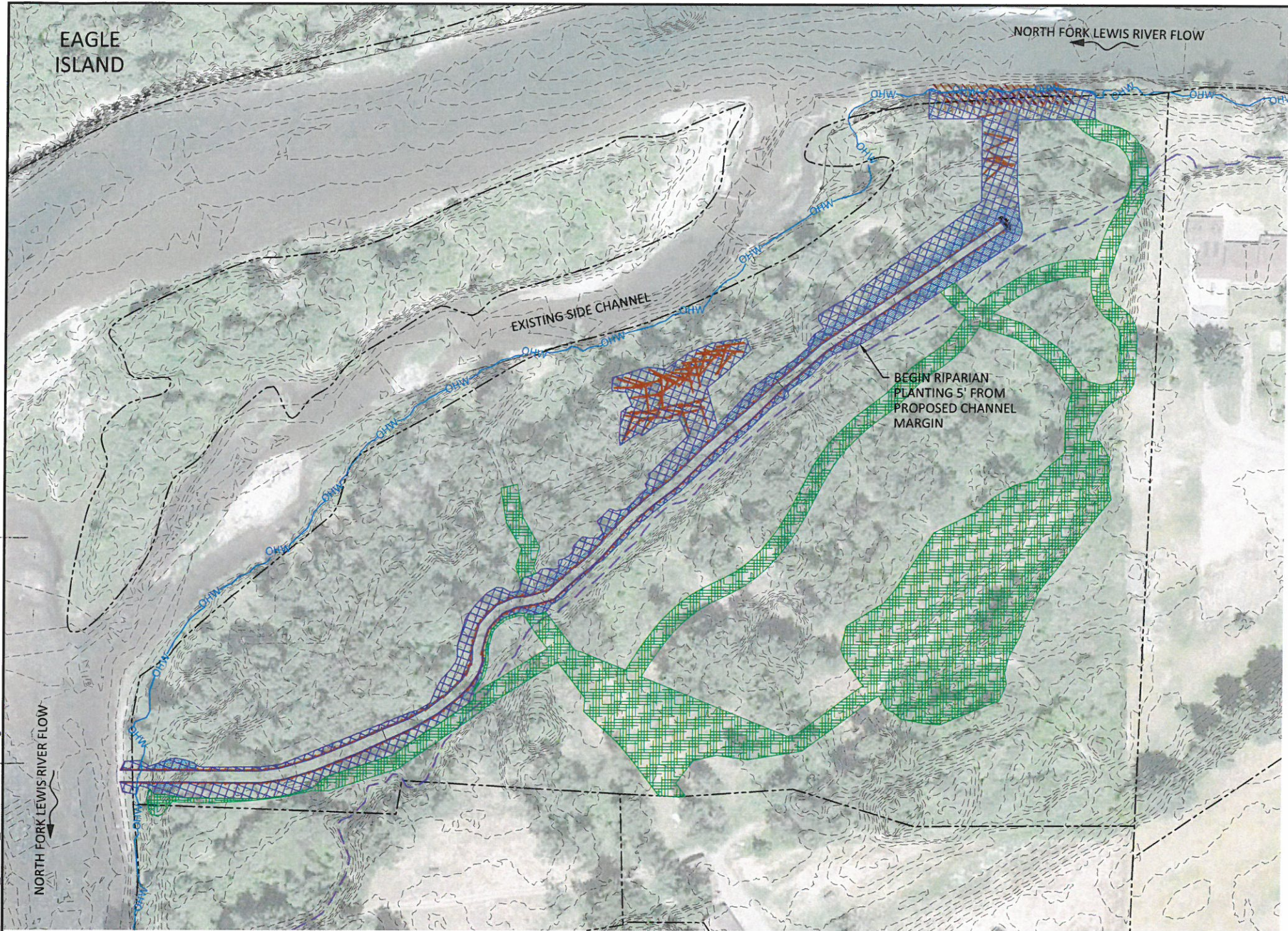


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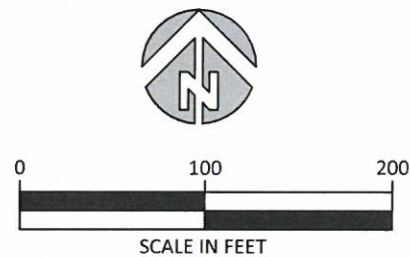
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PLAN



LEGEND

- PROPERTY LINES
- OHW — ORDINARY HIGH WATER
- - - EDGE OF FLOODPLAIN
- [Green cross-hatch] REVEGETATION AREA 1 - EROSION CONTROL SEED MIX
- [Blue cross-hatch] REVEGETATION AREA 2 - SHRUB & SMALL TREE PLANTINGS



NOTES:

WEED-FREE STRAW MULCH MATERIAL SHALL BE PER SECTION 9-14.4(1) OF THE STANDARD SPECIFICATIONS AND SHALL BE APPLIED AT A RATE OF 3 TONS PER ACRE TO ALL DISTURBED AREAS FOLLOWING SEED APPLICATION.

ACCESS ROUTES AND STAGING AREAS SHALL BE DECOMPACTED PRIOR TO APPLICATION OF SEED AND MULCH.

SITE ACCESS ROADS AND OTHER DISTURBED AREAS TO BE SEEDED WITH 30-LBS. PER ACRE OF NATIVE EROSION CONTROL SEED MIX.

REVEGETATION AREA 1 SHALL HAVE SEED AND STRAW MULCH APPLIED WITHIN 7 DAYS AFTER PROJECT COMPLETION.

Table 1. Revegetation Area #1 - Erosion Control Seeding 2.85 acres

Common Name	Scientific Name	Percentage of Mix
Blue Wildrye	<i>Elymus glaucus</i>	40%
Native Red Fescue	<i>Festuca rubra rubra</i>	40%
Tufted Hairgrass	<i>Deschampsia cespitosa</i>	10%
Sheep Fescue	<i>Festuca ovina</i>	5%
Quackgrass	<i>Agropyron repens</i>	5%

Table 2. Revegetation Area #2 – Riparian Plantings 1.46 acres

Common Name	Scientific Name	Plant Form	Min. Size	Qty
Trees - Approximate 10 foot spacing on center				
Oregon Ash	<i>Franxinus latifolia</i>	Bare root	24"	210
Cascara	<i>Rhamnus pushiana</i>	Bare root	24"	210
Black Cottonwood	<i>Populaus balsamifer ssp. Trichocarpa</i>	Bare root	24"	210
Shrubs - Approximate 4 foot spacing on center				
Red-Osier Dogwood	<i>Cornus Sericea</i>	Bare root	36"	400
Western Serviceberry	<i>Amelanchier alnifolia</i>	Bare root	36"	400
Black hawthorn	<i>Crateagus douglasii var. suksdorfii</i>	Bare root	36"	400
Pacific ninebark	<i>Physocarpus capitatus</i>	Bare root	36"	400
Indian plum	<i>Oemleria cerasiformis</i>	Bare root	36"	400
Thimbleberry	<i>Rubus parviflorus var. parviflorus</i>	Bare root	36"	400
Pacific willow	<i>Salix lucida</i>	Bare root	36"	400
Swamp Rose	<i>Rosa pisocarpa</i>	Bare root	36"	400

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REVEGETATION PLAN

SHEET
20 OF 20

Eagle Island Chum Spawning Channel **FINAL DESIGN REPORT**

Prepared by **INTER-FLUVE, INC.**

October 2013



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Eagle Island Chum Spawning Channel FINAL DESIGN REPORT

Prepared for

Washington Department of Fish & Wildlife
2108 Grand Boulevard
Vancouver, WA 98661

Prepared by

INTER-FLUVE, INC.
501 Portway Ave, Suite 101
Hood River, OR 97031
(541) 386.9003
www.interfluve.com

October 2013

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INTRODUCTION

Overview

This design report describes the investigative analysis and the elements of design for the construction of a chum salmon spawning channel (chum channel) in the floodplain of the lower North Fork Lewis River near Eagle Island. Analysis and design of the chum channel is being conducted for the Washington Department of Fish & Wildlife (WDFW) as part of their chum salmon recovery program for the Columbia River. The chum salmon recovery program aims to recover self-sustaining populations of chum salmon in key lower Columbia tributary basins. The Lewis River, which is believed to have historically supported a thriving chum salmon population, is a high priority for chum salmon recovery under this program.

Purpose

The overall goal of this design effort is to increase the availability of high quality spawning conditions for chum salmon in the lower Lewis River through construction of a chum spawning channel in the floodplain of the mainstem Lewis River near Eagle Island. Specific project objectives, presented in the form of project Design Criteria, are presented later in this document.

Project Area

The project area is located in the river-left (south) floodplain of the South Channel of the Lewis River at river mile (RM) 11.5 in the Eagle Island area. The property is owned by WDFW. A location and site map are presented in Figure 1.

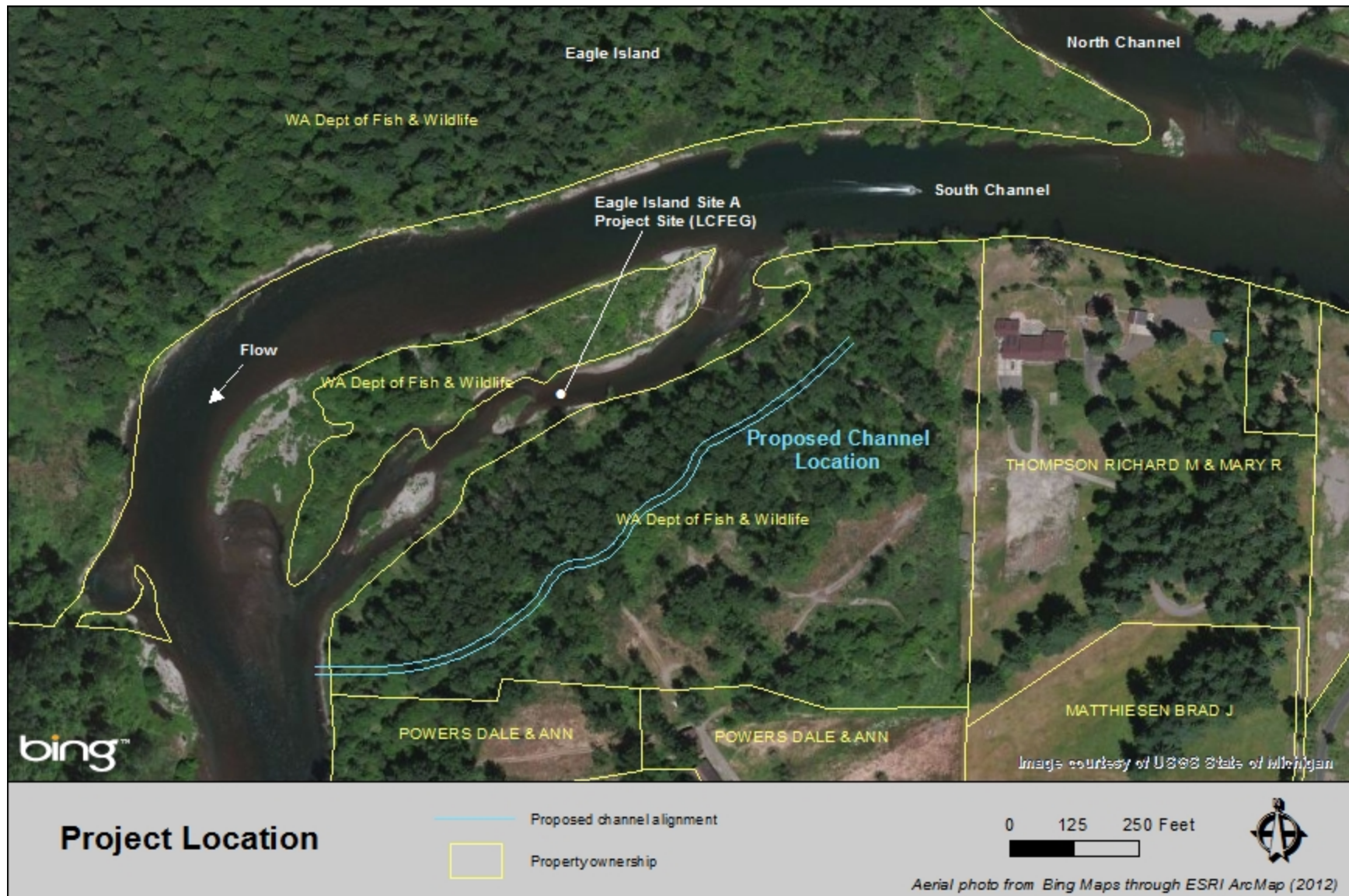


Figure 1. Project location map.

Coordination with Other Efforts

The Eagle Island area is also the site of other nearby restoration and assessment efforts, some that have already been completed and some that are in the planning or design phases. This effort is being coordinated with these other efforts and potential impacts of other efforts on the function and effectiveness of the chum channel are being considered as part of project design. Other nearby efforts include habitat restoration conducted by the Cowlitz Tribe at Eagle Island Sites A, B, and C in the South Channel. Site A (directly adjacent to project site) was completed in 2011 and included placement of log jams in a side-channel of the South Channel at RM 11.5. Sites B and C include log jams and off-channel enhancement work adjacent to and just downstream of the project site. These projects are in planning and design stages. The Eagle Island North Channel Design project, which is being conducted by the Lower Columbia Fish Enhancement Group, is designing a strategy for providing increased flow in the North Channel during the fall Chinook outmigration. Coordination with these other efforts is considered very important for this project. Close coordination is facilitated by all of these efforts having the same design engineering consulting firm (Inter-Fluve). The North Channel Design effort also has a technical oversight group composed of several staff from WDFW, which helps to further ensure coordination of these efforts.

Background and Site Selection

This site was selected as the highest priority site among several sites that were investigated as a preliminary phase of this effort. Preliminary site investigations were conducted for WDFW by Inter-Fluve in 2011 at four sites in the Lewis River Basin; two sites on the East Fork Lewis and two sites on the North Fork Lewis. These four sites were selected from a larger suite of potential sites on the East Fork, North Fork, and lower mainstem Lewis (downstream of the East Fork confluence) based on their geomorphic setting and potential to provide the upwelling conditions necessary for chum spawning. The four sites that received field investigation included: (1) Eagle Island – this project site, (2) Haapa – NF Lewis RM 14.5, (3) Pioneer – EF Lewis RM 6.5, and (4) Daybreak – EF Lewis RM 10. Site investigations at the four sites included groundwater pump tests, installation of surface and groundwater monitoring stations, geomorphic characterization, and select topographic survey. Based on the results of the site investigations, the Eagle Island site was identified as having the greatest potential for providing the groundwater flow conditions (i.e. upwelling) needed to support a chum spawning channel.

OBJECTIVES AND DESIGN CRITERIA

A set of project objectives and design criteria were developed based on consideration of the project goals and based on discussions with WDFW staff. These criteria and objectives are used to guide design components to ensure the goals of the project will be met.

General objectives and criteria

- Increase habitat quantity and quality for chum salmon spawning through the creation of an off-channel spawning channel.

- Maximize groundwater upwelling within the channel to the extent practicable given site conditions. If groundwater flow is determined to be insufficient to provide the required habitat criteria (e.g. depth and velocity), supplement with surface diversion (from the mainstem) or infiltration galleries (preferred due to less potential for introduction of fines).
- Protect the channel from scouring flows associated with relatively frequent mainstem flood events (i.e. less than the 5-yr flood).
- Protect banks from toe erosion and sloughing of fine sediment that can cause sedimentation of chum spawning areas.
- Discourage extensive periods of backwater inundation from the mainstem that may contribute high levels of fine sediment.
- Provide a substrate size composition that is preferred by chum salmon for spawning but that will also provide the necessary stability given anticipated scour conditions derived through hydraulic analysis; alternatively, provide other means of grade-control or control measures that will retain spawning gravels within the channel.
- Utilize available in-situ substrate material for the bed material composition to the extent possible.
- Incorporate features (e.g. control weirs) that will allow for operational flexibility to manage for potential flow variations during the spawning, incubation, and early rearing periods.
- Install a structure near the channel outlet to allow for WDFW fish trapping and monitoring operations.
- Establish access routes and locations to allow for long-term monitoring and maintenance.
- Avoid creation of habitat for species known to prey on juvenile chum salmon, in particular, coho fry and pre-smolts.
- Discourage colonization by invasive aquatic and riparian plant species.
- To the extent possible, minimize long-term maintenance requirements.
- Consider the existing and future potential effects of other nearby restoration efforts (i.e. Eagle Island North Channel Design and Eagle Island Sites A, B, & C).

PROJECT SITE INVESTIGATIONS

Topographic Data

Topographic survey data is utilized for site investigation and design. Survey data is used for the following: (1) as input for the hydraulic model, (2) to calibrate surface and groundwater monitoring stations to real elevations, (3) to develop a grading plan, and (4) to determine the location of key features such as trees, channel depressions, bankline locations, etc.

Site topographic data was acquired through site surveys and through the use of existing LiDAR (Light Detection and Ranging) data. Preliminary site surveys were conducted in October 2011 as part of the initial investigations of the four sites described above. More detailed follow-up surveys were conducted in August 2012 (see Figure 2). Surveys were conducted using survey grade GPS (RTK) equipment and Total Station survey instruments. Other existing survey datasets from nearby projects, including ground survey data and channel bathymetry data, were also utilized as appropriate.

LiDAR data were obtained through the National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Server. These data were collected in 2009/2010 for the US Army Corps of Engineers as part of a regional LiDAR effort in the Lower Columbia. These LiDAR data supersede previous LiDAR data collected by Clark County in 2002. The LiDAR data were collected to represent bare earth data within a 0.07 m tolerance. A hillshaded relief map created using the LiDAR data is included in Figure 2.

Due to potential known errors in LiDAR data due to the effects of vegetation and water, the ground survey data were used as the primary topographic data source but were supplemented with LiDAR “bare earth” data at the outer limits of the project site or where ground survey data were not collected (e.g. private property) or was collected at low densities.

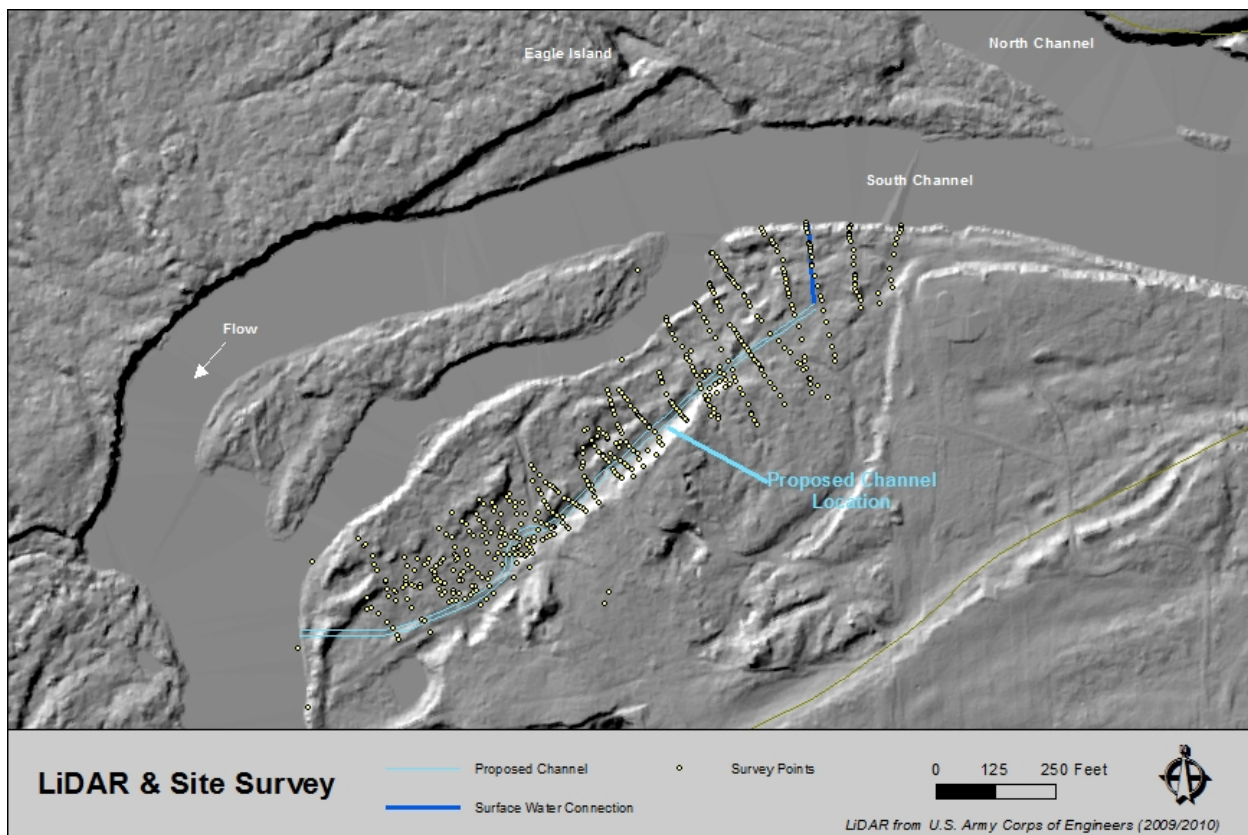


Figure 2. LiDAR hillshade map and site topographic survey points. Additional survey data of the North and South channels were also available and used for this project.

Geomorphology

The project site lies within the floodplain of the Lewis River and is underlain by river alluvium. The Lewis River in this area has been very laterally dynamic over the historical aerial photo record. The earliest aerial photos are from the late 1930s and show a very different configuration of the Lewis River in this area. The photo record shows that the mainstem of the Lewis River occupied this area as recently as 1948. In the 1950s and 60s there was considerable earthwork conducted at the project site, potentially related to both excavation for gravel extraction and fill for flood protection. Since the 1970s, conditions have been relatively stable in the project area, with the most change occurring as erosion of the river-right channel boundary of the South Channel at RM 11.4. Over the past few decades, there has also been a general trend in shifting flow from the North Channel to the South Channel. This channel shifting has been observed by WDFW fish biologists and can be seen in the photo record. Loss of flow to the North Channel has potential implications to salmonid habitat availability in this reach. As part of the Eagle Island North Channel Design project, this issue is being assessed and strategies are being developed to address the issue.

Human uses impacting the project site include flow management associated with the Lewis River hydro-system, interruption of bedload and wood transport due to the hydro-system, past removal of wood from the river (Inter-Fluve et al. 2009), past instream gravel mining, riparian clearing, and human development of floodplains and riparian areas. These practices have generally served to simplify habitats and reduce channel dynamics.

Although channel shifting has occurred in this area in the past, channel conditions have been relatively stable for the past few decades, particularly with respect to the outlet location of the proposed chum channel, which has remained in the same location at least since 1974.

Hydrology

Overview of Lewis River hydrology

The lower Lewis River experiences high flows from winter rains, rain-on-snow events, and spring/summer snowmelt. Flows in the lower river are further influenced by flow regulation from the Lewis River hydro-system, which consists of 3 dams on the mainstem Lewis River. The project site is located at RM 11.5, which is 8 miles below the most downstream dam, Merwin Dam (RM 19.5).

Flood flow magnitudes were developed for various flood recurrence intervals to be input into hydraulic modeling and design calculations (Table 1). The 10-, 50-, and 100-year flood flow magnitudes were obtained from the Lewis River Hydroelectric Projects Flood Management Technical Report (FLD-1) (PacifiCorp 2004b) (Table 2). The flows for the flow scenario "Regulated flows with 70,000 acre-feet dependable flood control storage" at Woodland, WA were utilized. These flows are conservative (i.e. higher) estimates of floods for the project site because Woodland is located downstream of the project area (RM 6-7); however, there are no significant tributaries between the project site and Woodland.

The FLD-1 study did not provide 2-year event flows for Woodland, WA but provided 2-year event floods for Ariel (USGS Station #14220500) for the scenario “Regulated flows with actual historic flood control storage”. Because a major tributary, Cedar Creek, enters the Lewis River downstream of Ariel, these flows were corrected for the subwatershed boundary (from LCFRB 2010) closest to the project area (RM 8.8 just downstream of Eagle Island). This was accomplished by calculating Cedar Creek flows as 17% of the East Fork near Heisson (USGS Station #14222500) flows, which is consistent with the methods outlined in the FLD-1 Study. The remainder of the tributary flows between Ariel and RM 8.8 were calculated using the USGS regional regression equations (Sumioka et al. 1998). Cedar Creek and other tributary flows were added to the 2-year flows at Ariel in order to obtain the 2-year event flows for the project area.

Table 1. Recurrence interval flows used for the project area.

Return Interval	Flow (cfs)
2-year	24,800
10-year	65,600
50-year	92,600
100-year	98,400
500-year	150,500

Table 2. Table of recurrence interval flows reproduced from PacifiCorp FLD-1 Study (reproduced from PacifiCorp 2004b).

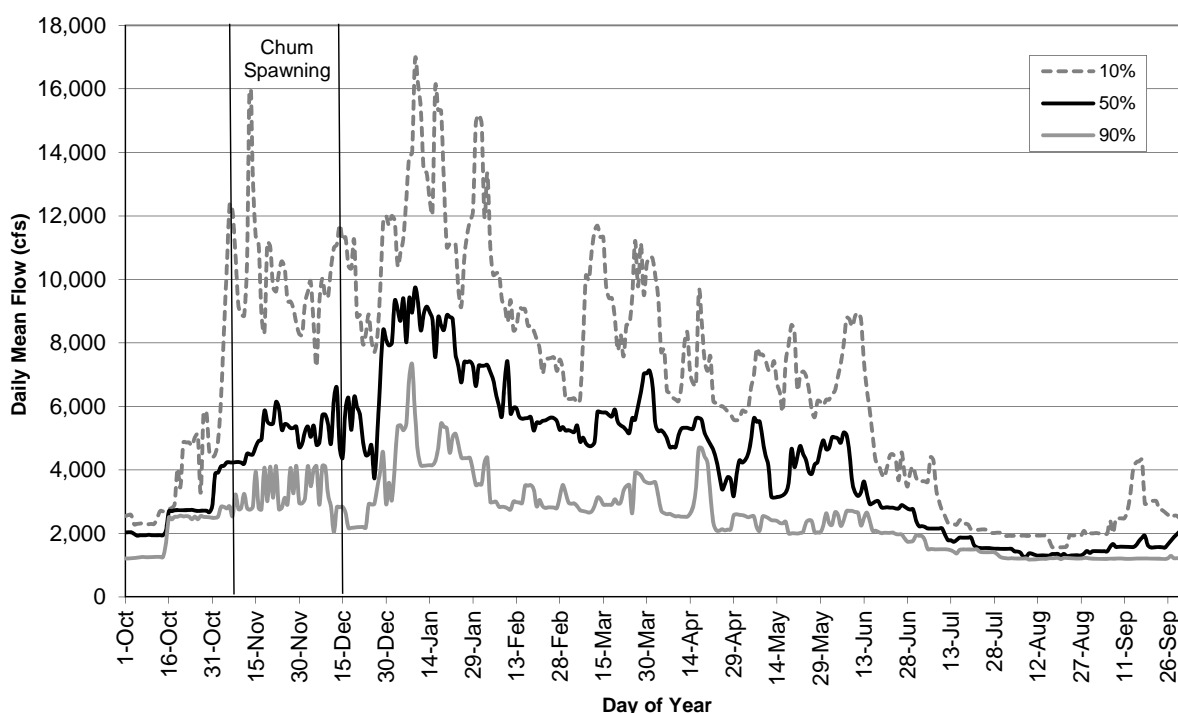
Location	Drainage Area (sq mi)	Flow Quantile (cfs) by Return Period (yrs)				
		2	10	50	100	500
Unregulated flows						
Near Ariel	731	42,000	71,900	99,100	111,000	140,000
Regulated flows with 70,000 acre-feet dependable flood control storage						
At Ariel	731	n/a	60,000	85,000	90,000	140,000
At Woodland	820	n/a	65,600	92,600	98,400	150,500
At mouth	1,046	n/a	85,400	119,400	128,200	187,600
Regulated flows with actual historic flood control storage						
At Ariel	731	22,000	60,000	n/a	n/a	n/a

Note: Analyses based on the period of record 1912-2000.

PacifiCorp is required, as part of their hydropower license, to maintain minimum flows in the lower river below Merwin Dam for specific seasons in order to support key fish life-stages. Table 3 gives the flow requirements for each period. These requirements provide relatively reliable low-end flow discharges for specific times of the year that are used to help guide the design of the spawning channel. Figure 3 shows a hydrograph of daily median, 10% exceedances, and 90% exceedance flows as well as the primary period of fall Chinook outmigration.

Table 3. Minimum flow requirements for the lower river below Merwin Dam.

Time period	Minimum flow requirement (cfs)
July 31 through October 15	1,200
October 16 through October 31	2,500
November 1 through December	4,200
December 16 through March 1	2,000
March 2 through March 15	2,200
March 16 through March 30	2,500
March 31 through June 30	2,700
July 1 through July 10	2,300
July 11 through July 20	1,900
July 21 through July 30	1,500

**Figure 3. Hydrograph showing daily median flows and 10% and 90% exceedances flows for the period 2002 to 2011.**

Water level monitoring

A total of 4 water level monitoring stations were installed at the site to track groundwater levels and their relationship to stage of the Lewis River. Water temperature was also collected at these sites. The sites included a groundwater monitoring well (piezometer) at the location of the pump test (described in the section below) (Piezometer 1), a second piezometer at the lower end of the potential chum channel alignment (Piezometer 2), and a third piezometer (Piezometer 3) in the

middle of the potential chum channel alignment. A river monitoring station was installed on the river-left side of the South Channel (River Station) at the upstream end of the project site. A map of the monitoring stations is included in Figure 4. Continuously recording pressure transducers and temperature monitors were placed at each of the monitoring stations and were monitored for the period August 21, 2012 to March 20, 2013. Additionally, water level monitoring was performed from November 2011 to April 2012 at all of these locations with the exception of Piezometer 3, which was installed in August of 2012. These results are presented in Figure 5.

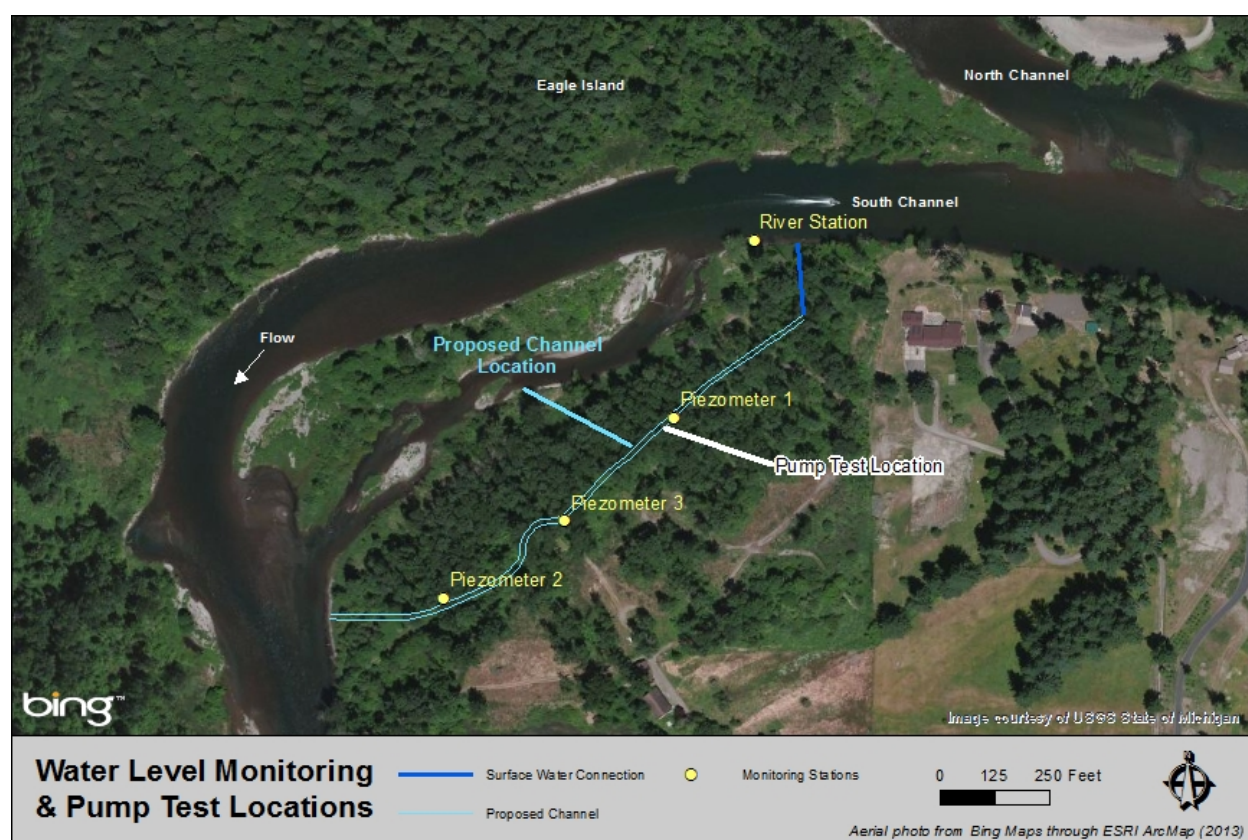


Figure 4. Location of water level and temperature monitoring stations and pump test.

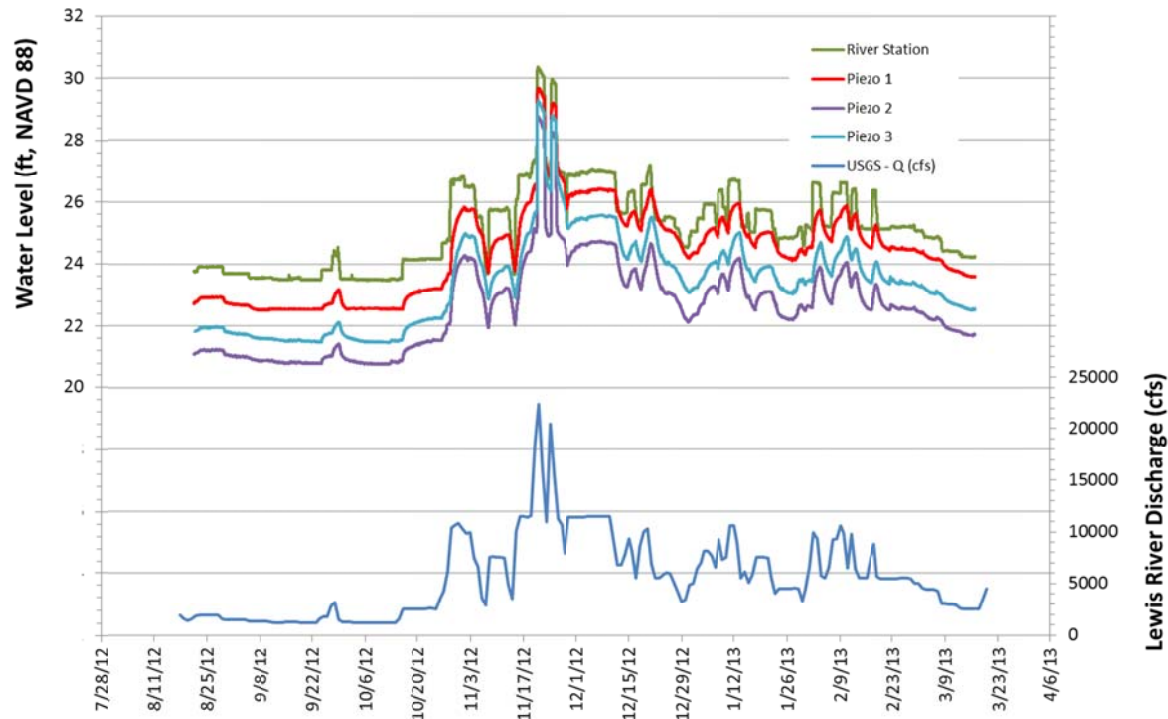


Figure 5. Water level monitoring data compared to river flow from the Ariel Gage (USGS #14220500)

Pump test

A pump test was performed on Oct 13, 2011 in order to evaluate groundwater flow conditions. Flow at the Ariel Gage (USGS #14220500) was 2,680 cfs on the day of the test. The pump test was performed at the location identified in Figure 4. An approximately 50 foot long by 5 foot wide trench was excavated below static groundwater level (Figure 6). A pump was used to draw down the water level in the trench for 2 -3 hours to achieve a drawdown in the groundwater gradient adjacent to the trench. The pumping rate was then adjusted until the pump outflow reached equilibrium with a new static water surface, at which point the pump discharge and static water elevation were measured. Surrounding ground topography, trench elevations, and water surface elevations were surveyed in order to determine static groundwater gradient. The depth of excavation was relatively shallow and the initial results suggested sufficient groundwater flow to provide upwelling during the spawning and incubation season. However, as discussed later in this document, groundwater flow alone is not expected to be able to also provide the depth and velocity requirements for chum spawning; for this reason, flow augmentation using an infiltration gallery collection system is incorporated into the design. The results of the pump test are included in Table 4. A pump rate of 0.17 cfs was measured. Based on a proposed channel length of 1,400 ft, it is estimated that this would equate to a flow of somewhere between 4 and 11 cfs at the channel outlet during the low flow period.



Figure 6. (A) looking upstream in the trench during the pump test. (B) The transition from soil to sand and to alluvium can be seen in the wall of the trench.

Table 4. Pump test results.

Metric	Value
Length of Proposed Channel (ft)	1,400
Gradient of Proposed Channel (%)	0.19%
Pump Test Result (cfs)	0.17
cfs/Lineal Foot	0.00311
cfs/ft ²	0.000518
Pump Test Excavation Depth (ft)	6
Trench Width (ft)	6

Hydraulics

Hydraulic modeling and analysis was conducted for the North Lewis River as well as for the proposed chum channel itself. Hydraulic analysis for the Lewis River was conducted in order to investigate the following: (1) the potential impact of flood flows overtopping the proposed chum channel, which has implications for scour and/or sediment deposition in the constructed channel, and (2) the likely extent and duration of backwatering from the channel outlet that may result in fine sediment deposition in the channel. Additionally, hydraulics of the proposed chum channel were evaluated to ensure that design criteria were achieved.

Lewis River hydraulics

In order to support multiple assessment and restoration efforts in the Eagle Island area, a two-dimensional hydraulic model was developed for the Lewis River in the project area. The detailed topographic survey of the project area, as well as topographic and bathymetric data collected for other nearby projects, was used for the model geometry. The 2D model extends upstream and downstream of Eagle Island, and includes the area of the proposed chum spawning channel. The extent of the model domain and site topography is shown in Figure 7.

A 2-D model calculates hydraulic parameters within a mesh (or grid) laid over the river and surrounding landscape. A 10 meter square grid was used for this model to optimize model resolution and computational time. The grid used for the hydraulic model is shown with an overlay of the 100-year recurrence interval flood inundation (the largest magnitude flow modeled) in Figure 8. For more information on the 2-D model setup and calibration, see the Lewis River – Eagle Island North Channel Habitat Restoration Design Report (Inter-Fluve 2013).

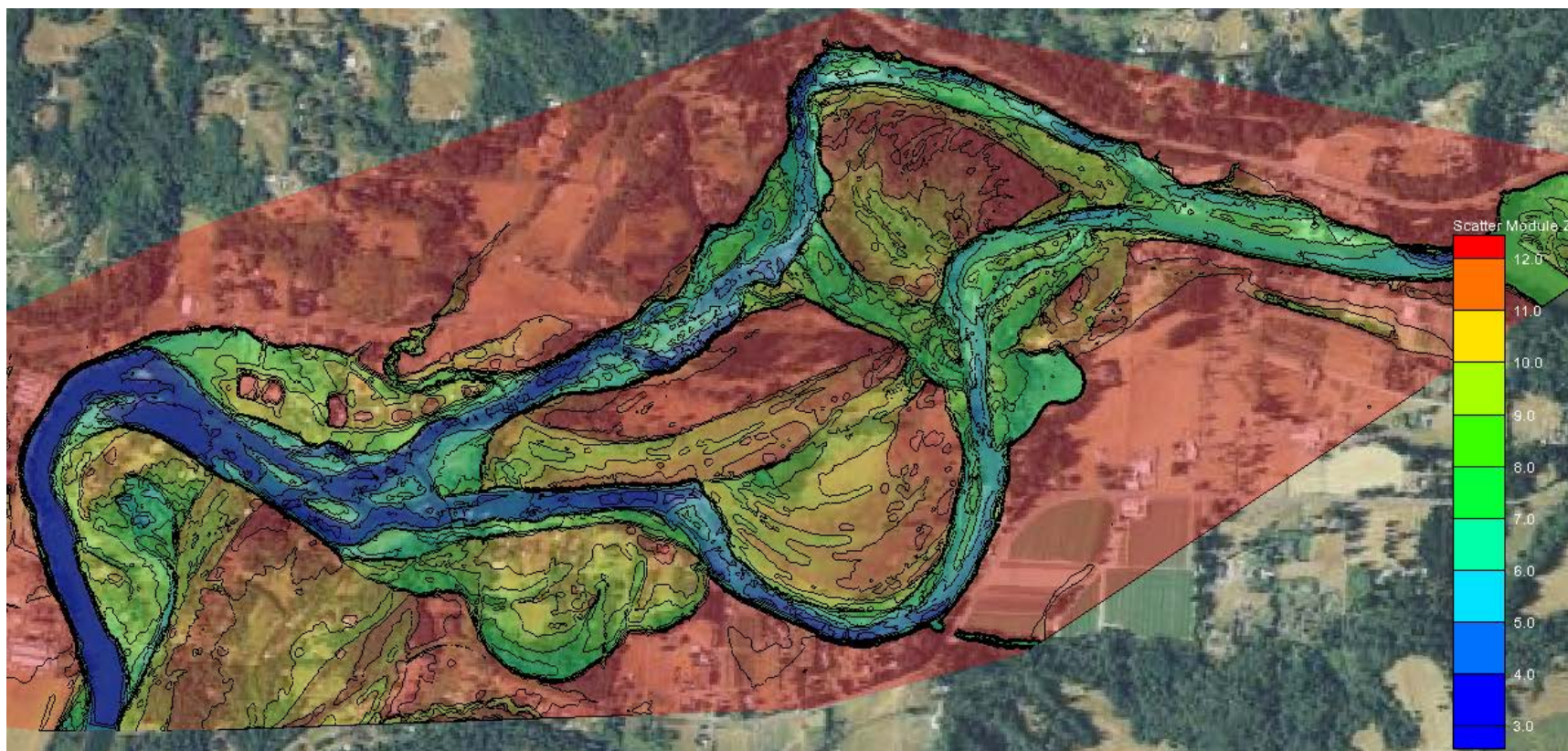


Figure 7. Existing topography (topography displayed in meters)



Figure 8. 10 meter grid, 100-yr flood.

Flood flow conditions were input into the model, including the 2-yr, 10-yr, 50-yr, and 100-yr floods. A low flow of 2,200 cfs was also used in the model. Preliminary results for the 2D model are presented in the Eagle Island North Channel Design Report. These results show that at low flows, the location of the chum channel is not currently connected by surface flows to the mainstem, but that there is surface water connectivity at the 2-yr flood. At the 2-yr flood, velocity is low (mostly <2.2 ft/s) in the vicinity of the project area and the direction of flow is generally parallel to the proposed chum channel. At the 10-yr event and larger, the flow is mainly less than 3.9 ft/s at the project area and the flow direction continues to remain generally parallel to the proposed channel except for at the downstream end where flow direction changes to the south as flows increase.

These modeling results have implications to the design of the chum channel. At relatively frequent flood flows (i.e. 2-yr event), the proposed chum channel would receive overland flow from the mainstem Lewis River. This overland flow has the potential to create scour of the channel banks as it enters the constructed channel. For this reason, it will be necessary to ensure there is adequate channel bank stability as well as floodplain roughness in order to limit flow energy. Floodplain roughness will also reduce the velocity of overland flow before it enters the constructed channel, which will reduce the potential for delivery of mainstem sediment (suspended load and wash load) to the channel. In most of the floodplain area between the Lewis River and the proposed chum channel, there is adequate floodplain roughness provided by existing vegetation and downed large wood. The design calls for adding floodplain roughness in the form of floodplain large wood placements near the upstream end of the constructed channel as this area will receive considerable vegetation disturbance during construction.

Hydraulic analysis was also used to investigate the potential extent and duration of backwater inundation of the constructed channel that will result from an increase in stage of the mainstem Lewis at the channel outlet. This analysis is used to inform the design slope of the channel since minimizing the backwater effect needs to be balanced with the need to reduce channel slope to achieve depth requirements for chum spawning. The water surface data collected at the site was used in conjunction with 1-D modeling of the proposed channel (described in the next section) for this analysis. Stage data collected on-site was believed to be better than the 2D model output because it is based on real and extrapolated empirical data.

The water surface monitoring station at the site is located along the river-left channel margin of the South Channel at the upstream end of the project area (see Figure 4). Because we are interested in the stage at the channel outlet for this analysis, we simulated stage at the outlet by applying the mainstem channel slope between the two locations. This slope was based on the average of two water surface slope calculations obtained during two different field surveys. This simulated stage data was then plotted against flow at the Ariel Gage (USGS #14220500) in order to provide a simulated stage-discharge relationship (Figure 9) that allows for estimating stage over a broad range of flows and for creating stage-duration curves. A stage-duration curve was created for the chum spawning period (Nov 8 – Dec 15) in order to assess the potential impact of backwater conditions on spawning (Figure 10). A stage exceedence plot was also generated for the simulated outlet gage (Figure 11). These data sources were used to provide values for the downstream boundary condition for hydraulic modeling of the chum channel itself (described in the next

section) as well as to determine channel elevations and dimensions as discussed later in the Elements of Design section.

Any potential changes to flow in the South Channel as a result of the North Channel design project (LCFEG project) could affect backwater conditions in the constructed channel; however, these effects would only be expected to reduce the amount of backwater, and so the effect on sedimentation can be mostly dismissed.

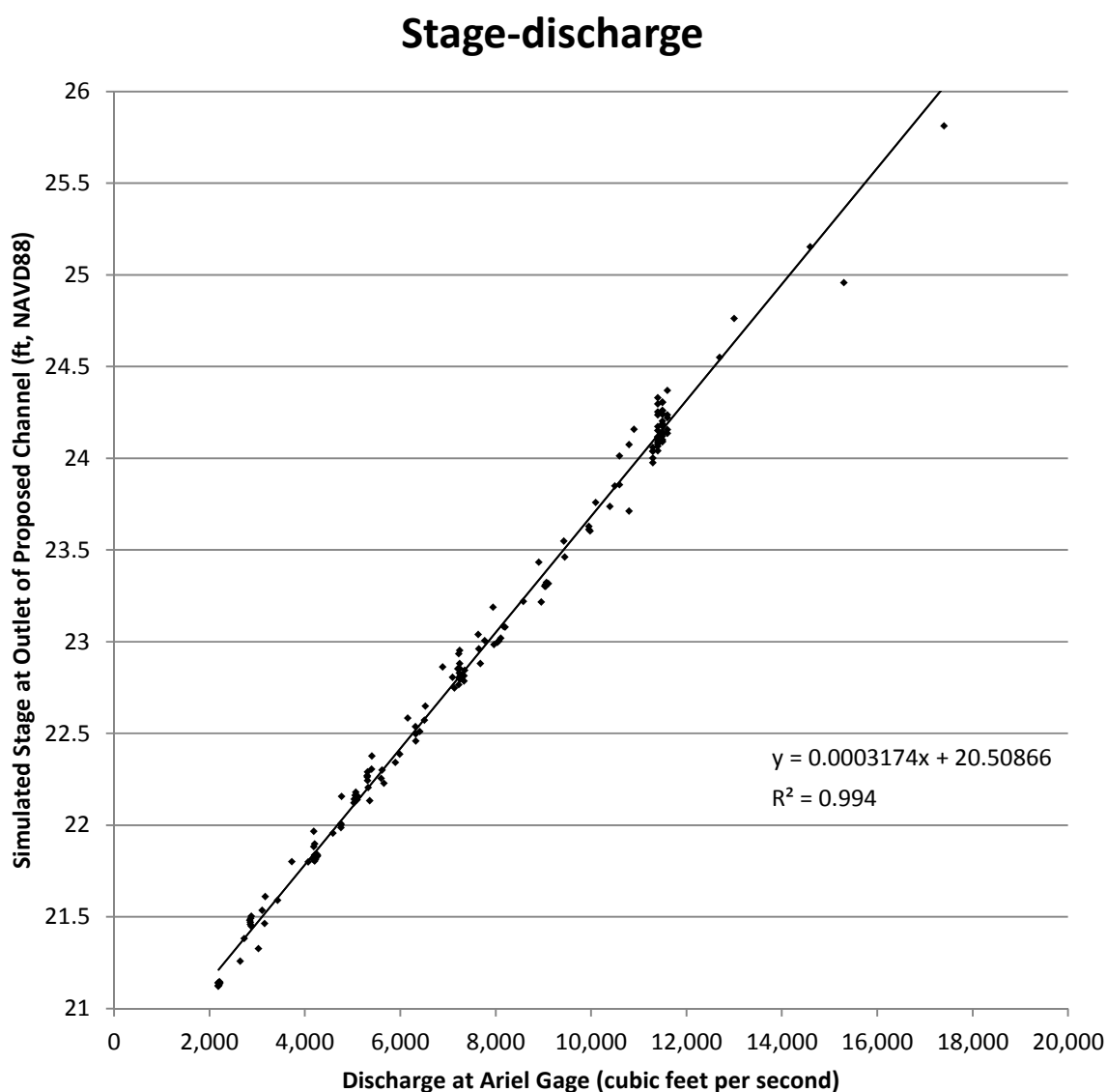


Figure 9. Stage-discharge relationship at the outlet of the proposed chum channel. Stage at the outlet was extrapolated using water level monitoring data from the upstream end of the site (see text).

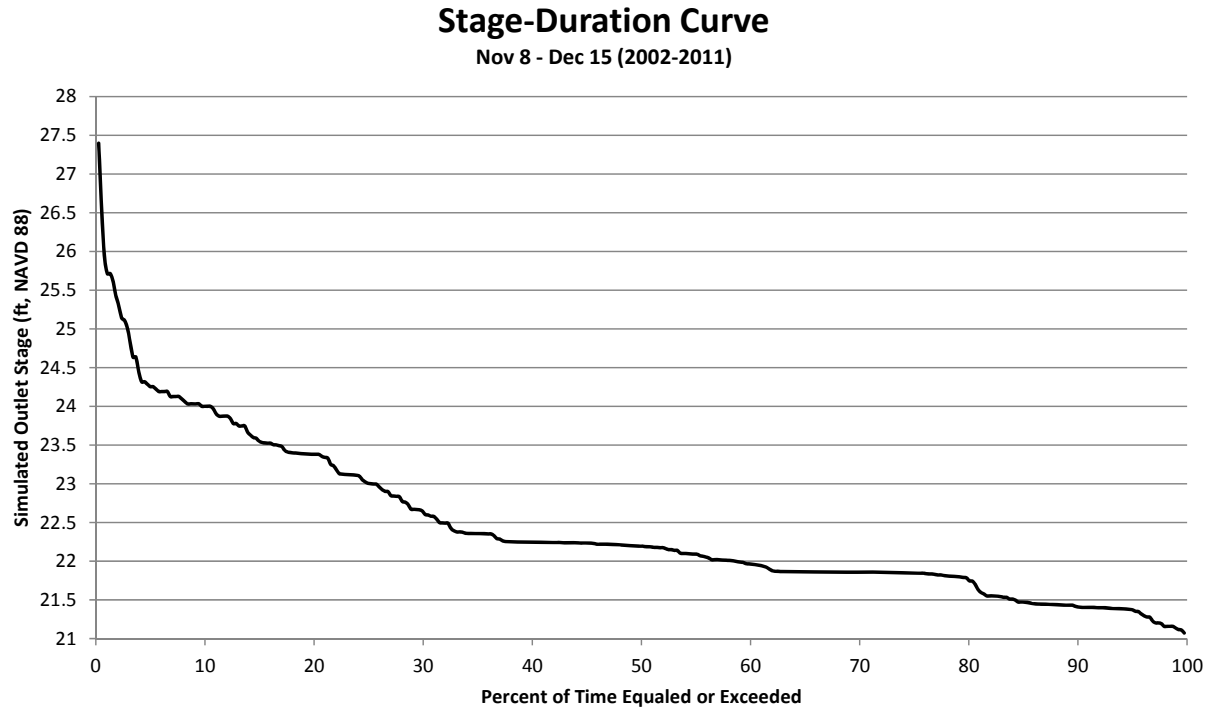


Figure 10. Stage-duration curve for the chum spawning period for the Lewis River (South Channel) at the outlet of the proposed chum channel. Stage at the outlet was extrapolated using water level monitoring data from the upstream end of the site and the relationship with flow at the Ariel USGS Gage (see text and Figure 9). Data from the Ariel Gage from the last 10 years (2002 – 2011) was used for development of the stage-duration curve.

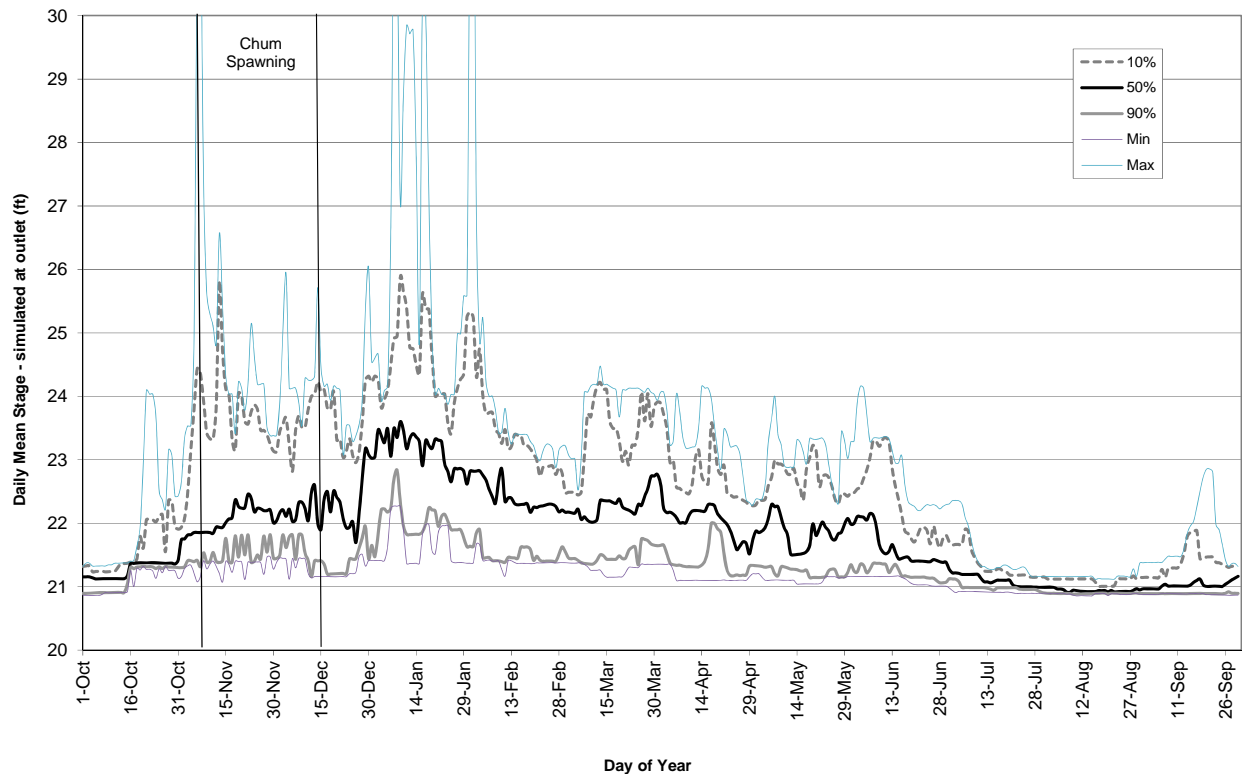


Figure 11. Stage exceedence plot for the simulated gage at the proposed channel outlet. This was developed by simulating gage data at the outlet based on the piezometer data at the upstream end of the project site, then applying the stage-discharge relationship with the Ariel Gage to develop exceedence values. Flow values include the latest 10 years of data (2002 – 2011) from the Ariel Gage.

Proposed chum channel hydraulics

Proposed hydraulic conditions of the chum spawning channel were analyzed for non-flood flow conditions to ensure the design of the channel will achieve habitat criteria during the fish use period, including chum spawning, incubation, and rearing. Hydraulic modeling was conducted using the U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS 4.1.0). HEC-RAS is a 1-dimensional hydraulic model that was used to perform hydraulic computations including estimates of water depth, velocity, and shear along the channel length. The objective of modeling the proposed channel was to determine appropriate channel dimensions and slope that would be most likely to provide desired habitat conditions (depth, velocity, and shear) under estimated flow conditions. Desired habitat conditions are described later in this report under .

Model hydrology

The hydrologic analysis for the site included a pump test in the area of the proposed channel. The methods and results of this test are described previously in the Pump test section. The pump test provided estimates of low flow discharge supplied by groundwater, which will be expected to sustain spawning and incubating conditions in the channel. Results of the groundwater pump test suggest that groundwater gains over the length of the proposed channel will result in an outflow

volume of 4 to 9 cfs. In addition to groundwater inputs, the current design includes a supplemental source of inflow that takes water from the Lewis River via an infiltration gallery collection system and piping. This is necessary to provide the required depth and velocities to support chum spawning, which would not be supported by groundwater flow alone. The model was run with the entire range of estimated flows derived from groundwater inflow and additional flows from flow augmentation. A groundwater inflow of 4 cfs was used as a conservative estimate, which is based on the lowest groundwater inflow volumes determined by the pump test. Flow augmentation at the top of the proposed channel is currently designed for a flow of approximately 5 cfs during average mainstem flow conditions. Therefore, flow was modeled with 5 cfs at the upstream end with steadily increasing flow accumulating to 9 cfs in the channel near the downstream end.

Model geometry

Ground survey using total station and RTK survey equipment was used as the primary source of topographic data. LiDAR data was used to supplement topography at the far extent of the model domain. From the combined survey and LiDAR data, a 3-dimensional surface was constructed in AutoCAD and the proposed channel was graded into the existing topography. In AutoCAD, a total of 27 cross-sections were cut along the 1,345-foot proposed channel. Sections were evenly spaced at 50-ft intervals, with supplemental sections at the two proposed control weirs. The modeled geometry for the proposed channel is a simple rectangular channel. Channel geometry was simplified in order to facilitate multiple iterations of channel width. Widths were varied from 15 to 8 ft in order to determine the optimal width to achieve desired habitat conditions with assumed flows. Channel slope was an additional variable that was iteratively varied to determine the optimal slope to provide sufficient depth, velocity, and shear stress. Slope was varied between 0.2% and 0.06% during the modeling process.

Model boundary conditions

Model boundary conditions consisted of a normal depth boundary at the top of the model and a known water surface elevation boundary at the downstream end of the model. The known water surface boundary was developed through hydrologic analysis of the mainstem Lewis River as described previously under the Hydraulics – Lewis River section and summarized in Figure 9. Figure 9 is a stage-duration curve that provides estimated mainstem river stage at the outflow of the proposed channel. Eight separate model runs were conducted with a range of downstream boundary conditions based on Lewis River flows expected during chum spawning. The range of discharge (and associated stage) in the Lewis River at the downstream end of the chum channel during spawning generally ranges from 2,000 cfs (21.14 ft) to 10,000 cfs (23.68 ft). At the high stage of 23.68 ft, the river creates a backwater condition at the outlet of the proposed channel. At the low stage of 21.14 ft, the downstream boundary condition and the weirs control the hydraulics in the proposed channel. This flow represents very low mainstem flows.

Model results

Several iterations of flow conditions, slope, and channel geometry were carried out in order to achieve desired habitat conditions within optimal design parameters. The final modeled conditions include a channel that is 14 ft wide below the downstream control weir, 12 ft wide between the

downstream and upstream control weirs, and 10 ft wide above the upstream control weir. The channel has near vertical side-slopes. A consistent channel slope of 0.06% was used along the length of the proposed channel. Channel invert elevations were adjusted to take maximum advantage of ambient hydraulic head gradients (i.e. intercepted groundwater), provide sufficient grade for sediment transport, and provide maximum water depth without significantly increasing backwater conditions at the downstream end (Figure 12). The resulting chum channel hydraulics achieve habitat criteria with sufficient depth (>0.6 ft depth) and velocity (>0.7 ft/s) up to a downstream boundary condition in the Lewis River of 37th percentile exceedance flow (5,500 cfs) indicating that the habitat criteria are achieved the majority of the time (i.e. 63% of the time). Average velocities in the chum channel are lower than the velocity criteria of 0.7 ft/sec for Lewis River flows above the 37th percentile due to the backwater conditions at the downstream end (Table 5).

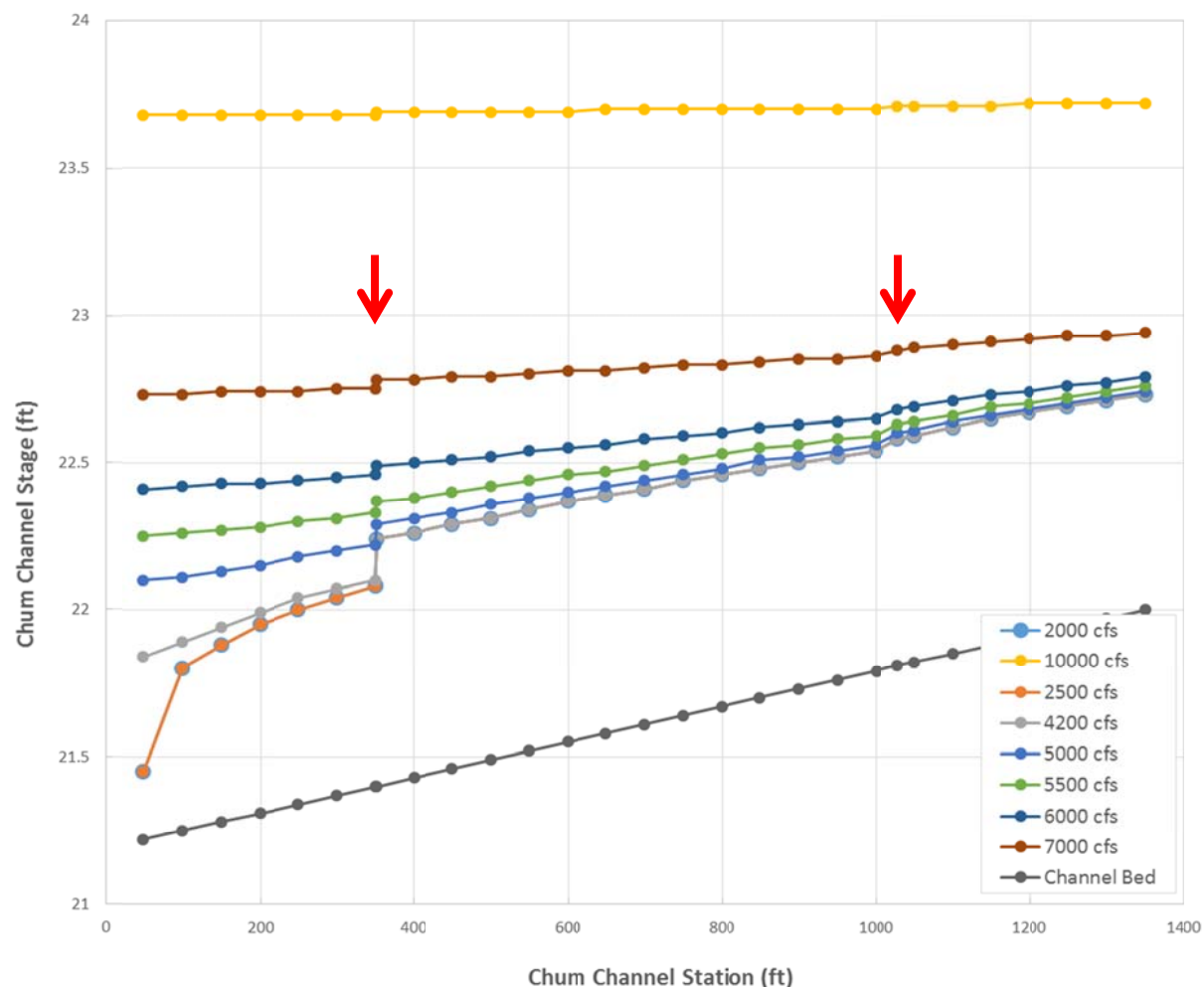


Figure 12. Water surface elevations along the proposed chum channel for varying flow rates in the Lewis River from low flow (2,000 cfs) up to the 14th percentile exceedance flow (10,000 cfs). Weirs are located at stn 3+53.08 and stn 10+27.06, and denoted by the red arrows.

Table 5. Average flow depth, velocity, and shear for the proposed chum channel at varying downstream boundary conditions.

Downstream Boundary Condition - Lewis River Flowrate (cfs)	Average Modeled Flow Depth (ft)	Average Modeled Velocity (ft/sec)	Average Modeled Shear (lb/ft²)
2,000	0.75	0.77	0.0246
2,500	0.75	0.77	0.0246
4,200	0.76	0.76	0.0232
5,000	0.82	0.70	0.0192
5,500	0.88	0.66	0.0164
6,000	0.97	0.60	0.0134
7,000	1.20	0.48	0.0082
1,0000	2.07	0.27	0.0022

Substrate samples

Subsurface substrate samples were collected at two locations within the proposed alignment in order to assess how much of the in-situ material could be incorporated back into the constructed channel. Samples were collected at two locations; one approximately 100 feet upstream from the proposed outlet and one approximately midway along the proposed channel alignment. Samples were collected by hand digging holes down to static groundwater level and then collecting a representative substrate sample and delivering to the lab for sieve analysis. These results are presented in Figure 13 and Figure 14.

Subsurface material at the site consists of river alluvium ranging from silts to cobbles. The material distribution varies across the site and determining the specific make-up of the full amount of material to be excavated for the channel will not be possible. However, preliminary results indicate that possibly one-third to one-half of the material could be re-used as spawning gravel in the constructed channel, which would likely be sufficient to provide all of the required spawning gravel. Additional sampling of material is recommended prior to construction in order to further investigate the potential for re-use of in-situ gravels.

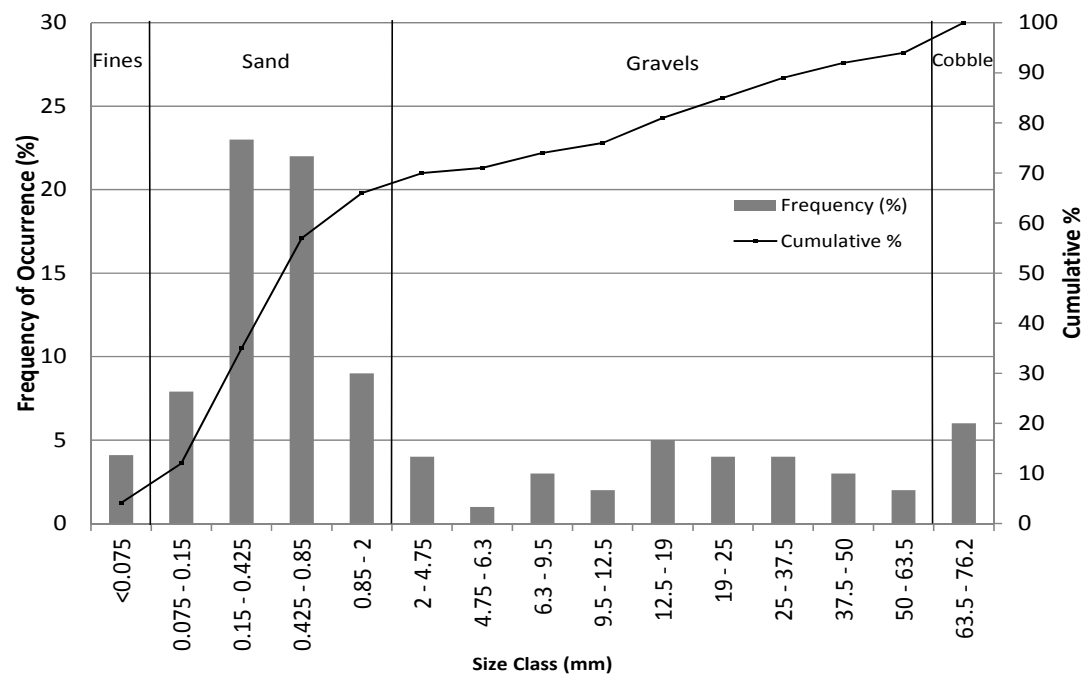


Figure 13. Subsurface bulk sample results at upstream sample site.

Table 6. Size classes and percent composition of subsurface material collected at the upstream sample site.

Size Class	Size percent finer than (mm)
D5	0.08
D16	0.18
D50	0.67
D84	23.00
D95	65.00
D100	<76.2

Material	Percent Composition
Fines	4%
Sand	62%
Gravel	28%
Cobble	6%
Boulder	0%

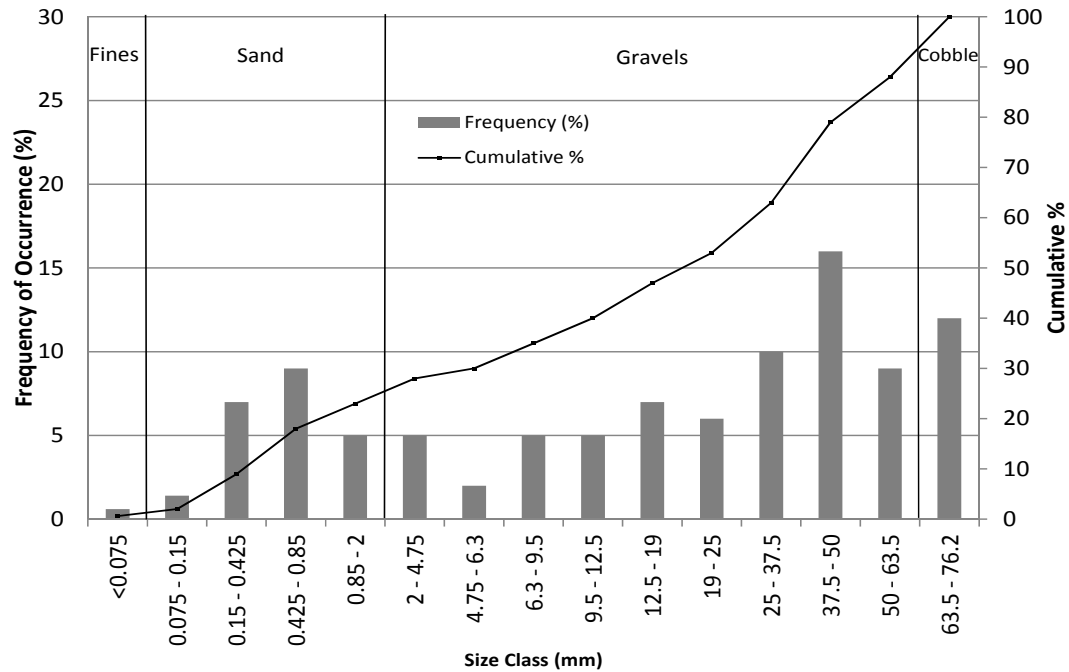


Figure 14. Subsurface bulk sample results at downstream sample site.

Table 7. Size classes and percent composition of subsurface material collected at the downstream sample site.

Size Class	Size percent finer than (mm)
D5	0.25
D16	0.71
D50	22.00
D84	58.00
D95	71.00
D100	<76.2

Material	Percent Composition
Fines	1%
Sand	22%
Gravel	65%
Cobble	12%
Boulder	0%

Chum salmon life history and habitat requirements

A summary of chum life history and habitat requirements were compiled from the literature in order to inform channel designs. Chum salmon typically enter the Lewis River in October and spawn in November and December. Fry emerge from late Feb to April and emigrate from the system in May and June. A life stage periodicity chart is included in . Chum salmon select spawning areas with upwelling groundwater (Groot and Margolis 1991; Bjornn and Reiser 1991), such as floodplain side-channels fed by hyporheic flow. These upwelling areas may have the advantage of improved aeration and metabolite removal (Schroder 1974). Additional habitat criteria are included in the section below in Table 8.

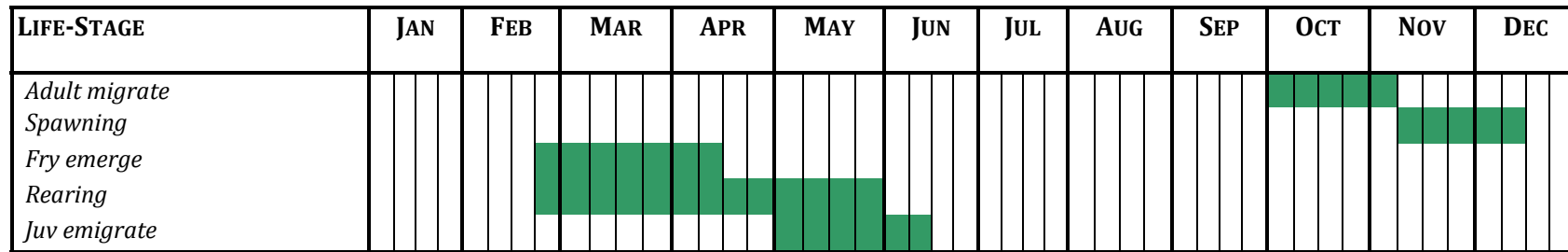


Figure 15. Life-stage periodicity chart for chum salmon in the Lewis River (reproduced from PacifiCorp 2004a).

Specific habitat criteria

The following specific habitat criteria (Table 8) were developed through consultation with various sources, which are listed in the table. These criteria are primarily expressed as ranges to allow for design flexibility in meeting criteria.

Table 8. Specific habitat criteria.

Metric	Value or Range	Notes and Sources
Channel width (ft)	12 - 40	Range recommended by Bell (1990) for artificial spawning channels.
Water depth (ft)	0.4 – 1.6	Lower range derived from chart in Quinn (2005). Upper range from Smith (1973, as cited in Bjornn and Reiser 1991). Consistent with “Use Areas” measured in Hamilton and Hardy Creek by Johnson et al. (2008)
Water velocity (ft/s)	0.7 – 3.3	Lower range from “Use Areas” in Hamilton Creek from Johnson et al. (2008). Upper range from Smith (1973)
Slope	0.0006 (0.06%)	Recommended value given by Bell (1990) for artificial spawning channels
Substrate size (inches)	80%: 0.5 – 2 20%: 2 - 4	Size distribution recommended by Bell (1990) for artificial spawning channels
Minimum flow (ft ³ /s)	3.6	This was the minimum flow recorded in Hamilton Springs from Nov 2005 to May 2006 by Johnson et al. (2008).

ELEMENTS OF DESIGN

Planform

The location and planform pattern of the spawning channel was selected based on site topography, geomorphic considerations, landownership, and the location of existing trees. The channel generally follows a floodplain swale that was created by the historical position of the Lewis River. Former channel locations that form natural depressions in floodplains are frequently indicators of “paleo-channels” that convey groundwater/hyporheic flow more readily than other floodplain areas. This is particularly the case when these channels are formed across the inside of meander bends, which results in an increase in the groundwater gradient through the site. Utilizing a natural depression also limits excavation quantities. The channel pattern was also adjusted to limit the disturbance to existing mature timber and wetlands, which were surveyed and mapped during the site topographic survey. At the downstream end of the channel, the planform was further adjusted to avoid crossing private property. This will simplify construction and future monitoring and maintenance.

Profile

The elevation and slope of the channel was determined through a combination of hydraulic analysis, geomorphic considerations, and chum spawning requirements. The slope of the channel is 0.06%, generally slightly less than the groundwater slope (0.19%) as determined from piezometer data and site surveys. The elevation of the channel invert (base) at the outlet was selected to achieve sufficient depth while taking into account the extent of backwater influence from the Lewis River. A more detailed discussion of the hydraulic analysis used to determine channel geometry is included above in the Hydraulics – Proposed chum channel section.

Cross-section

Channel cross-section dimensions were determined through consideration of channel hydraulics, achieving habitat criteria, providing for bank stability, and for allowing growth of native riparian vegetation. Channel width varies 10 to 12 to 14 feet based on achieving the maximum width while still accomplishing depth criteria. Channel banks have near vertical sides of 2-3 feet height, and are held in place by logs laid parallel to the banks and fastened to log pilings buried vertically behind them. These toe logs are designed to prevent erosion and sloughing of the channel banks that can contribute fine sediment into the channel, and will be keyed into the streambed to prevent undermining by spawning fish. The toe logs will be backfilled with native river gravel acquired from site excavations to further reduce the potential for introduction of fine sediment. Above the vertical toe logs the banks are sloped back to a stable grade in order to facilitate establishment of riparian vegetation. The upper bank slope will be 2:1 with some variation based on matching existing topography and to accommodate existing trees.

Control weirs

The design includes three cross-channel control weirs that allow for operational flexibility to control channel gradient and hydraulics, as well as to allow for fish sampling. The most downstream weir is located 353 feet upstream from the channel outlet and is designed to accommodate attachment of a fyke net for capturing and sampling juvenile fish. Two other weirs are spaced along the length of the channel primarily as a means to regulate channel velocity and depth. Weirs will be constructed of sheet piles driven into the bed with a notched spillway set at the channel invert elevation. Flash boards can be installed for stage regulation, or screens can be installed to prevent fish passage. These weirs will provide the operational flexibility to ensure that channel depths and velocities are suitable to support chum spawning, incubation, and juvenile rearing for a broad range of flow conditions.

Channel bed substrate

Channel bed substrate of the appropriate size for chum spawning will be placed in the channel. The gravel mix will generally match the gravel sizes specified for spawning channels by Bell (1990) (Table 8). The specific mix, which is included in Table 9, has been developed and used with success over time by WDFW in other chum spawning channels.

Table 9. Spawning gravel mix.

Diameter of Gravel	Percent by Volume
4 – 6 Inch Rock	2
2.5 – 4 Inch Rock	13
1 – 2.5 Inch Rock	35
3/4 -1 Inch Rock	35
3/8 -3/4 Inch Rock	10
No. 4 – 3/8 Inch Rock	5
No 10 – No 4 Material	0

Riparian planting

Riparian areas along the channel margin will be planted with native trees and shrubs in order to provide for long-term riparian functions and habitat. Woody riparian plantings will begin 5 feet from the channel edge in order to allow for ease of access to the channel for monitoring and maintenance activities. Existing open areas to be utilized for construction and material staging will be planted with upland coniferous tree species. Other disturbed areas (e.g. access roads) will be planted with an erosion control seed mix.

Channel stability and flood protection

Streambank stability within the chum channel is provided by the log toe construction. Upper banks will be protected via bank sloping and planting of woody riparian species. Stability along the mainstem Lewis River at the location of the infiltration gallery will be provided by a rock toe and large wood placements.. Logs and woody debris will be placed on the floodplain between the river and the constructed channel at the upstream end of the project area in order to provide hydraulic roughness in an area that will receive considerable disturbance to the existing vegetation conditions during construction. This floodplain roughness will help to limit the volume and erosive energy of flood flow entering the new channel.

Supplemental flow design

In order to ensure adequate flow conditions during the spawning, egg incubation, and early rearing periods, flow supplementation will be provided by drawing water from near the Lewis River. Flow supplementation was included because pump test results indicate that groundwater inputs will be less than needed to fully achieve habitat criteria (depth, velocity, width). The current design for flow supplementation includes an infiltration gallery water collection system located along the bank of the Lewis River near the upstream end of the project site. This system will collect and transmit water into the head of the spawning channel. Additionally, a control valve in the system will provide operational flexibility by regulating the flow rate into the channel, or shutting off flow if necessary. Furthermore, the supplemental flow system could also provide flushing flows for periodic channel maintenance (e.g. to flush fines from the channel or to scour vegetation).

The flow supplementation system will be composed of slotted pipe well screen. The well screen will be 16" PVC pipe with 0.125" wide slots spaced 0.25" apart to provide 133 sq-in open area per foot of pipe. The well screens will be installed near the riverbank. To improve transmission of water

toward the well screen, the pipe will be surrounded by a blanket of drain rock. To provide erosion protection, the river bank soils will be replaced by erosion protection stone. Two 80' lengths of well screen will be installed to provide up to 7 cfs. The well screens will manifold at a 24" tee and flow through HDPE-S conveyance pipe to the head of the new channel. The pipe outlet will be fitted with a gate valve. A trash rack installed at the pipe outlet will prevent fish from entering the pipe. Riprap will be wrapped around the end of the channel at the pipe outlet zone to protect banks from scour and to create a small energy dissipation pool. A cleanout stand pipe will be installed to provide a back flush maintenance point in case the drain rock and well screen eventually become clogged by sediment.

A riverbank log structure installed over the top of the well screen area will provide additional erosion protection and create mainstem river habitat to replace trees removed for the well screen installation.

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ATTACHMENT 1

2D Hydraulic Model Graphical Outputs & HEC-RAS Tabular Outputs

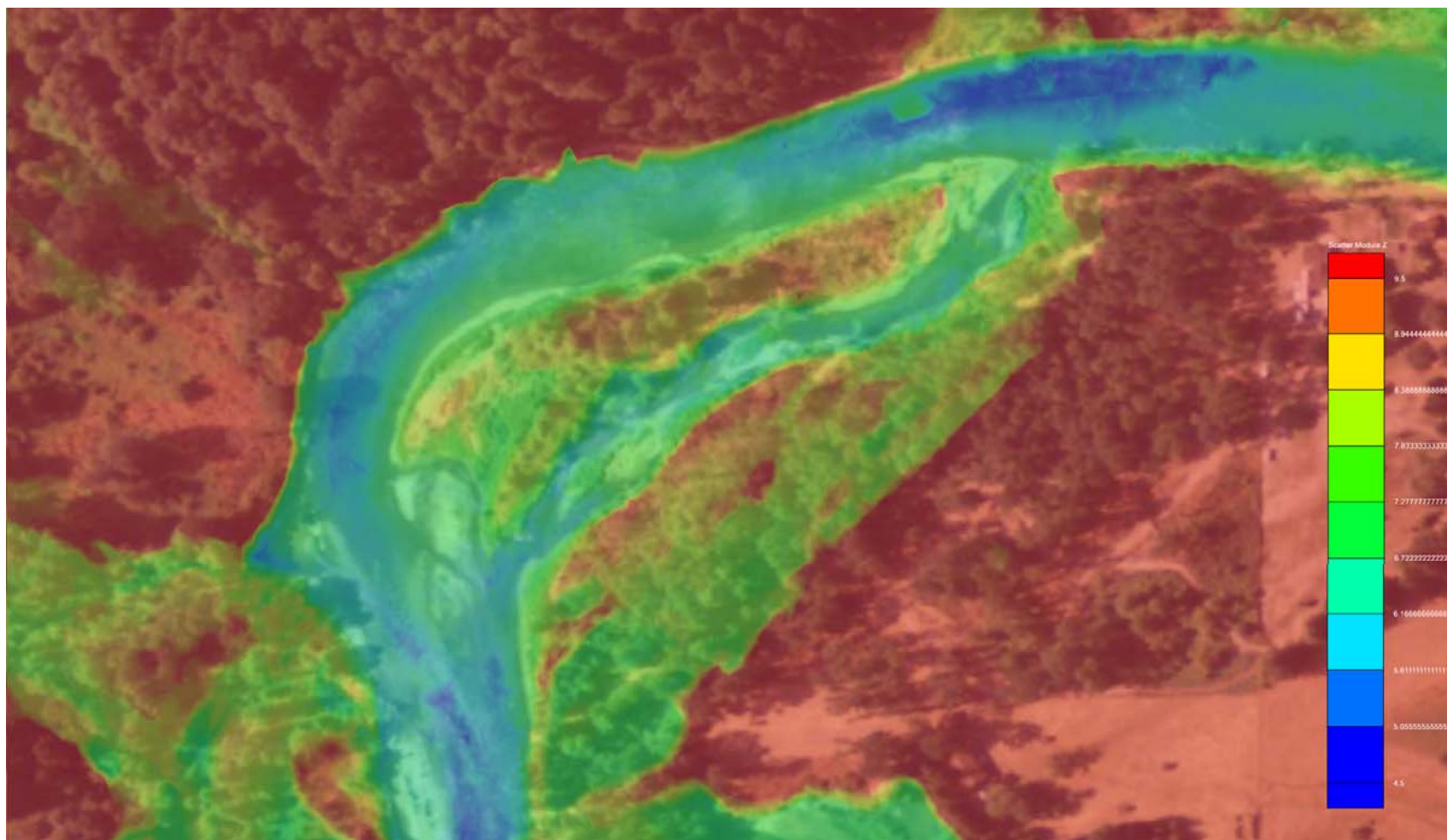


Figure 16. Existing Topography (m). Preliminary.

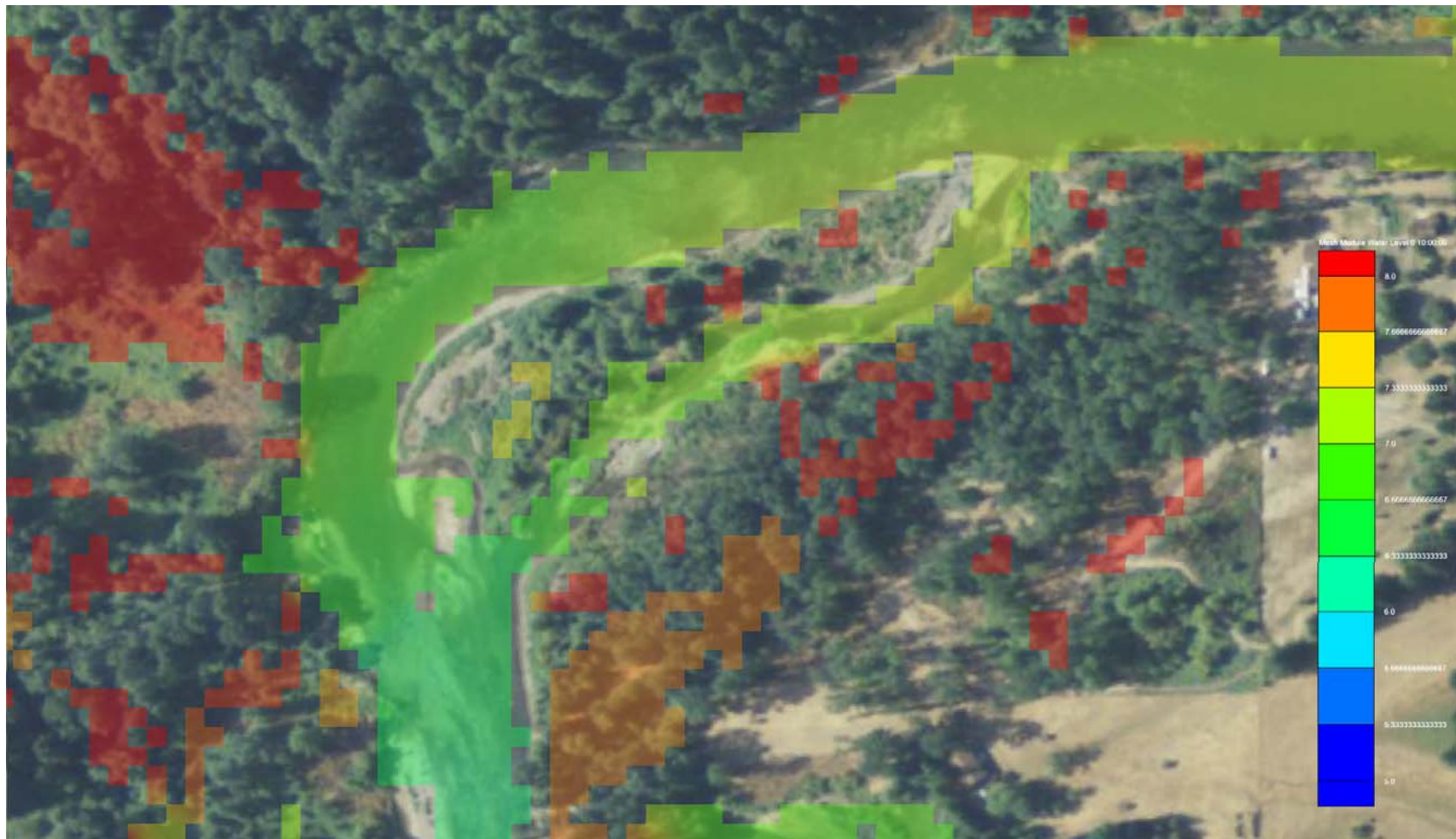


Figure 17. Low flow – water surface elevation (WSE) (m). Preliminary.

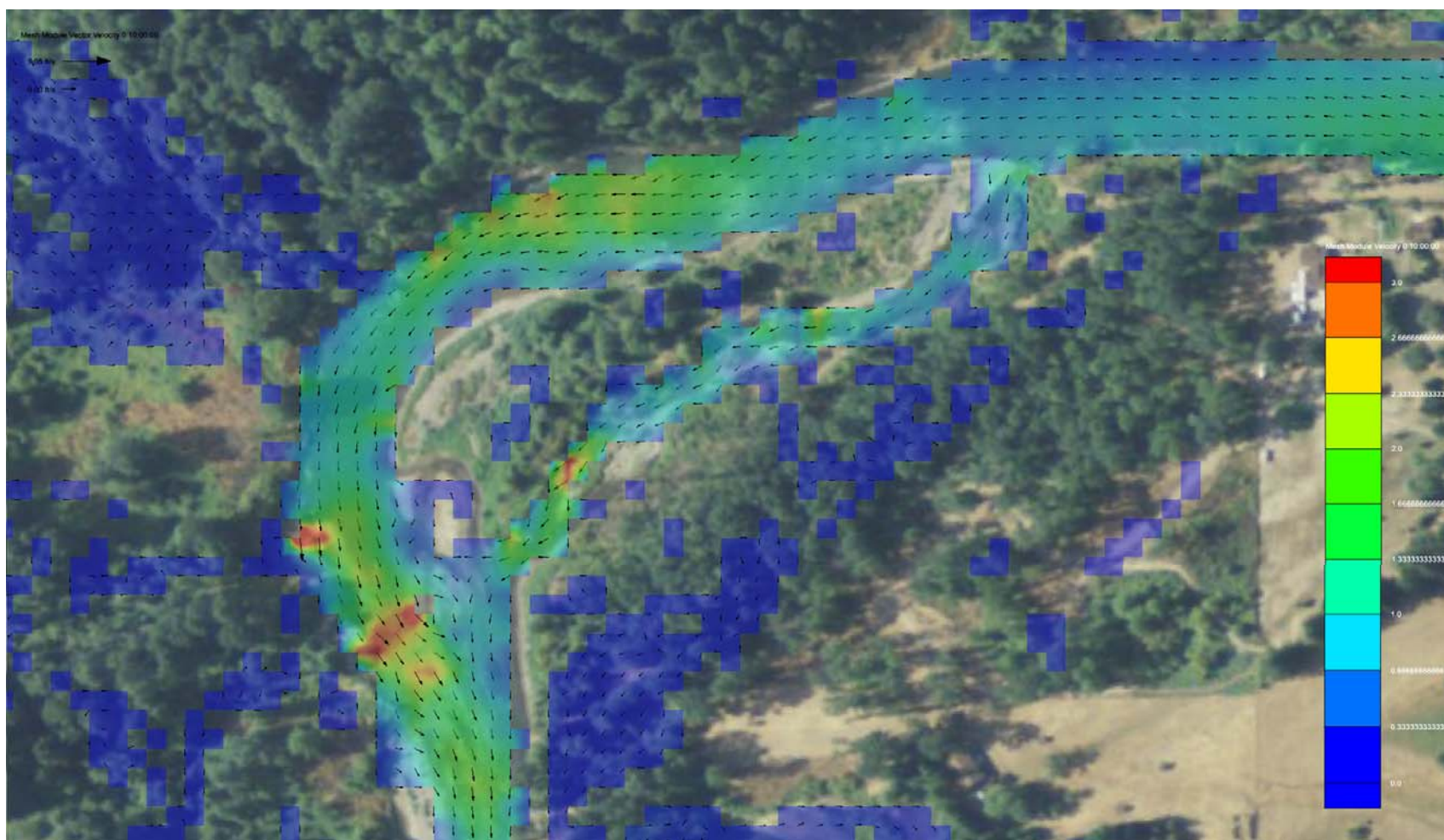


Figure 18. Low flow, Velocity (m/s). Preliminary.

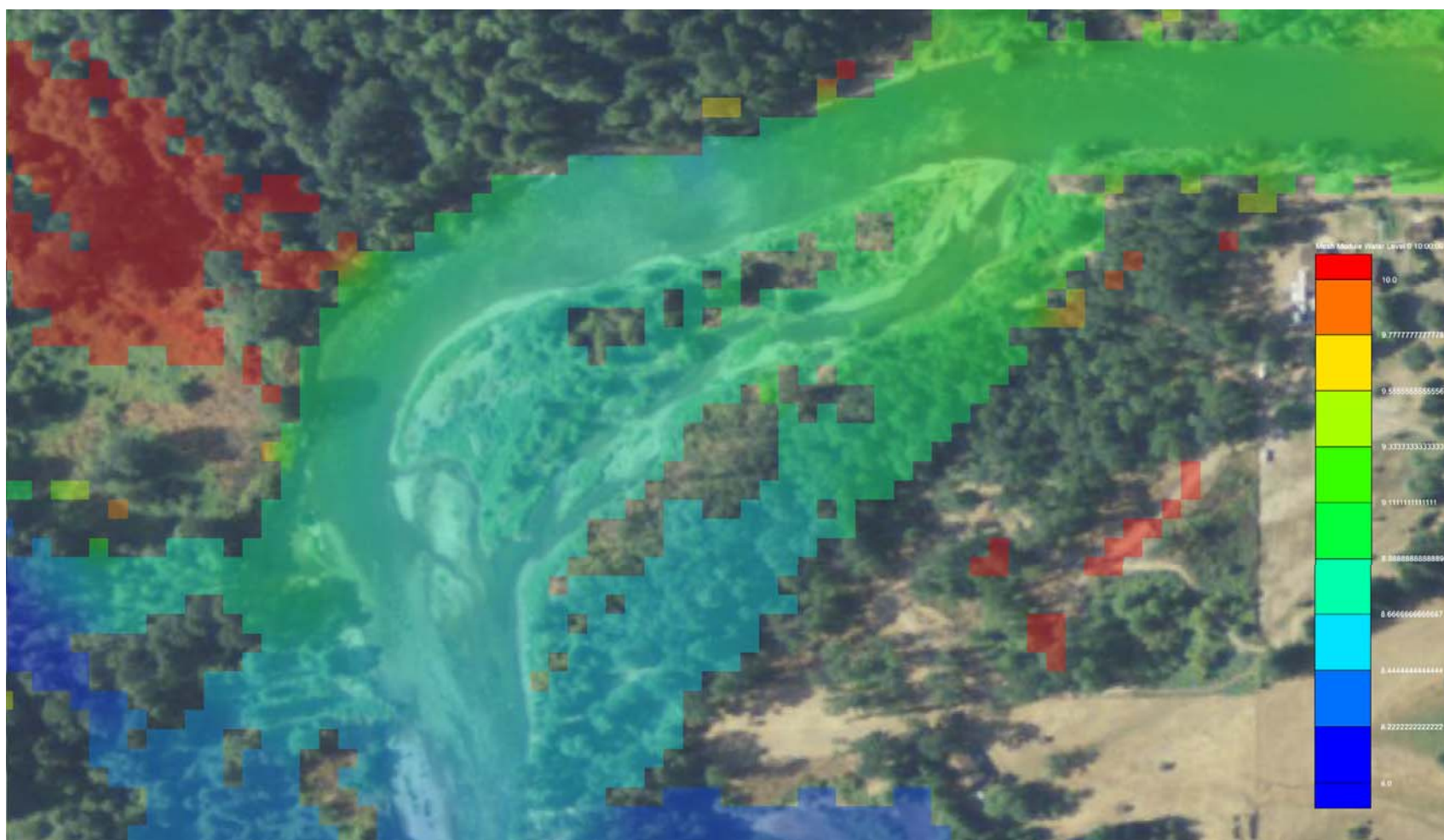


Figure 19. 2-yr flow, WSE (m). Preliminary

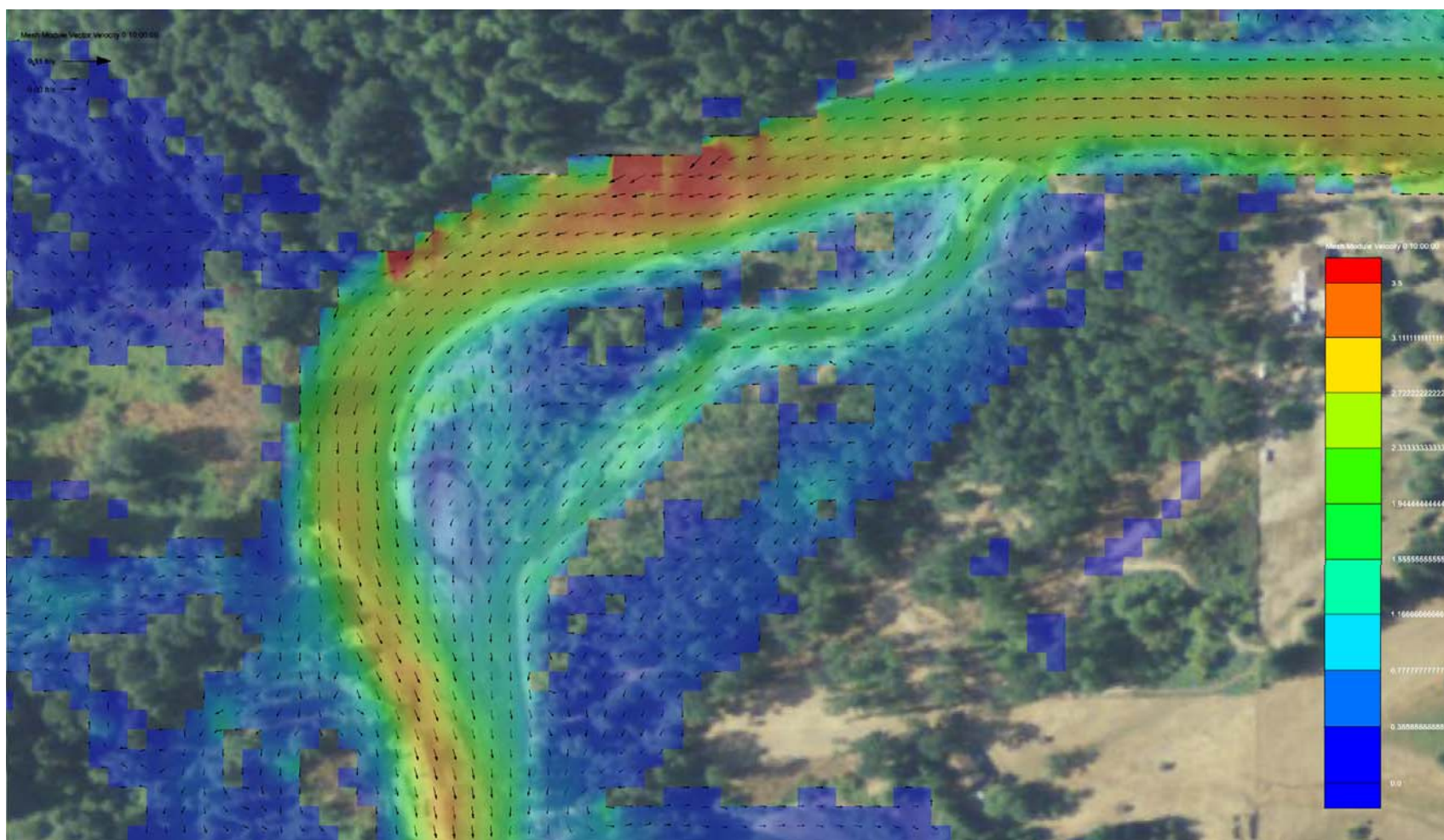


Figure 20. 2-yr flow, velocity (m/s). Preliminary.

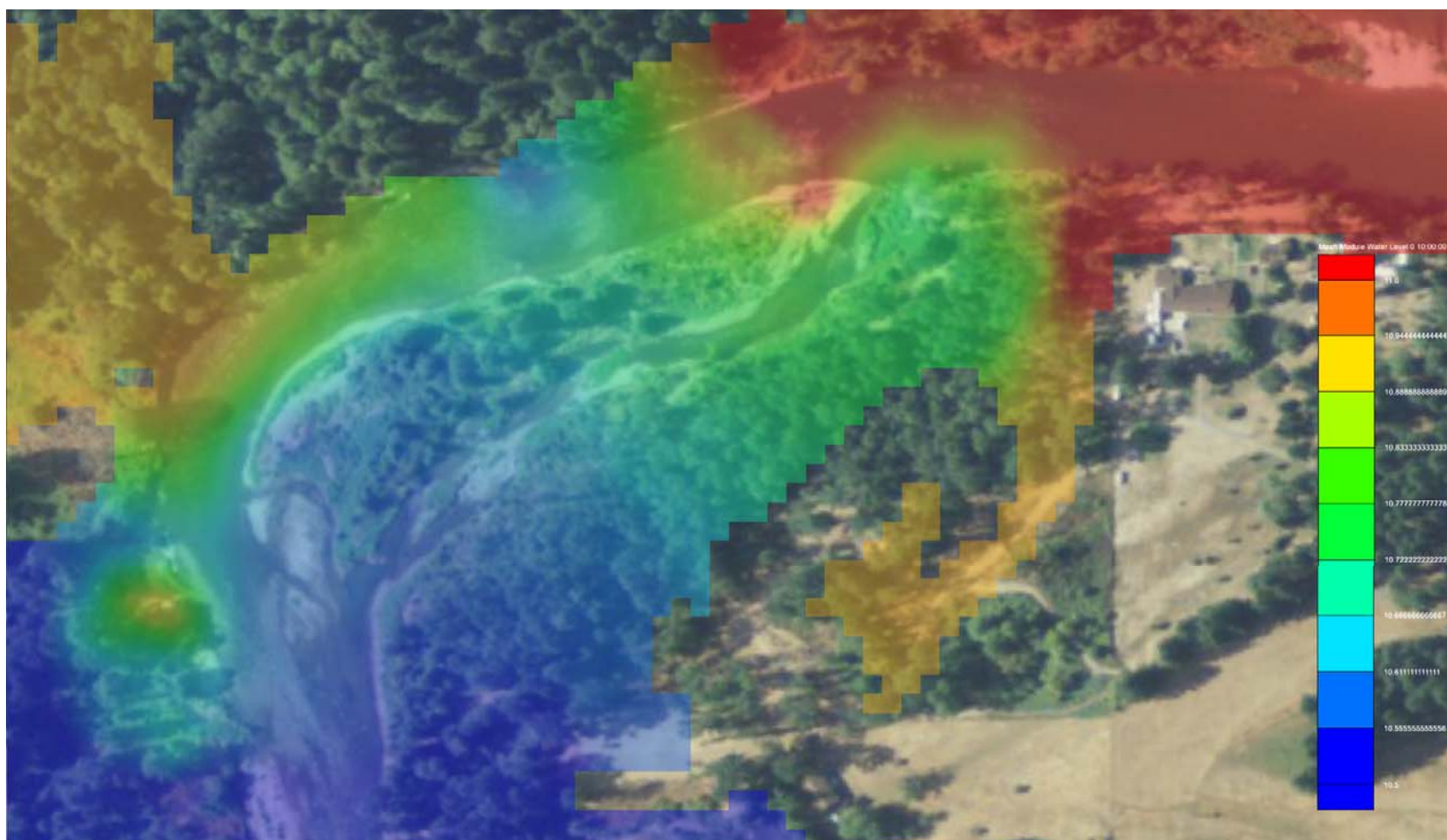


Figure 21. 10-yr flow, WSE (m). Preliminary.

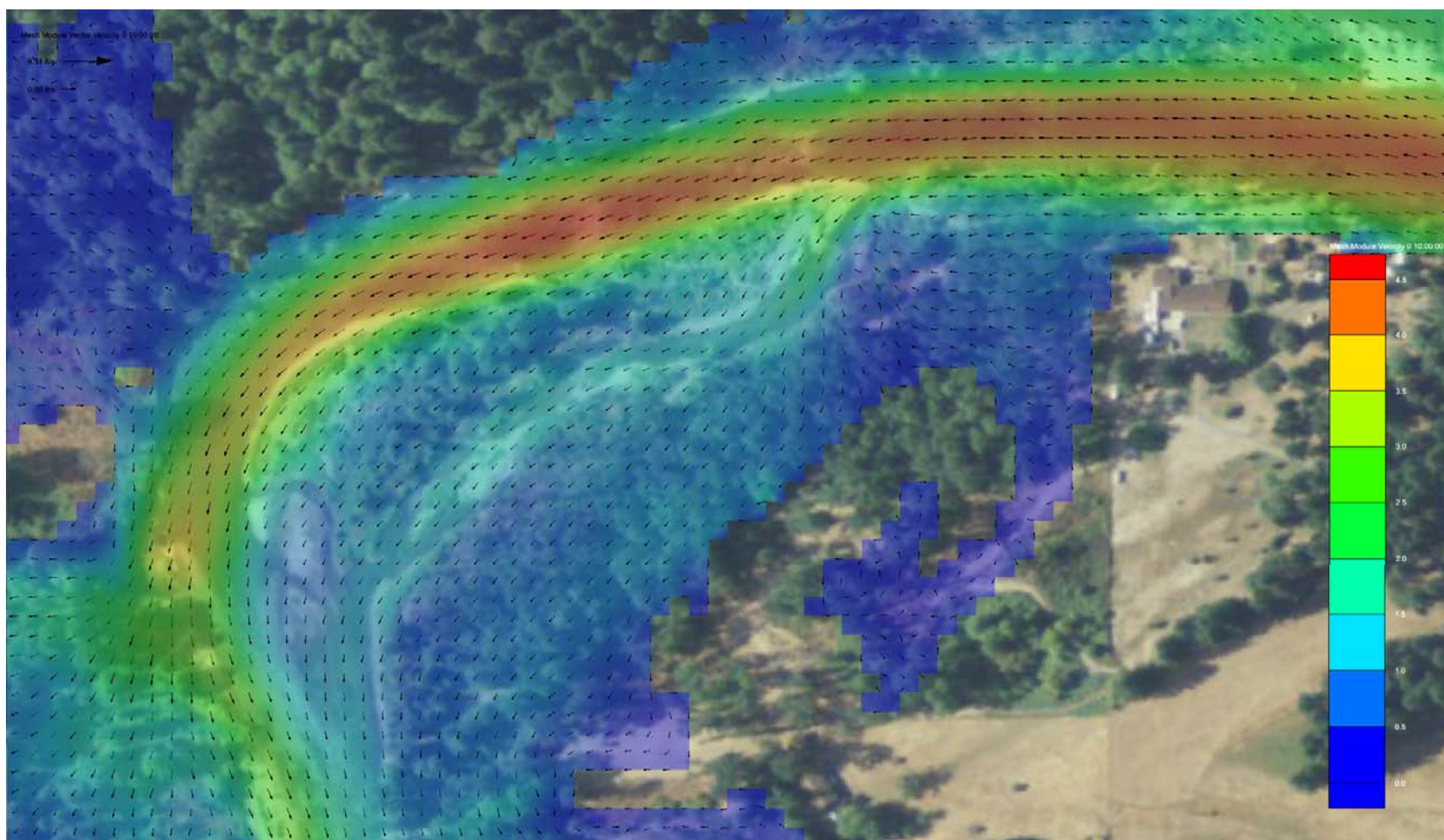


Figure 22. 10-yr flow, velocity (m/s). Preliminary.

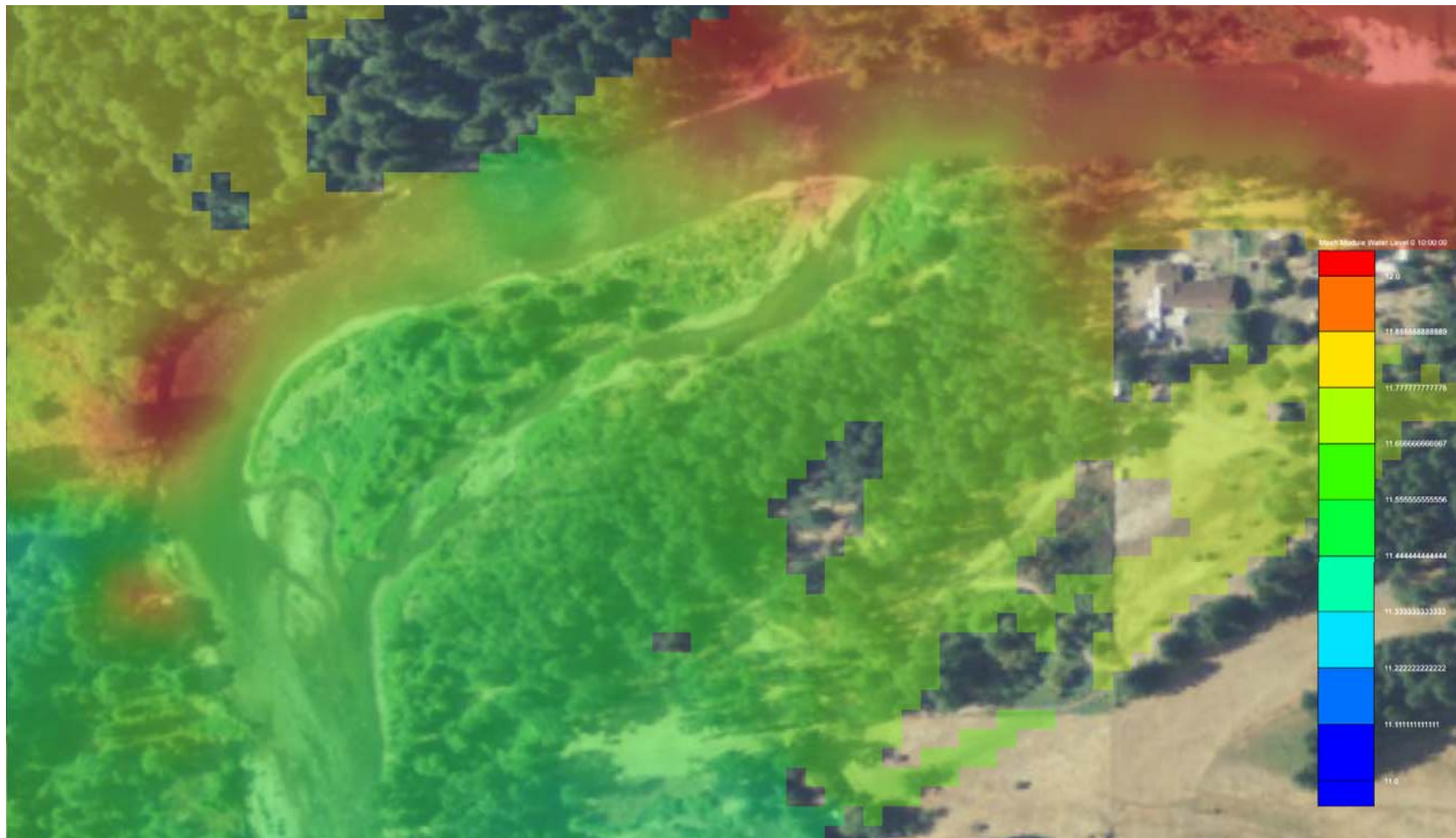


Figure 23. 50-yr flow, WSE (m). Preliminary.

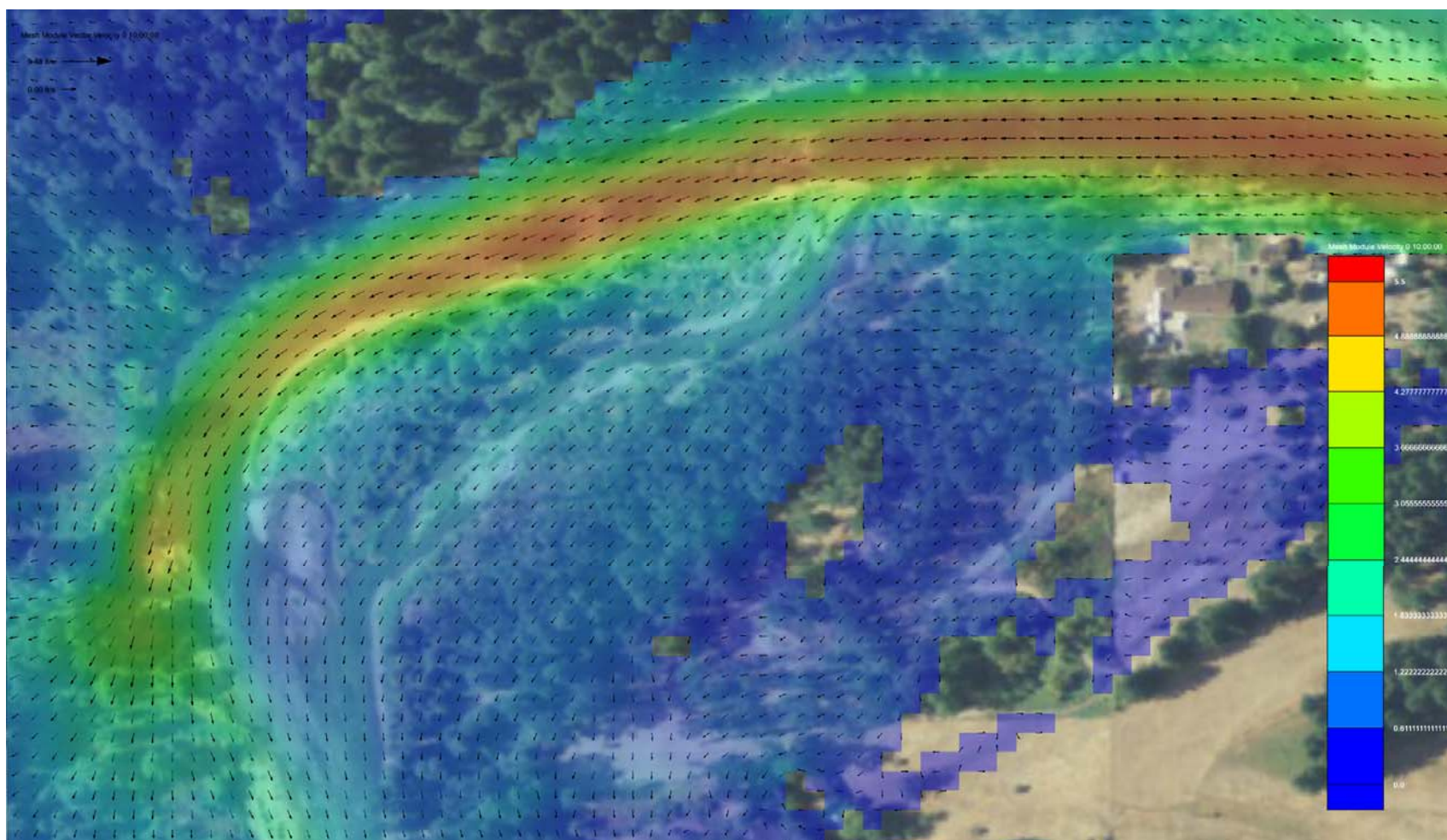


Figure 24. 50-yr flow, velocity (m/s). Preliminary.

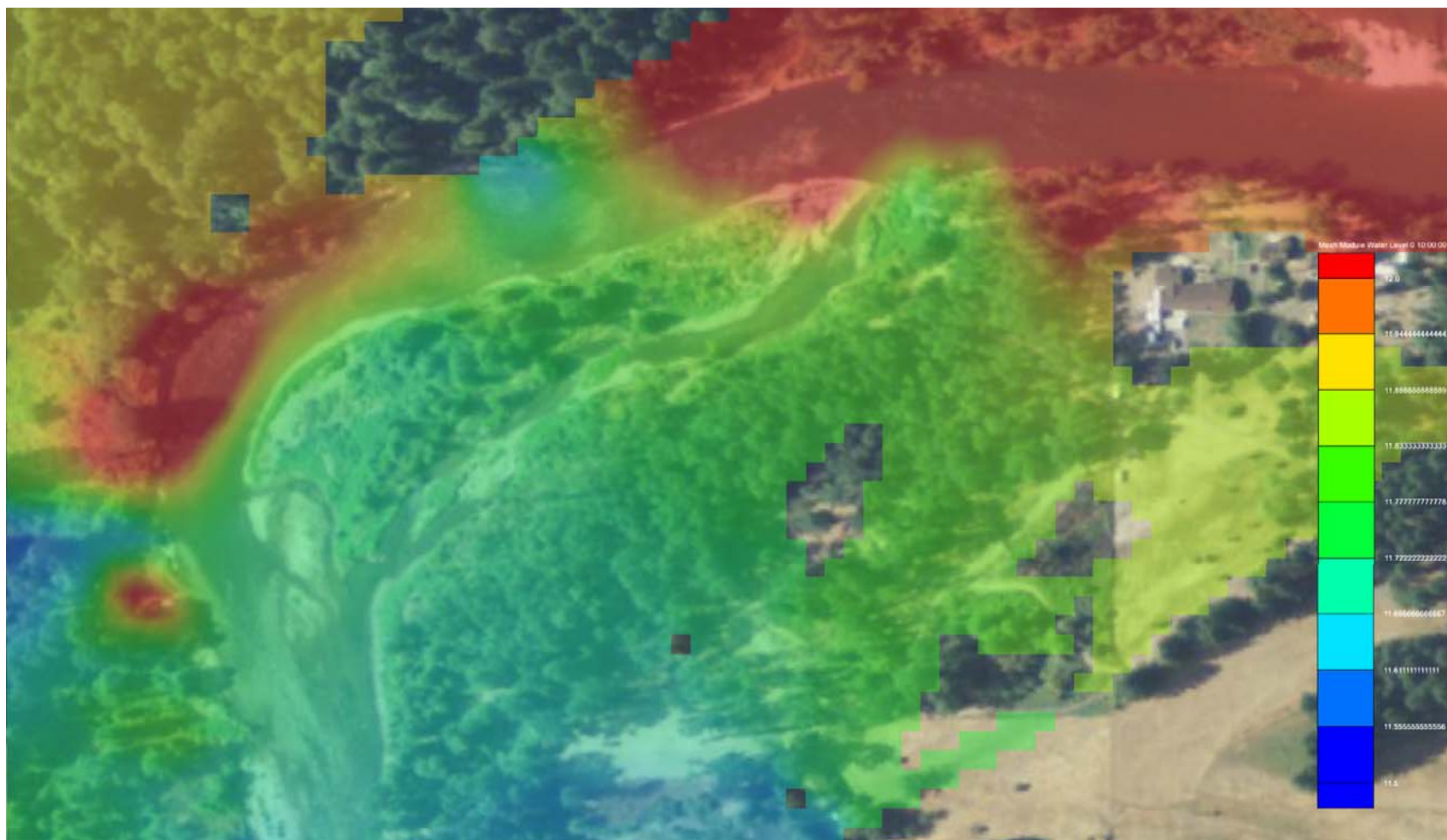


Figure 25. 100-yr flow, WSE (m). Preliminary.

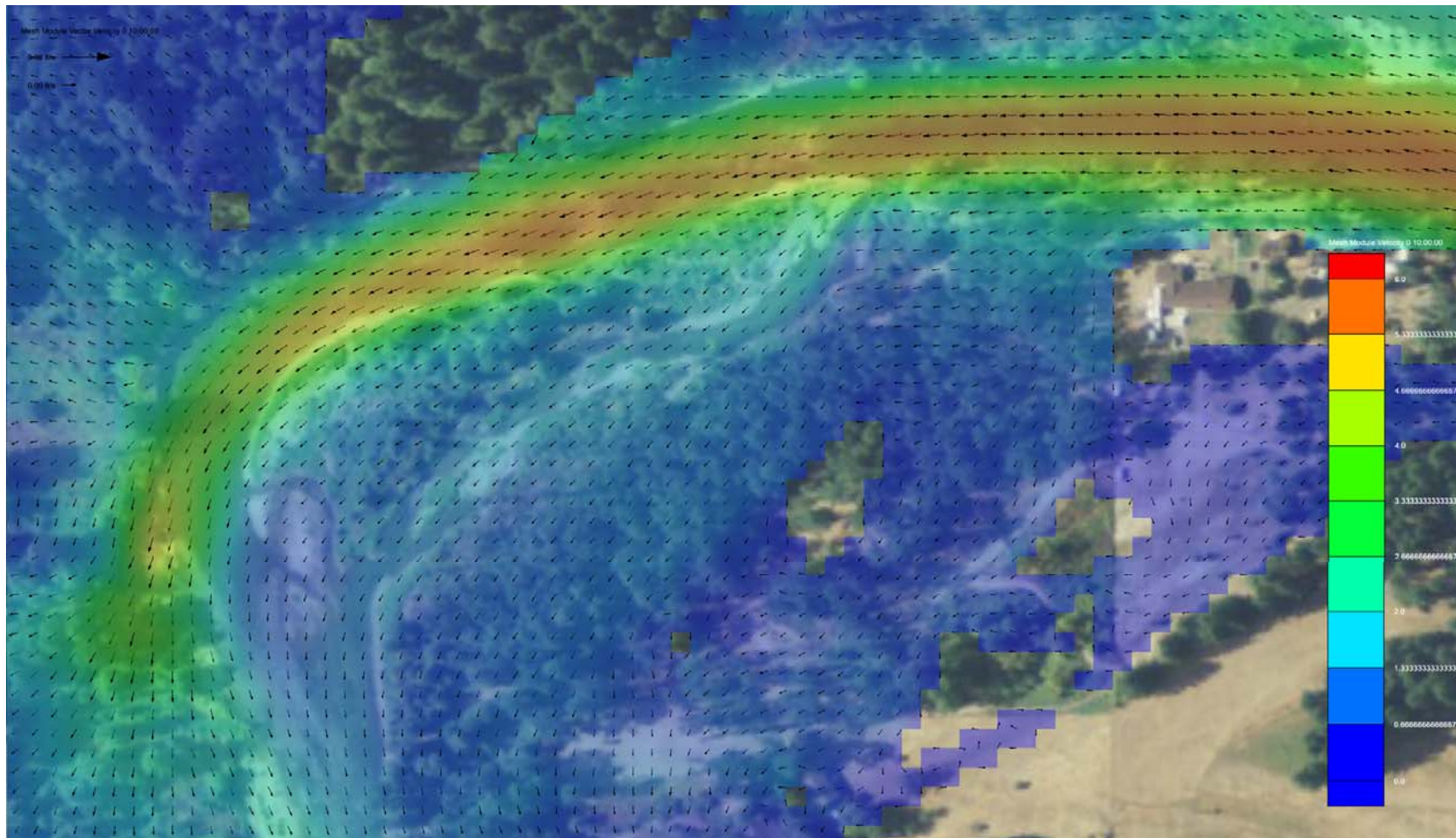


Figure 26. 100-yr flow, velocity (m/s). Preliminary

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_2000c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.73	22.20	22.74	0.000464	0.68	7.35	10.02	0.14	0.01856
cl4	1300	PF 1	5.00	21.97	22.71		22.72	0.000449	0.67	7.43	10.02	0.14	0.01814
cl4	1250	PF 1	5.00	21.94	22.69		22.70	0.000434	0.67	7.51	10.02	0.14	0.01768
cl4	1200	PF 1	5.00	21.91	22.67		22.68	0.000417	0.66	7.61	10.02	0.13	0.01719
cl4	1150	PF 1	5.00	21.88	22.65		22.66	0.000400	0.65	7.70	10.02	0.13	0.01669
cl4	1100	PF 1	6.00	21.85	22.62		22.63	0.000571	0.78	7.73	10.01	0.16	0.02385
cl4	1050	PF 1	6.00	21.82	22.59		22.60	0.000567	0.77	7.74	10.01	0.16	0.02376
cl4	1029.18	PF 1	6.00	21.81	22.58	22.03	22.59	0.000566	0.77	7.75	10.04	0.16	0.02370
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.54		22.55	0.000497	0.72	8.34	11.09	0.15	0.02058
cl4	950	PF 1	6.00	21.76	22.52		22.53	0.000401	0.66	9.15	12.05	0.13	0.01695
cl4	900	PF 1	6.00	21.73	22.50		22.51	0.000384	0.65	9.28	12.05	0.13	0.01642
cl4	850	PF 1	6.00	21.70	22.48		22.49	0.000366	0.64	9.42	12.05	0.13	0.01587
cl4	800	PF 1	7.00	21.67	22.46		22.47	0.000485	0.74	9.50	12.05	0.15	0.02119
cl4	750	PF 1	7.00	21.64	22.44		22.44	0.000473	0.73	9.58	12.05	0.14	0.02080
cl4	700	PF 1	7.00	21.61	22.41		22.42	0.000460	0.72	9.66	12.05	0.14	0.02040
cl4	650	PF 1	7.00	21.58	22.39		22.40	0.000448	0.72	9.74	12.03	0.14	0.01999
cl4	600	PF 1	7.00	21.55	22.37		22.38	0.000432	0.71	9.85	12.05	0.14	0.01949
cl4	550	PF 1	8.00	21.52	22.34		22.35	0.000558	0.81	9.89	12.06	0.16	0.02523
cl4	500	PF 1	8.00	21.49	22.31		22.32	0.000553	0.81	9.92	12.05	0.16	0.02508
cl4	450	PF 1	8.00	21.46	22.29		22.30	0.000548	0.80	9.95	12.06	0.16	0.02491
cl4	400	PF 1	8.00	21.43	22.26		22.27	0.000541	0.80	9.98	12.05	0.16	0.02470
cl4	351.51	PF 1	8.00	21.40	22.24	21.62	22.25	0.000395	0.70	11.51	13.77	0.13	0.01845
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.08		22.09	0.000767	0.85	9.37	13.84	0.18	0.02962
cl4	300	PF 1	8.00	21.37	22.04		22.05	0.000773	0.85	9.40	14.05	0.18	0.02956
cl4	250	PF 1	8.00	21.34	22.00		22.01	0.000809	0.86	9.27	14.04	0.19	0.03053
cl4	200	PF 1	9.00	21.31	21.95		21.96	0.001146	1.01	8.95	14.04	0.22	0.04190
cl4	150	PF 1	9.00	21.28	21.88		21.90	0.001369	1.06	8.47	14.04	0.24	0.04759
cl4	100	PF 1	9.00	21.25	21.80	21.48	21.82	0.001843	1.17	7.72	14.04	0.28	0.05884
cl4	50	PF 1	9.00	21.22	21.45	21.45	21.57	0.030583	2.75	3.27	14.02	1.01	0.43132

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_2500c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.73	22.20	22.74	0.000464	0.68	7.35	10.02	0.14	0.01856
cl4	1300	PF 1	5.00	21.97	22.71		22.72	0.000449	0.67	7.43	10.02	0.14	0.01814
cl4	1250	PF 1	5.00	21.94	22.69		22.70	0.000434	0.67	7.51	10.02	0.14	0.01768
cl4	1200	PF 1	5.00	21.91	22.67		22.68	0.000417	0.66	7.61	10.02	0.13	0.01719
cl4	1150	PF 1	5.00	21.88	22.65		22.66	0.000400	0.65	7.70	10.02	0.13	0.01669
cl4	1100	PF 1	6.00	21.85	22.62		22.63	0.000571	0.78	7.73	10.01	0.16	0.02385
cl4	1050	PF 1	6.00	21.82	22.59		22.60	0.000567	0.77	7.74	10.01	0.16	0.02376
cl4	1029.18	PF 1	6.00	21.81	22.58	22.03	22.59	0.000566	0.77	7.75	10.04	0.16	0.02370
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.54		22.55	0.000497	0.72	8.34	11.09	0.15	0.02058
cl4	950	PF 1	6.00	21.76	22.52		22.53	0.000401	0.66	9.15	12.05	0.13	0.01695
cl4	900	PF 1	6.00	21.73	22.50		22.51	0.000384	0.65	9.28	12.05	0.13	0.01642
cl4	850	PF 1	6.00	21.70	22.48		22.49	0.000366	0.64	9.42	12.05	0.13	0.01587
cl4	800	PF 1	7.00	21.67	22.46		22.47	0.000485	0.74	9.50	12.05	0.15	0.02119
cl4	750	PF 1	7.00	21.64	22.44		22.44	0.000473	0.73	9.58	12.05	0.14	0.02080
cl4	700	PF 1	7.00	21.61	22.41		22.42	0.000460	0.72	9.66	12.05	0.14	0.02040
cl4	650	PF 1	7.00	21.58	22.39		22.40	0.000448	0.72	9.74	12.03	0.14	0.01999
cl4	600	PF 1	7.00	21.55	22.37		22.38	0.000432	0.71	9.85	12.05	0.14	0.01949
cl4	550	PF 1	8.00	21.52	22.34		22.35	0.000558	0.81	9.89	12.06	0.16	0.02523
cl4	500	PF 1	8.00	21.49	22.31		22.32	0.000553	0.81	9.92	12.05	0.16	0.02508
cl4	450	PF 1	8.00	21.46	22.29		22.30	0.000548	0.80	9.95	12.06	0.16	0.02491
cl4	400	PF 1	8.00	21.43	22.26		22.27	0.000541	0.80	9.98	12.05	0.16	0.02470
cl4	351.51	PF 1	8.00	21.40	22.24	21.62	22.25	0.000395	0.70	11.51	13.77	0.13	0.01845
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.08		22.09	0.000767	0.85	9.37	13.84	0.18	0.02962
cl4	300	PF 1	8.00	21.37	22.04		22.05	0.000773	0.85	9.40	14.05	0.18	0.02956
cl4	250	PF 1	8.00	21.34	22.00		22.01	0.000809	0.86	9.27	14.04	0.19	0.03053
cl4	200	PF 1	9.00	21.31	21.95		21.96	0.001146	1.01	8.95	14.04	0.22	0.04190
cl4	150	PF 1	9.00	21.28	21.88		21.90	0.001369	1.06	8.47	14.04	0.24	0.04759
cl4	100	PF 1	9.00	21.25	21.80	21.48	21.82	0.001843	1.17	7.72	14.04	0.28	0.05884
cl4	50	PF 1	9.00	21.22	21.45	21.45	21.57	0.030583	2.75	3.27	14.02	1.01	0.43132

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_4200c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.73	22.20	22.74	0.000464	0.68	7.35	10.02	0.14	0.01858
cl4	1300	PF 1	5.00	21.97	22.71		22.72	0.000450	0.67	7.43	10.02	0.14	0.01816
cl4	1250	PF 1	5.00	21.94	22.69		22.70	0.000434	0.67	7.51	10.02	0.14	0.01770
cl4	1200	PF 1	5.00	21.91	22.67		22.68	0.000418	0.66	7.60	10.02	0.13	0.01721
cl4	1150	PF 1	5.00	21.88	22.65		22.66	0.000401	0.65	7.70	10.02	0.13	0.01671
cl4	1100	PF 1	6.00	21.85	22.62		22.63	0.000572	0.78	7.72	10.01	0.16	0.02389
cl4	1050	PF 1	6.00	21.82	22.59		22.60	0.000569	0.78	7.74	10.01	0.16	0.02380
cl4	1029.18	PF 1	6.00	21.81	22.58	22.03	22.59	0.000568	0.77	7.75	10.04	0.16	0.02374
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.54		22.55	0.000499	0.72	8.33	11.09	0.15	0.02062
cl4	950	PF 1	6.00	21.76	22.52		22.53	0.000402	0.66	9.14	12.05	0.13	0.01699
cl4	900	PF 1	6.00	21.73	22.50		22.51	0.000385	0.65	9.27	12.05	0.13	0.01645
cl4	850	PF 1	6.00	21.70	22.48		22.49	0.000367	0.64	9.41	12.05	0.13	0.01591
cl4	800	PF 1	7.00	21.67	22.46		22.47	0.000487	0.74	9.49	12.05	0.15	0.02124
cl4	750	PF 1	7.00	21.64	22.44		22.44	0.000475	0.73	9.56	12.05	0.14	0.02086
cl4	700	PF 1	7.00	21.61	22.41		22.42	0.000462	0.73	9.65	12.05	0.14	0.02046
cl4	650	PF 1	7.00	21.58	22.39		22.40	0.000450	0.72	9.73	12.03	0.14	0.02006
cl4	600	PF 1	7.00	21.55	22.37		22.38	0.000434	0.71	9.84	12.05	0.14	0.01956
cl4	550	PF 1	8.00	21.52	22.34		22.35	0.000561	0.81	9.87	12.06	0.16	0.02533
cl4	500	PF 1	8.00	21.49	22.31		22.32	0.000556	0.81	9.90	12.05	0.16	0.02519
cl4	450	PF 1	8.00	21.46	22.29		22.30	0.000551	0.81	9.92	12.06	0.16	0.02503
cl4	400	PF 1	8.00	21.43	22.26		22.27	0.000545	0.80	9.96	12.05	0.16	0.02483
cl4	351.51	PF 1	8.00	21.40	22.24	21.62	22.24	0.000398	0.70	11.48	13.77	0.13	0.01856
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.10		22.11	0.000684	0.82	9.71	13.84	0.17	0.02728
cl4	300	PF 1	8.00	21.37	22.07		22.08	0.000674	0.82	9.81	14.05	0.17	0.02678
cl4	250	PF 1	8.00	21.34	22.04		22.05	0.000686	0.82	9.75	14.05	0.17	0.02713
cl4	200	PF 1	9.00	21.31	21.99		22.01	0.000924	0.94	9.57	14.04	0.20	0.03590
cl4	150	PF 1	9.00	21.28	21.94		21.96	0.001011	0.97	9.30	14.04	0.21	0.03831
cl4	100	PF 1	9.00	21.25	21.89		21.90	0.001145	1.01	8.95	14.05	0.22	0.04188
cl4	50	PF 1	9.00	21.22	21.84	21.45	21.85	0.000921	0.89	15.13	35.11	0.20	0.03281

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_5000c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.74	22.20	22.75	0.000444	0.67	7.45	10.02	0.14	0.01800
cl4	1300	PF 1	5.00	21.97	22.72		22.73	0.000429	0.66	7.54	10.02	0.13	0.01754
cl4	1250	PF 1	5.00	21.94	22.70		22.71	0.000412	0.66	7.63	10.02	0.13	0.01705
cl4	1200	PF 1	5.00	21.91	22.68		22.69	0.000395	0.65	7.73	10.02	0.13	0.01654
cl4	1150	PF 1	5.00	21.88	22.66		22.67	0.000379	0.64	7.84	10.02	0.13	0.01603
cl4	1100	PF 1	6.00	21.85	22.64		22.65	0.000537	0.76	7.88	10.01	0.15	0.02281
cl4	1050	PF 1	6.00	21.82	22.61		22.62	0.000530	0.76	7.92	10.01	0.15	0.02259
cl4	1029.18	PF 1	6.00	21.81	22.60	22.03	22.61	0.000527	0.76	7.93	10.04	0.15	0.02248
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.56		22.57	0.000461	0.70	8.54	11.09	0.14	0.01950
cl4	950	PF 1	6.00	21.76	22.54		22.55	0.000370	0.64	9.39	12.05	0.13	0.01600
cl4	900	PF 1	6.00	21.73	22.52		22.53	0.000352	0.63	9.54	12.05	0.12	0.01543
cl4	850	PF 1	6.00	21.70	22.51		22.51	0.000334	0.62	9.69	12.05	0.12	0.01486
cl4	800	PF 1	7.00	21.67	22.48		22.49	0.000440	0.71	9.80	12.05	0.14	0.01974
cl4	750	PF 1	7.00	21.64	22.46		22.47	0.000425	0.71	9.90	12.05	0.14	0.01926
cl4	700	PF 1	7.00	21.61	22.44		22.45	0.000410	0.70	10.02	12.05	0.14	0.01877
cl4	650	PF 1	7.00	21.58	22.42		22.43	0.000396	0.69	10.13	12.03	0.13	0.01829
cl4	600	PF 1	7.00	21.55	22.40		22.41	0.000379	0.68	10.27	12.05	0.13	0.01773
cl4	550	PF 1	8.00	21.52	22.38		22.39	0.000483	0.77	10.35	12.06	0.15	0.02274
cl4	500	PF 1	8.00	21.49	22.36		22.37	0.000472	0.77	10.42	12.06	0.15	0.02237
cl4	450	PF 1	8.00	21.46	22.33		22.34	0.000460	0.76	10.51	12.06	0.14	0.02197
cl4	400	PF 1	8.00	21.43	22.31		22.32	0.000448	0.75	10.60	12.06	0.14	0.02153
cl4	351.51	PF 1	8.00	21.40	22.29	21.62	22.30	0.000323	0.65	12.26	13.77	0.12	0.01594
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.22		22.22	0.000424	0.71	11.28	13.84	0.14	0.01935
cl4	300	PF 1	8.00	21.37	22.20		22.20	0.000395	0.69	11.59	14.06	0.13	0.01825
cl4	250	PF 1	8.00	21.34	22.18		22.18	0.000379	0.68	11.74	14.06	0.13	0.01771
cl4	200	PF 1	9.00	21.31	22.15		22.16	0.000467	0.76	11.84	14.06	0.15	0.02199
cl4	150	PF 1	9.00	21.28	22.13		22.14	0.000454	0.75	11.94	14.06	0.14	0.02157
cl4	100	PF 1	9.00	21.25	22.11		22.12	0.000440	0.75	12.06	14.06	0.14	0.02108
cl4	50	PF 1	9.00	21.22	22.10	21.45	22.10	0.000260	0.58	24.12	35.25	0.11	0.01267

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_5500c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.76	22.20	22.77	0.000414	0.66	7.63	10.02	0.13	0.01709
cl4	1300	PF 1	5.00	21.97	22.74		22.75	0.000397	0.65	7.72	10.02	0.13	0.01660
cl4	1250	PF 1	5.00	21.94	22.72		22.73	0.000380	0.64	7.83	10.02	0.13	0.01608
cl4	1200	PF 1	5.00	21.91	22.70		22.71	0.000363	0.63	7.95	10.02	0.12	0.01553
cl4	1150	PF 1	5.00	21.88	22.69		22.69	0.000345	0.62	8.07	10.02	0.12	0.01499
cl4	1100	PF 1	6.00	21.85	22.66		22.67	0.000485	0.74	8.14	10.01	0.14	0.02121
cl4	1050	PF 1	6.00	21.82	22.64		22.65	0.000474	0.73	8.20	10.01	0.14	0.02085
cl4	1029.18	PF 1	6.00	21.81	22.63	22.03	22.64	0.000469	0.73	8.23	10.04	0.14	0.02068
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.59		22.60	0.000406	0.67	8.89	11.10	0.13	0.01776
cl4	950	PF 1	6.00	21.76	22.58		22.58	0.000323	0.61	9.80	12.05	0.12	0.01448
cl4	900	PF 1	6.00	21.73	22.56		22.57	0.000305	0.60	9.98	12.05	0.12	0.01390
cl4	850	PF 1	6.00	21.70	22.55		22.55	0.000287	0.59	10.17	12.06	0.11	0.01333
cl4	800	PF 1	7.00	21.67	22.53		22.53	0.000375	0.68	10.31	12.06	0.13	0.01758
cl4	750	PF 1	7.00	21.64	22.51		22.52	0.000359	0.67	10.45	12.06	0.13	0.01703
cl4	700	PF 1	7.00	21.61	22.49		22.50	0.000343	0.66	10.60	12.06	0.12	0.01648
cl4	650	PF 1	7.00	21.58	22.47		22.48	0.000328	0.65	10.75	12.04	0.12	0.01594
cl4	600	PF 1	7.00	21.55	22.46		22.47	0.000311	0.64	10.93	12.06	0.12	0.01535
cl4	550	PF 1	8.00	21.52	22.44		22.45	0.000391	0.72	11.07	12.06	0.13	0.01950
cl4	500	PF 1	8.00	21.49	22.42		22.43	0.000377	0.71	11.20	12.06	0.13	0.01899
cl4	450	PF 1	8.00	21.46	22.40		22.41	0.000362	0.71	11.34	12.06	0.13	0.01845
cl4	400	PF 1	8.00	21.43	22.38		22.39	0.000347	0.70	11.49	12.06	0.13	0.01790
cl4	351.51	PF 1	8.00	21.40	22.37	21.62	22.38	0.000247	0.60	13.33	13.77	0.11	0.01315
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.33		22.33	0.000284	0.63	12.79	13.85	0.11	0.01450
cl4	300	PF 1	8.00	21.37	22.31		22.32	0.000260	0.61	13.22	14.07	0.11	0.01349
cl4	250	PF 1	8.00	21.34	22.30		22.31	0.000245	0.59	13.47	14.06	0.11	0.01293
cl4	200	PF 1	9.00	21.31	22.28		22.29	0.000295	0.66	13.68	14.06	0.12	0.01579
cl4	150	PF 1	9.00	21.28	22.27		22.28	0.000280	0.65	13.90	14.06	0.11	0.01522
cl4	100	PF 1	9.00	21.25	22.26		22.26	0.000265	0.64	14.14	14.07	0.11	0.01463
cl4	50	PF 1	9.00	21.22	22.25	21.45	22.25	0.000146	0.48	29.57	35.33	0.08	0.00821

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_6000c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.79	22.20	22.80	0.000367	0.63	7.92	10.02	0.13	0.01566
cl4	1300	PF 1	5.00	21.97	22.77		22.78	0.000350	0.62	8.04	10.02	0.12	0.01512
cl4	1250	PF 1	5.00	21.94	22.76		22.76	0.000332	0.61	8.18	10.02	0.12	0.01457
cl4	1200	PF 1	5.00	21.91	22.74		22.75	0.000314	0.60	8.32	10.02	0.12	0.01400
cl4	1150	PF 1	5.00	21.88	22.73		22.73	0.000297	0.59	8.47	10.02	0.11	0.01345
cl4	1100	PF 1	6.00	21.85	22.71		22.71	0.000414	0.70	8.56	10.01	0.13	0.01888
cl4	1050	PF 1	6.00	21.82	22.69		22.69	0.000399	0.69	8.66	10.01	0.13	0.01841
cl4	1029.18	PF 1	6.00	21.81	22.68	22.03	22.68	0.000393	0.69	8.71	10.04	0.13	0.01818
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.65		22.66	0.000321	0.63	9.57	11.10	0.12	0.01500
cl4	950	PF 1	6.00	21.76	22.64		22.65	0.000253	0.57	10.59	12.06	0.11	0.01214
cl4	900	PF 1	6.00	21.73	22.63		22.63	0.000237	0.56	10.80	12.06	0.10	0.01159
cl4	850	PF 1	6.00	21.70	22.62		22.62	0.000222	0.54	11.03	12.06	0.10	0.01105
cl4	800	PF 1	7.00	21.67	22.60		22.61	0.000286	0.62	11.22	12.06	0.11	0.01447
cl4	750	PF 1	7.00	21.64	22.59		22.59	0.000271	0.61	11.42	12.06	0.11	0.01390
cl4	700	PF 1	7.00	21.61	22.58		22.58	0.000256	0.60	11.62	12.06	0.11	0.01335
cl4	650	PF 1	7.00	21.58	22.56		22.57	0.000243	0.59	11.82	12.04	0.11	0.01283
cl4	600	PF 1	7.00	21.55	22.55		22.56	0.000228	0.58	12.06	12.06	0.10	0.01228
cl4	550	PF 1	8.00	21.52	22.54		22.54	0.000284	0.65	12.25	12.07	0.11	0.01545
cl4	500	PF 1	8.00	21.49	22.52		22.53	0.000270	0.64	12.45	12.07	0.11	0.01491
cl4	450	PF 1	8.00	21.46	22.51		22.52	0.000257	0.63	12.65	12.07	0.11	0.01436
cl4	400	PF 1	8.00	21.43	22.50		22.50	0.000243	0.62	12.86	12.07	0.11	0.01382
cl4	351.51	PF 1	8.00	21.40	22.49	21.62	22.49	0.000172	0.53	14.96	13.78	0.09	0.01011
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.46		22.47	0.000184	0.55	14.66	13.86	0.09	0.01060
cl4	300	PF 1	8.00	21.37	22.45		22.46	0.000167	0.53	15.19	14.08	0.09	0.00981
cl4	250	PF 1	8.00	21.34	22.44		22.45	0.000157	0.52	15.50	14.07	0.09	0.00937
cl4	200	PF 1	9.00	21.31	22.43		22.44	0.000188	0.57	15.78	14.07	0.09	0.01137
cl4	150	PF 1	9.00	21.28	22.43		22.43	0.000177	0.56	16.08	14.08	0.09	0.01090
cl4	100	PF 1	9.00	21.25	22.42		22.42	0.000167	0.55	16.39	14.08	0.09	0.01043
cl4	50	PF 1	9.00	21.22	22.41	21.45	22.42	0.000087	0.40	35.34	35.42	0.07	0.00558

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_7000c River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	22.94	22.20	22.95	0.000210	0.53	9.46	10.02	0.10	0.01045
cl4	1300	PF 1	5.00	21.97	22.93		22.94	0.000197	0.52	9.66	10.03	0.09	0.00996
cl4	1250	PF 1	5.00	21.94	22.93		22.93	0.000184	0.51	9.87	10.03	0.09	0.00949
cl4	1200	PF 1	5.00	21.91	22.92		22.92	0.000173	0.50	10.08	10.02	0.09	0.00904
cl4	1150	PF 1	5.00	21.88	22.91		22.91	0.000161	0.49	10.30	10.03	0.08	0.00861
cl4	1100	PF 1	6.00	21.85	22.90		22.90	0.000220	0.57	10.48	10.01	0.10	0.01191
cl4	1050	PF 1	6.00	21.82	22.89		22.89	0.000208	0.56	10.67	10.01	0.10	0.01143
cl4	1029.18	PF 1	6.00	21.81	22.88	22.03	22.89	0.000203	0.56	10.77	10.04	0.09	0.01120
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	22.86		22.86	0.000164	0.51	11.86	11.11	0.09	0.00920
cl4	950	PF 1	6.00	21.76	22.85		22.86	0.000128	0.46	13.15	12.07	0.08	0.00739
cl4	900	PF 1	6.00	21.73	22.85		22.85	0.000119	0.45	13.44	12.07	0.07	0.00703
cl4	850	PF 1	6.00	21.70	22.84		22.84	0.000112	0.44	13.74	12.08	0.07	0.00670
cl4	800	PF 1	7.00	21.67	22.83		22.84	0.000143	0.50	14.01	12.08	0.08	0.00871
cl4	750	PF 1	7.00	21.64	22.83		22.83	0.000134	0.49	14.29	12.08	0.08	0.00833
cl4	700	PF 1	7.00	21.61	22.82		22.82	0.000126	0.48	14.57	12.08	0.08	0.00797
cl4	650	PF 1	7.00	21.58	22.81		22.82	0.000119	0.47	14.84	12.05	0.07	0.00764
cl4	600	PF 1	7.00	21.55	22.81		22.81	0.000112	0.46	15.15	12.08	0.07	0.00729
cl4	550	PF 1	8.00	21.52	22.80		22.81	0.000138	0.52	15.44	12.09	0.08	0.00912
cl4	500	PF 1	8.00	21.49	22.79		22.80	0.000130	0.51	15.71	12.09	0.08	0.00876
cl4	450	PF 1	8.00	21.46	22.79		22.79	0.000123	0.50	16.00	12.09	0.08	0.00841
cl4	400	PF 1	8.00	21.43	22.78		22.79	0.000117	0.49	16.29	12.09	0.07	0.00807
cl4	351.51	PF 1	8.00	21.40	22.78	21.62	22.78	0.000082	0.42	18.94	13.80	0.06	0.00590
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	22.75		22.76	0.000086	0.43	18.71	13.88	0.06	0.00607
cl4	300	PF 1	8.00	21.37	22.75		22.75	0.000078	0.41	19.36	14.09	0.06	0.00563
cl4	250	PF 1	8.00	21.34	22.74		22.75	0.000074	0.41	19.73	14.09	0.06	0.00540
cl4	200	PF 1	9.00	21.31	22.74		22.74	0.000088	0.45	20.09	14.10	0.07	0.00656
cl4	150	PF 1	9.00	21.28	22.74		22.74	0.000083	0.44	21.93	28.25	0.06	0.00624
cl4	100	PF 1	9.00	21.25	22.73		22.73	0.000078	0.43	23.12	43.76	0.06	0.00597
cl4	50	PF 1	9.00	21.22	22.73	21.45	22.73	0.000039	0.31	46.61	35.64	0.04	0.00304

EAGLE ISLAND CHUM SPAWNING CHANNEL – FINAL DESIGN REPORT

HEC-RAS Plan: Chum_Final_10000 River: PR BACKWATER Reach: cl4 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)
cl4	1350	PF 1	5.00	22.00	23.72	22.20	23.72	0.000032	0.29	17.34	10.92	0.04	0.00265
cl4	1300	PF 1	5.00	21.97	23.72		23.72	0.000030	0.29	17.65	11.04	0.04	0.00255
cl4	1250	PF 1	5.00	21.94	23.72		23.72	0.000029	0.28	17.97	11.15	0.04	0.00245
cl4	1200	PF 1	5.00	21.91	23.72		23.72	0.000027	0.28	18.29	11.26	0.04	0.00236
cl4	1150	PF 1	5.00	21.88	23.71		23.72	0.000026	0.27	18.61	11.37	0.04	0.00228
cl4	1100	PF 1	6.00	21.85	23.71		23.71	0.000038	0.32	18.65	10.02	0.04	0.00324
cl4	1050	PF 1	6.00	21.82	23.71		23.71	0.000037	0.32	18.92	10.02	0.04	0.00313
cl4	1029.18	PF 1	6.00	21.81	23.71	22.03	23.71	0.000033	0.31	19.42	11.66	0.04	0.00301
cl4	1029.17		Inl Struct										
cl4	1000	PF 1	6.00	21.79	23.70		23.70	0.000025	0.28	21.61	12.89	0.04	0.00240
cl4	950	PF 1	6.00	21.76	23.70		23.70	0.000020	0.26	23.81	13.86	0.03	0.00195
cl4	900	PF 1	6.00	21.73	23.70		23.70	0.000019	0.25	24.21	13.98	0.03	0.00189
cl4	850	PF 1	6.00	21.70	23.70		23.70	0.000018	0.25	24.62	14.10	0.03	0.00182
cl4	800	PF 1	7.00	21.67	23.70		23.70	0.000022	0.28	29.65	21.96	0.03	0.00225
cl4	750	PF 1	7.00	21.64	23.70		23.70	0.000022	0.28	25.44	14.33	0.03	0.00232
cl4	700	PF 1	7.00	21.61	23.70		23.70	0.000021	0.28	25.85	14.43	0.03	0.00224
cl4	650	PF 1	7.00	21.58	23.70		23.70	0.000021	0.27	26.21	14.51	0.03	0.00218
cl4	600	PF 1	7.00	21.55	23.69		23.70	0.000020	0.27	26.69	14.67	0.03	0.00210
cl4	550	PF 1	8.00	21.52	23.69		23.69	0.000024	0.30	27.13	14.79	0.04	0.00266
cl4	500	PF 1	8.00	21.49	23.69		23.69	0.000023	0.30	28.13	25.32	0.04	0.00257
cl4	450	PF 1	8.00	21.46	23.69		23.69	0.000022	0.30	28.23	22.23	0.03	0.00249
cl4	400	PF 1	8.00	21.43	23.69		23.69	0.000021	0.29	28.42	15.14	0.03	0.00242
cl4	351.51	PF 1	8.00	21.40	23.69	21.62	23.69	0.000015	0.25	32.91	17.37	0.03	0.00179
cl4	351.50		Inl Struct										
cl4	350	PF 1	8.00	21.40	23.68		23.68	0.000015	0.25	33.04	17.49	0.03	0.00177
cl4	300	PF 1	8.00	21.37	23.68		23.68	0.000014	0.24	33.84	17.29	0.03	0.00167
cl4	250	PF 1	8.00	21.34	23.68		23.68	0.000018	0.21	39.68	35.49	0.03	0.00138
cl4	200	PF 1	9.00	21.31	23.68		23.68	0.000016	0.20	46.77	45.47	0.03	0.00127
cl4	150	PF 1	9.00	21.28	23.68		23.68	0.000012	0.17	71.86	61.12	0.03	0.00095
cl4	100	PF 1	9.00	21.25	23.68		23.68	0.000011	0.19	69.10	50.85	0.03	0.00113
cl4	50	PF 1	9.00	21.22	23.68	21.45	23.68	0.000008	0.17	82.47	39.90	0.02	0.00083

ATTACHMENT 2

Engineer's Cost Opinion

Engineer's Cost Opinion for Eagle Island Chum Channel

No.	Description	Unit	Quantity	Unit Cost	Total Cost	Design and Quantity Assumptions
1	Mobilization and demobilization	LS	1	\$ 33,000	\$ 33,000	Calculated at 5% of construction sub-total. Rounded to the nearest \$1,000.
2	Site access measures	LS	1	\$ 5,000	\$ 5,000	Includes access road improvements, traffic control, and site restoration.
3	Environmental protection measures	LS	1	\$ 68,000	\$ 68,000	Includes dewatering, sheetpile coffer dam, coordinate with fish relocation, and erosion control BMPs
4	Clearing and grubbing	AC	2.0	\$ 8,000	\$ 16,000	Includes clearing and grubbing of channel area and staging areas
5	Excavation to subgrade	LS	1	\$ 101,788	\$ 101,788	Excavation to subgrade. Includes haul to fill area and grading. Measurement by pre and post survey of fill area. Final design criteria and analysis will likely alter these estimates up or down. Assumes disposal to be on-site using off-road trucks.
6	Log toe construction	LS	1	\$ 233,200	\$ 233,200	Furnish logs in sufficient quantity to construct the length and height of channel shown in the plan. Furnish 2 piles per segment/group of stacked toe logs. Includes on-site movement and cutting to adjust length. Includes furnishing threaded rod, washers, bolts, drilling equipment for log-log connections in log toe construction. Includes pilings placement and fastening of toe logs.
7	Native backfill	CY	1,581	\$ 8	\$ 12,648	Includes excavation from fill area, haul.
8	Spawning gravel mix & placement	CY	1,205	\$ 60	\$ 72,300	Furnish specified spawning gravel (as specified in Final Design Plans). Includes hauling and installing spawning gravel mix from stockpile area.
9	Sheetpile control weirs	EA	3	\$ 6,000	\$ 18,000	Includes materials and labor for 2 sheetpile weirs as shown in Final Design Plans.
10	Flow supplementation	LS	1	\$ 41,552	\$ 41,552	Includes materials and labor for construction of flow supplementation system, including pipe trench and backfill with native material, light loose riprap, drain rock, pipe and fittings, well screen and fittings, canal gate, trash rack.
11	Riverbank log structure	LS	1	\$ 40,196	\$ 40,196	Furnish, deliver and install logs with root wads attached and cut logs. Includes excavation, stockpile, hauling, installing and fastening logs, and backfilling log structure. Excess material to be hauled to fill area. Includes cable and hardware for log to log connections.
12	Floodplain wood	LS	1	\$ 39,000	\$ 39,000	Furnish, deliver, and install. Includes cable and hardware for log to log connections.
13	Revegetation	AC	2	\$ 10,000	\$ 20,000	Includes materials and labor for planting riparian areas and staging areas (based on revegetation plan in Final Design Plans).
Construction Total					\$700,684	General Notes: - Costs assume all materials (wood and rock) are purchased and hauled to the site from a nearby source
Key LS = Lump Sum CY = Cubic Yard LF = Lineal Foot AC = Acre EA = Each						

ATTACHMENT 3

Specifications

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DIVISION 2	EARTHWORK
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Attachments	Drawings, HPA Permit Requirements

DIVISION 1 – AMENDMENTS AND SPECIAL CONDITIONS

DIVISION 1 - INTRODUCTION

The following Amendments and Special Provisions shall be used in conjunction with the *Washington State Department of Transportation's Standard Specifications for Road, Bridge and Municipal Construction 2012* (WSDOT Standard Specifications). Additional specifications in the following contract sections are included for items not covered by the WSDOT Standard Specifications.

DIVISION 2 – EARTHWORK

SECTION 2-05 EXCAVATION TO SUBGRADE

This section is added.

2-05.1 Description

The work includes excavating earthen material from the new channel vertical and horizontal alignment to achieve subgrade to the lines and grades shown on the project plans; hauling the excavated material to a designated on-site fill area, and grading the fill site.

2-05.2 Materials

The Contractor shall provide all required materials for the project.

2-05.3 Construction Requirements

2-05.3(1) Site Excavation

1. General Excavation Requirements

The Contractor shall excavate to the lines, grades, slopes, and elevations shown on the Contract Drawings.

Excavation on slopes shall proceed downward, working from top of slope to toe of slope. As the work progresses, it is anticipated that some slope material will slough into the cut area. The Contractor shall remove this material and will make a final pass to clear up the slope with the excavator bucket along the sections' edges when the excavation is completed.

In performing the excavation the Contractor shall pay particular attention to the conditions of issued permits and authorizations requiring the minimization of turbidity and siltation and adherence to water quality requirements.

2. Schedule Constraints and Avoidance of In-Water Work

All work shall be scheduled per the Hydraulic Project Approval issued by WDFW.

3. Management of Excavated Surfaces

The Contractor shall be aware of the potential for erosion, and potential water quality problems. The Contractor shall control the potential for erosion of materials from freshly exposed excavated surfaces and stockpiled materials.

In planning for rain events, the Contractor shall be prepared to install plastic, straw bales or other Best Management Practices (BMPs) with Project Manager approval. It is the Contractor's responsibility to install BMPs as necessary to prevent siltation.

In case an excavated area fills with water during excavation operations, Contractor shall pump the water out and discharge it to an infiltration area, subject to water quality requirements and monitoring.

2-05.3(2) Fill Disposal

An on-site fill area is designated in the Plans. Excavated material shall be hauled to the fill area and graded. Edges of the fill area shall be graded to smoothly transition to adjacent ground surfaces.

2-05.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

2-05.5 Payment

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

“Excavation to Subgrade” per lump sum

The unit contract prices for Excavation to Subgrade shall be full compensation for all costs incurred for excavating, loading, spoiling and placing, or otherwise disposing of the material.

The unit contract prices for all other items shall be full compensation for all costs incurred for material and labor for installation, placing, and disposing of the excess material.

DIVISION 8- MISCELLANEOUS CONSTRUCTION

SECTION 8-26 SITE ACCESS MEASURES

This section is added.

8-26.1 Description

The work consists of construction, maintenance, and removal of access road improvements, and temporary traffic control.

8-26.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials are described in the project plans.

8-26.3 Construction Requirements

8-26.3(1) Site Access Measures

Temporary traffic control requirements shall include barricades and construction signage at the entrance to the project site and any other measures required by State or local regulations.

8-26.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Site Access Measures,” will be measured by lump sum.

8-26.5 Payment

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

bid items: “Site Access Measures” per lump sum

The unit contract prices for “Site Access Measures” shall be full compensation for all costs incurred for equipment, materials and labor for furnishing, installing, securing, maintaining, and removal of access road, temporary traffic control, and general site restoration.

SECTION 8-27 ENVIRONMENTAL PROTECTION MEASURES

This section is added.

8-27.1 Description

The work consists of dewatering, sheetpile cofferdam, coordinating with the Owner for fish salvage relocation activities, and erosion control Best Management Practices (BMPs).

8-27.2 Materials

The Contractor shall provide all required materials for the project except as

directed by the Project Manager. Materials are described in the project plans.

8-27.3 Construction Requirements

8-27.3(1) Environmental Protection Measures

This work consists of furnishing and installing any and all equipment, materials, and labor required for dewatering, installation of sheetpile cofferdams, and erosion control BMPs.

It is anticipated that water will need to be pumped from the excavation area. Water that comes in contact with construction activity should be pumped away from the site and infiltrated into the ground without entering the waterway. If infiltration becomes an ineffective means to control turbidity, additional and alternative methods, such as pumping into a filter bag, shall be employed.

8-27.3(2) Cofferdam

The contractor shall isolate the work area from the waterway by installing cofferdams per the plans. No turbidity from construction activities shall enter the waterway.

8-27.3(3) Pumps

To help prevent turbidity from leaking through the cofferdam, the contractor shall provide and operate pumps to lower the water surface within each isolated area and discharge to an infiltration area. Pumping capacity exceeding 600 gpm shall be required.

8-27.3(4) Coordination with Fish Rescue

The Contractor shall provide minimum 5 days advance notice to the Owner before each cofferdam installation date. The Contractor shall understand that cofferdam installation requires coordination with the Owner and only after the Owner has completed fish rescue can the cofferdams be completed.

8-27.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Environmental Protection Measures” will be measured by lump sum.

8-27.5 Payment

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

bid items: “Environmental Protection Measures” per lump sum

The unit contract prices for “Environmental Protection Measures” shall be

full compensation for all costs incurred for equipment, materials and labor for furnishing, installing, securing, maintaining and removal of environmental protection measures as outlined in the plan.

SECTION 8-30 LOG TOE CONSTRUCTION

This section is added.

8-30.1 Description

The work consists of furnishing logs and installing them parallel along the channel to form log walls to create channel banks that armor the toe and sides of the spawning channel as shown on the project plans.

8-30.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials are described in the project plans.

8-30.3 Construction Requirements

8-30.3(1) Log Toe Construction

This work consists of furnishing and installing horizontal logs to construct the length and height of stacked-log-channel-bank as shown in the plans. The work also consists of furnishing and installing two vertical timber piles per segment of log toe to secure the horizontal logs as shown on the project plans. Each segment of stacked logs shall be drilled and threaded rods driven in, secured with washers and bolts to secure the horizontal logs to two vertical timber piles.

This work includes installing timber piles.

The work shall occur within the confines of the planned limits of disturbance. To achieve the required depth for installed timber piles, a vibratory pile driver capable of installing timber piles is recommended.

8-30.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Log Toe Construction,” will be measured by lump sum.

8-30.5 Payment

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

bid items: “Log Toe Construction” per lump sum

The unit contract prices for “Log Toe Construction,” shall be full compensation for all costs incurred for equipment, materials, and labor for excavating, building, installing and backfilling. Wood fastening hardware including furnishing and installing threaded rod, washers, bolts, drilling equipment for log to log connections shall be considered incidental to “Log Toe Construction”.

SECTION 8-31 NATIVE BACKFILL

This section is added.

8-31.1 Description

The work consists of hauling approved material from the stockpile site shown on the project plans to the proposed channel to backfill behind (landward of) the log toe sidewalls.

8-31.2 Materials

The Contractor shall utilize coarse material sorted from material excavated from the proposed channel area for the project except as directed by the Project Manager.

8-31.3 Construction Requirements

8-31.3(1) Native Backfill

This work consists of hauling and placing native backfill material from the material removed from the proposed channel location as shown in the plans. The Native Backfill shall be placed per Method A, as defined in 2-03.3(14)C.

8-31.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Native Backfill” will be measured by cubic yards.

8-31.5 Payment

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

bid items: “Native Backfill” per cubic yards

The unit contract prices for “Native Backfill,” shall be full compensation for all costs incurred for equipment and labor for excavating, installing and compacting material.

SECTION 8-32 SPAWNING GRAVEL

This section is added.

8-32.1 Description

The work consists of furnishing and installing Spawning Gravel to form the new channel within the confines of the Toe Logs and to the lines and grades shown on the project plans.

8-32.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Spawning Gravel mix shall meet the requirements of the gradation defined within the plan set.

8-32.3 Construction Requirements

8-32.3(1) Spawning Gravel

The work consists of placing Spawning Gravel to form the new channel within the confines of the Toe Logs and to the lines and grades shown on the project plans.

8-32.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Spawning Gravel” will be measured by cubic yards.

8-32.5 Payment

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

bid items: “Spawning Gravel” per cubic yards

The unit contract prices for “Spawning Gravel,” shall be full compensation for all costs incurred for equipment and labor for excavating, installing and compacting material.

SECTION 8-33 CONTROL WEIRS

This section is added.

8-33.1 Description

The work consists of installing control weirs as shown on the project plans. A single installation consists of installing of sheet pile, attaching brackets to sheet pile to facilitate installation of fish screen or flashboards during channel maintenance and operations by the Owner.

8-33.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials are described in the project plans.

8-33.3 Construction Requirements

8-33.3(1) Control Weirs

This work consists of installing sheet pile, constructing a fish screen slot, and attaching brackets for fish screens or flashboards. Riprap shall be placed as shown in plan.

Contractor shall submit shop drawings signed and stamped by a Professional Structural Engineer for the sheet pile and pile cap design as well as submit supporting computations for approval.

8-33.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Control Weir” will be measured by the number installed.

8-33.5 Payment

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

bid items: “Control Weir” per each

The unit contract prices for “Control Weirs,” shall be full compensation for all costs incurred for design, equipment, materials, labor, excavating, construction, installation, and riprap.

SECTION 8-34 FLOW SUPPLEMENTATION

This section is added.

8-34.1 Description

The work consists of constructing a water intake structure to supply water to the proposed chum spawning channel.

8-34.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials include: riprap, drain rock, wells screen pipe and fittings, conveyance pipe and fittings, canal gate, and trash rack Materials are described in the project plans.

8-34.3 Construction Requirements

8-34.3(1) Flow Supplementation

This work consists of furnishing and installing any and all equipment, materials, and labor required for construction of flow supplementation system including: excavating and backfilling pipe trench; riprap, drain rock, wells screen pipe and fittings, conveyance pipe and fittings, canal gate, and trash rack.

8-34.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Flow Supplementation” will be measured by lump sum.

8-34.5 Payment

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

bid items: “Flow Supplementation” per lump sum

The unit contract prices for “Flow Supplementation” shall be full compensation for all costs incurred for equipment, materials and labor for constructing the system per the plan.

SECTION 8-35 RIVERBANK LOG STRUCTURE

This section is added.

8-35.1 Description

The work consists of installing wood within and along the edge of the riverbank as shown on the project plans and as directed by Project Manager.

8-35.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials are described in the project plans.

8-35.3 Construction Requirements

8-35.3(1) Riverbank Log Structure

This works consists of furnishing and installing riverbank log structure as indicated in the plans. The task includes excavation, stockpile, hauling, installing, and fastening logs, backfilling log structures, and hauling excess fill material to fill areas as indicated on plans.

This work includes installing timber piles.

The work shall occur within the confines of the planned limits of disturbance. To achieve the required depth for installed timber piles, a vibratory pile driver

capable of installing timber piles is recommended.

8-35.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Riverbank Log Structure” will be measured by lump sum.

8-35.5 Payment

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

bid items: “Riverbank Log Structure” lump sum.

The unit contract prices for “Riverbank log Structure” shall be full compensation for all costs incurred for equipment, materials and labor for furnishing, securing, and installing wood. Wood fastening hardware including furnishing and installing threaded rod, washers, bolts, drilling equipment for log to log connections shall be considered incidental to “Riverbank log Structure” construction.

SECTION 8-36 FLOODPLAIN WOOD

This section is added.

8-36.1 Description

The work consists of installing wood within the floodplain to increase surface roughness as shown on the project plans and as directed by Project Engineer.

8-36.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Quantities and descriptions of materials are included in the project plans.

8-36.3 Construction Requirements

8-36.3(1) Floodplain wood

This work consists of furnishing and installing floodplain wood as indicated in the plans.

This work includes installing timber piles.

The work shall occur within the confines of the planned limits of disturbance. To achieve the required depth for installed timber piles, a vibratory pile driver capable of installing timber piles is recommended.

8-36.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Floodplain Wood” will be measured by lump sum

8-36.5 Payment

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

bid items: “Floodplain Wood” lump sum.

The unit contract prices for “Floodplain Wood,” shall be full compensation for all costs incurred for equipment, materials, and labor for furnishing, securing, and installing wood. Wood fastening hardware including cable and clamps for log to log connections shall be considered incidental to “Floodplain Wood” construction.

SECTION 8-37 REVEGETATION

Section 8-02 Roadside Restoration shall hereby be apply as the controlling specification for Revegation. Section 8-02 is hereby supplemented as follows:

8-37.1 Description

The work consists of furnishing and installing plantings for all disturbed areas per the plan.

8-37.2 Materials

The Contractor shall provide all required materials for the project except as directed by the Project Manager. Materials are described in the project plans.

8-37.4 Measurement

Measurement will be based on the item from the bid list installed and the work for that portion completed.

“Revegetation” will be measured by the acres installed.

8-37.5 Payment

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

bid items:

“Revegetation” per acre

The unit contract prices for “Revegetation,” shall be full compensation for all costs incurred for equipment, materials, labor, excavating,

ATTACHMENT 4

Wetland Report

Preliminary Wetland Assessment WDFW Chum Channels Project

November 9, 2012



Provided for:
Washington Department of Fish and Wildlife
2108 Grand Boulevard
Vancouver, WA 98661

Preliminary Wetland Assessment WDFW Chum Channels Project

Provided for



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November 9, 2012

WDFW Chum Channels Project

Preliminary Wetland Assessment

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FIGURES

Figure 1 Aerial Photograph of Project Area

Figure 2 Project Area Photographs

APPENDICES

Wetland Rating Forms

INTRODUCTION

The Washington Department of Fish and Wildlife (WDFW) is proposing to complete a salmon habitat enhancement project on the North Fork Lewis River in order to provide spawning and rearing habitat for Chum Salmon. The proposed Chum Channels Project will create valuable side channel habitat in floodplain areas that historically supported these types of features. These side channels will be created through excavation to suitable grades and the installation of strategically placed engineered log jams to ensure the longevity of the project.

Wetlands within the project area were initially identified by project staff during early surveying activities. In order to categorize and determine the approximate boundary of the on-site wetlands, a preliminary wetland assessment was completed. It was determined through the course of the assessment that the project area contains jurisdictional wetlands as defined and regulated by the U.S. Army Corps of Engineers, Washington Department of Ecology, and Clark County. The results of the assessment are detailed below.

METHODS

The wetland predetermination was completed using the methods for wetland identification defined in the wetland delineation was conducted according to the Routine Onsite method described in the 1987 Corps of Engineers Wetlands Delineation Manual (Department of the Army 1987), and the Corps of Engineers Western Mountains, Valleys, and Coast Regional Supplement (Department of the Army, 2008) hereafter, referred to as the manual. According to the manual, jurisdictional wetlands are defined as:

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The manual uses three parameters in making wetland determinations: hydrophytic vegetation, hydric soils and wetland hydrology.

Hydrophytic vegetation are plants that due to morphological, physiological, and/or reproductive adaptations, have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions. Hydric soils are soils that are saturated,

flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. Wetland hydrology is present when an area is inundated or saturated to the surface for at least 5 percent of the growing season. The growing season is defined as the portion of the year when soil temperature at 19.7 inches below the soil surface is greater than biological zero (5 degrees C). Except in certain situations defined in the manual, evidence of all the three parameters (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.

Following the background information review, an on-site investigation was completed on November 8, 2012. In order to determine if wetlands were present within the study area, transects were walked throughout the project area. General notes on vegetation and other important characteristics of the site were recorded and photographs from representative locations were taken. In areas where wetlands were suspected, observation points were selected to correspond with terrain features, vegetation, hydrology and any mapped hydric soils identified on the site. At each observation point, the vegetation, soils and hydrology were characterized and this information was then used as the basis for making wetland determinations.

To determine if hydrophytic vegetation was present, the vegetation on the site was compared to the National List of Plant Species that Occur in Wetlands: 1988 - Northwest (Region 9) (Reed 1988) to determine plant wetland indicator status. This list places plants into four categories:

Obligate wetland plants (OBL) -- plants likely to occur in wetlands greater than 99 percent of the time.

Facultative wetland plants (FACW) -- plants likely to occur in wetlands 67 to 99 percent of the time.

Facultative plants (FAC) -- plants equally likely to occur in wetland and non-wetland areas (34-66 percent of the time).

Facultative upland plants (FACU) -- plants that only occur in wetlands 1 to 33 percent of the time.

Hydrophytic vegetation is present when more than 50 percent of the dominant species have an indicator status of OBL, FACW, and/or FAC. The presence or absence of hydric soils was determined by digging soil pits to a depth of 18 inches and examining the soil

for hydric soil indicators. Organic soils such as peats and mucks are considered hydric soils. Mineral hydric soils are generally either gleyed or have bright mottles and/or low matrix chroma immediately below the A-horizon or 10 inches (whichever is shallower). Soil colors are determined using the Munsell Soil Color Chart (Kollmorgen Instr. Corp. 1990).

BACKGROUND INFORMATION

The project site is located on a narrow forested floodplain adjacent to a small, river-right side channel of the North Fork Lewis River, at approximately RM 11.5. Prior to the completion of the site visit, existing information concerning the conditions of the site was reviewed. This review included current and historic aerial photographs; NRCS soil maps, national wetland inventory maps, and published topographic maps.

Soils

The Clark County soil Survey shows the entire project area mapped as Riverwash, cobbly (Rc). This soil is located on floodplains with slopes between 0 and 2 percent. The parent material consists of sandy alluvium, cobble, and gravels. This soil is listed as seasonally flooded and not ponded. Organic matter content in the upper soil layers is around 3% or less. This soil is not listed as hydric in the Clark County Soil Survey.

Mapped Wetlands

The National Wetland Inventory (NWI) maps have the following wetland units mapped within the project area:

- PFOA- Palustrine, Forested, Temporarily Flooded

The NWI map indicates that the entire western portion of the project area is mapped as forested wetlands. Although wetlands were identified within the project during the site visit, their actual extent is much less than that shown within the NWI map. It should be noted that NWI maps are produced from aerial photo and topographic map interpretation and are not meant to represent the extent of jurisdictional wetlands. This is especially the case in this instance where the project area is located adjacent to a large river and thereby subject to scouring and deposition patterns during high water events.

SITE VISIT RESULTS

A site visit was completed on November 8 in order to access the conditions of the project area and verify the presence or absence of jurisdictional wetlands within or directly adjacent to the project area. The project area consists of a relatively narrow floodplain bench vegetated with mixed native deciduous trees and shrubs (Figure 1). The topography of the site is best described as gently rolling and highly variable with many small depressions and historic drainage ways located throughout the project area. Through the course of the site visit, a single forested wetland was identified and its boundaries demarcated (Figure 1). The boundaries of the wetland were easily identifiable and corresponded with rapid changes in elevation and dominant vegetation type. Approximate wetland boundaries were recorded using a geoXT GPS receiver. The condition of the uplands and wetlands within the project area are detailed below.

Uplands

Vegetation throughout the majority of the project area is dominated by a canopy of medium-aged black cottonwood (*Populus trichocarpa*) trees and small groups of Oregon ash (*Fraxinus latifolia* – FACW), and big-leaf maple *Acer macrophyllum* – FACU) trees. Shrub layer vegetation is well developed and includes the following species: beaked hazlenut (*Corylus cornuta* – FACU), salmonberry (*Rubus spectabilis* – FAC), osoberry (*Oemleria cerasiformis* – FACU), snowberry (*Symphoricarpos albus* – FACU), Pacific ninebark (*Physocarpus capitatus* – FAC+), Scotch broom (*Cytisus scoparius* – UPL), trailing blackberry (*Rubus ursinus* – UPL), and cascara (*Rhamnus purshiana* – FAC-). Emergent vegetation is somewhat sparse and limited to swordfern (*Polystichum munitum* – FACU), orchardgrass (*Dactylis glomerata* - FACU), perennial ryegrass (*Lolium perenne* - FACU), reed canarygrass (*Phalaris arundinacea* - FACW), and other mixed forbs. Soil samples within these upland areas revealed sandy silt loam 10YR 3/2 soils with no reductions or concretions. No primary indicators of wetland hydrology were observed.

Wetlands

The wetlands within the project area are located within a prominent depression that runs through the entire western portion of the project area (Figure 1). Figure 1 illustrates that three separate wetland polygons were mapped but these three wetland areas are so similar in terms of soil, vegetation, and hydrology that they will be described as one single wetland unit. The total area of wetlands on the site is roughly 1 acre. The palustrine forested wetlands on the site are likely supported by interactions

with the seasonally high ground water table, surface runoff from adjacent slopes, and periodic flooding from the North Fork Lewis River. The entire wetland is forested in nature and has a canopy comprised of Oregon ash and black cottonwood trees. Understory vegetation is dominated by red-osier dogwood (*Cornus stolonifera* – FACW), Pacific ninebark, salmonberry, and Douglas spiraea (*Spiraea douglasii* – FACW). Emergent vegetation is mostly comprised of slough sedge (*Carex obnupta* - OBL), stinging nettle (*Urtica dioica* – FAC+), and a few small clumps of reed canarygrass. Photographs of various areas within the wetland are presented in Figure 2. Positive indicators of wetland soils included low chroma color soil matrices (10YR 2/2 and 10YR 3/1) and the presence of soil mottles. Positive indicators of wetland hydrology included soil saturation within the upper 12” of the soil and small areas of inundation.

The Washington Department of Ecology’s (Ecology) Western Washington Wetland Rating System was used to qualitatively score wetland functions provided by the wetland and determine its regulatory classification. Based on the rating system, the on-site forested wetland received a score of 8 for water quality functions, 7 for hydrologic functions, and 19 for habitat functions yielding a total score 34 and a Category III rating. Although the wetland is relatively undisturbed and contains a diverse native vegetation community a score of 34 is on the lower end for a Category III wetland. This is likely due to the undisturbed nature of the surrounding area and low opportunity to provide water quality and hydrologic wetland functions.

SUMMARY

A preliminary wetland assessment was conducted on the WDFW Chum Channels project area to determine the presence or absence of jurisdictional wetlands as defined by the U.S. Army Corps of Engineers and other regulatory entities. Through the process of the assessment, a palustrine forested wetland was identified and its approximate boundaries determined. The boundaries of the wetland were easily identifiable in the field through rapid changes in elevation and vegetation. The wetland would be classified as a Category II wetland using Ecology’s wetland rating system.

The wetlands on this site are subject to protection under section 404 and 401 of the Federal Clean Water Act in addition to regulation on a local level by Clark County. It is recommended that this report be forwarded to the appropriate regulatory agencies prior to the commencement of activities on the site that may impact jurisdictional wetlands.

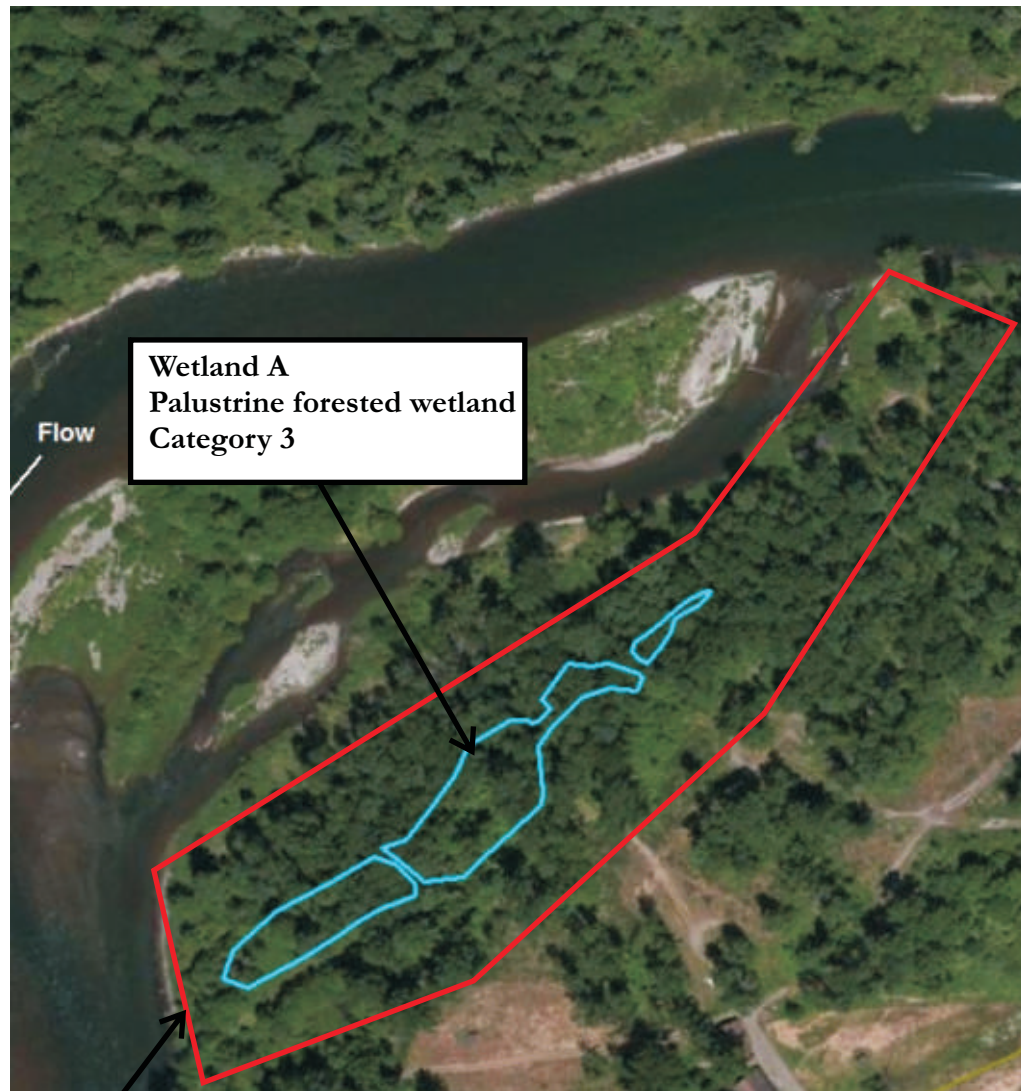
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Wetland A
Palustrine forested wetland
Category 3

Flow

Project Area



150' 300'

Approx. Scale 1"= 300'



1020 Wasco Street, Suite I
Hood River, OR 97031
inter-fluve.com

Aerial Photograph WDFW Chum Channels Project Clark County, WA

Project: Chum Channels Project
Client: WDFW
County: Clark County
Purpose: Preliminary Wetland Assess.

Figure 1



Wetland A - Ponded area in eastern section



Wetland A- Typical conditions



Wetland A- Typical conditions



Wetland A- Western portion of wetland



1020 Wasco Street, Suite I
Hood River, OR 97031
inter-fluve.com

Site Photographs WDFW Chum Channels Project Clark County, WA

Project: Chum Channels Project
Client: WDFW
County: Clark County
Purpose: Preliminary Wetland Assess.

Figure 2

Wetland name or number A

WETLAND RATING FORM – WESTERN WASHINGTON

Version 2 - Updated July 2006 to increase accuracy and reproducibility among users
Updated Oct 2008 with the new WDFW definitions for priority habitats

Name of wetland (if known): Wetland A Date of site visit: 11/7/12

Rated by Brian Bieger Trained by Ecology? Yes x No Date of training 8/07

SEC: 9 TOWNSHIP: 5n RANGE: 1E Is S/T/R in Appendix D? Yes No x

Map of wetland unit: Figure 1 Estimated size 1 acre

SUMMARY OF RATING

Category based on FUNCTIONS provided by wetland

I II III x IV

Category I = Score ≥ 70
Category II = Score 51-69
Category III = Score 30-50
Category IV = Score < 30

Score for Water Quality Functions

8

Score for Hydrologic Functions

7

Score for Habitat Functions

19

TOTAL score for Functions

34

Category based on SPECIAL CHARACTERISTICS of wetland

I II Does not Apply

III

Final Category (choose the “highest” category from above)

Summary of basic information about the wetland unit

Wetland Unit has Special Characteristics	Wetland HGM Class used for Rating	
Estuarine	Depressional	x
Natural Heritage Wetland	Riverine	
Bog	Lake-fringe	
Mature Forest	Slope	
Old Growth Forest	Flats	
Coastal Lagoon	Freshwater Tidal	
Interdunal		
None of the above	Check if unit has multiple HGM classes present	

Wetland name or number _____

Does the wetland unit being rated meet any of the criteria below?

If you answer YES to any of the questions below you will need to protect the wetland according to the regulations regarding the special characteristics found in the wetland.

Check List for Wetlands That May Need Additional Protection (in addition to the protection recommended for its category)	YES	NO
SP1. <i>Has the wetland unit been documented as a habitat for any Federally listed Threatened or Endangered animal or plant species (T/E species)?</i> For the purposes of this rating system, "documented" means the wetland is on the appropriate state or federal database.		X
SP2. <i>Has the wetland unit been documented as habitat for any State listed Threatened or Endangered animal species?</i> For the purposes of this rating system, "documented" means the wetland is on the appropriate state database. Note: Wetlands with State listed plant species are categorized as Category I Natural Heritage Wetlands (see p. 19 of data form).		X
SP3. <i>Does the wetland unit contain individuals of Priority species listed by the WDFWf or the state?</i>		X
SP4. <i>Does the wetland unit have a local significance in addition to its functions?</i> For example, the wetland has been identified in the Shoreline Master Program, the Critical Areas Ordinance, or in a local management plan as having special significance.		X

To complete the next part of the data sheet you will need to determine the Hydrogeomorphic Class of the wetland being rated.

The hydrogeomorphic classification groups wetlands into those that function in similar ways. This simplifies the questions needed to answer how well the wetland functions. The Hydrogeomorphic Class of a wetland can be determined using the key below. See p. 24 for more detailed instructions on classifying wetlands.

Classification of Wetland Units in Western Washington

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides (i.e. except during floods)?

NO – go to 2

YES – the wetland class is **Tidal Fringe**

If yes, is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)? **YES – Freshwater Tidal Fringe** **NO – Saltwater Tidal Fringe (Estuarine)**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is rated as an **Estuarine** wetland.* Wetlands that were called estuarine in the first and second editions of the rating system are called Salt Water Tidal Fringe in the Hydrogeomorphic Classification. Estuarine wetlands were categorized separately in the earlier editions, and this separation is being kept in this revision. To maintain consistency between editions, the term “Estuarine” wetland is kept. Please note, however, that the characteristics that define Category I and II estuarine wetlands have changed (see p.).

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it.

Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3

YES – The wetland class is **Flats**

If your wetland can be classified as a “Flats” wetland, use the form for **Depressional** wetlands.

3. Does the entire wetland unit **meet both** of the following criteria?

____ The vegetated part of the wetland is on the shores of a body of permanent open water (without any vegetation on the surface) at least 20 acres (8 ha) in size;

____ At least 30% of the open water area is deeper than 6.6 ft (2 m)?

NO – go to 4

YES – The wetland class is **Lake-fringe (Lacustrine Fringe)**

4. Does the entire wetland unit **meet all** of the following criteria?

____ The wetland is on a slope (*slope can be very gradual*),

____ The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.

____ The water leaves the wetland **without being impounded**?

NOTE: *Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3ft diameter and less than 1 foot deep).*

NO - go to 5

YES – The wetland class is **Slope**

Wetland name or number _____

5. Does the entire wetland unit **meet all of the following criteria?**

_____ The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river

_____ The overbank flooding occurs at least once every two years.

NOTE: The riverine unit can contain depressions that are filled with water when the river is not flooding.

NO - go to 6 **YES – The wetland class is **Riverine****

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year. *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7 **YES – The wetland class is Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding. The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8 **YES – The wetland class is Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within your wetland. NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

<i>HGM Classes within the wetland unit being rated</i>	<i>HGM Class to Use in Rating</i>
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake-fringe	Lake-fringe
Depressional + Riverine along stream within boundary	Depressional
Depressional + Lake-fringe	Depressional
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE under wetlands with special characteristics

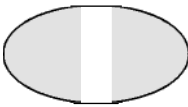
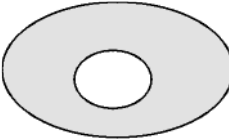

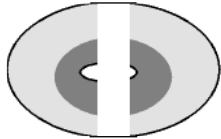
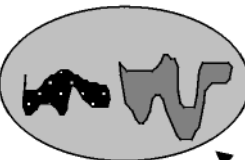
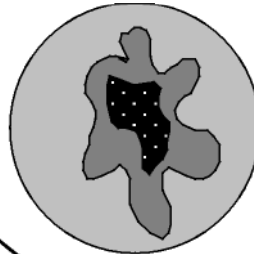

If you are unable still to determine which of the above criteria apply to your wetland, or if you have more than 2 HGM classes within a wetland boundary, classify the wetland as **Depressional** for the rating.

D Depressional and Flats Wetlands		Points (only 1 score per box)
WATER QUALITY FUNCTIONS - Indicators that the wetland unit functions to improve water quality		
D	D 1. Does the wetland unit have the <u>potential</u> to improve water quality?	(see p.38)
D	D 1.1 Characteristics of surface water flows out of the wetland: Unit is a depression with no surface water leaving it (no outlet) points = 3 Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2 Unit has an unconstricted, or slightly constricted, surface outlet (<i>permanently flowing</i>) points = 1 Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and no obvious natural outlet and/or outlet is a man-made ditch points = 1 (If ditch is not permanently flowing treat unit as "intermittently flowing") Provide photo or drawing	Figure <u>1</u> 3
D	S 1.2 The soil 2 inches below the surface (or duff layer) is clay or organic (<i>use NRCS definitions</i>) YES points = 4 NO points = 0	0
D	D 1.3 Characteristics of persistent vegetation (emergent, shrub, and/or forest Cowardin class) Wetland has persistent, ungrazed, vegetation > = 95% of area points = 5 Wetland has persistent, ungrazed, vegetation > = 1/2 of area points = 3 Wetland has persistent, ungrazed vegetation > = 1/10 of area points = 1 Wetland has persistent, ungrazed vegetation < 1/10 of area points = 0 Map of Cowardin vegetation classes	Figure <u>1</u> 5
D	D1.4 Characteristics of seasonal ponding or inundation. This is the area of the wetland unit that is ponded for at least 2 months, but dries out sometime during the year. Do not count the area that is permanently ponded. Estimate area as the average condition 5 out of 10 yrs. Area seasonally ponded is > 1/2 total area of wetland Area seasonally ponded is > 1/4 total area of wetland Area seasonally ponded is < 1/4 total area of wetland points = 2 points = 0 Map of Hydroperiods	Figure <u>1</u> 0
D	Total for D 1 Add the points in the boxes above	8
D	D 2. Does the wetland unit have the <u>opportunity</u> to improve water quality? Answer YES if you know or believe there are pollutants in groundwater or surface water coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater downgradient from the wetland. <i>Note which of the following conditions provide the sources of pollutants. A unit may have pollutants coming from several sources, but any single source would qualify as opportunity.</i> — Grazing in the wetland or within 150 ft — Untreated stormwater discharges to wetland — Tilled fields or orchards within 150 ft of wetland — A stream or culvert discharges into wetland that drains developed areas, residential areas, farmed fields, roads, or clear-cut logging — Residential, urban areas, golf courses are within 150 ft of wetland — Wetland is fed by groundwater high in phosphorus or nitrogen — Other _____ YES multiplier is 2 NO multiplier is 1	(see p. 44) multiplier <u>1</u>
D	TOTAL - Water Quality Functions Multiply the score from D1 by D2 Add score to table on p. 1	8

D Depressional and Flats Wetlands		Points (only 1 score per box)
HYDROLOGIC FUNCTIONS - Indicators that the wetland unit functions to reduce flooding and stream degradation		
	D 3. Does the wetland unit have the <u>potential</u> to reduce flooding and erosion?	(see p.46)
D	<p>D 3.1 Characteristics of surface water flows out of the wetland unit</p> <p>Unit is a depression with no surface water leaving it (no outlet) points = 4</p> <p>Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2</p> <p>Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and no obvious natural outlet and/or outlet is a man-made ditch points = 1</p> <p>(If ditch is not permanently flowing treat unit as "intermittently flowing")</p> <p>Unit has an unconstricted, or slightly constricted, surface outlet (<i>permanently flowing</i>) points = 0</p>	4
D	<p>D 3.2 Depth of storage during wet periods</p> <p><i>Estimate the height of ponding above the bottom of the outlet. For units with no outlet measure from the surface of permanent water or deepest part (if dry). Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7</i></p> <p>The wetland is a "headwater" wetland points = 5</p> <p>Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5</p> <p>Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3</p> <p>Unit is flat (yes to Q. 2 or Q. 7 on key) but has small depressions on the surface that trap water points = 1</p> <p>Marks of ponding less than 0.5 ft points = 0</p>	3
D	<p>D 3.3 Contribution of wetland unit to storage in the watershed</p> <p><i>Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.</i></p> <p>The area of the basin is less than 10 times the area of unit The points = 5</p> <p>area of the basin is 10 to 100 times the area of the unit The area points = 3</p> <p>of the basin is more than 100 times the area of the unit Entire points = 0</p> <p>unit is in the FLATS class points = 5</p>	0
D	Total for D 3 <i>Add the points in the boxes above</i>	7
D	<p>D 4. Does the wetland unit have the <u>opportunity</u> to reduce flooding and erosion?</p> <p>Answer YES if the unit is in a location in the watershed where the flood storage, or reduction in water velocity, it provides helps protect downstream property and aquatic resources from flooding or excessive and/or erosive flows. Answer NO if the water coming into the wetland is controlled by a structure such as flood gate, tide gate, flap valve, reservoir etc. OR you estimate that more than 90% of the water in the wetland is from groundwater in areas where damaging groundwater flooding does not occur.</p> <p><i>Note which of the following indicators of opportunity apply.</i></p> <ul style="list-style-type: none"> — Wetland is in a headwater of a river or stream that has flooding problems — Wetland drains to a river or stream that has flooding problems — Wetland has no outlet and impounds surface runoff water that might otherwise flow into a river or stream that has flooding problems — Other _____ <p>YES multiplier is 2 NO multiplier is 1</p>	(see p. 49)
D	TOTAL - Hydrologic Functions Multiply the score from D 3 by D 4 <i>Add score to table on p. 1</i>	multiplier <u>1</u> 7

These questions apply to wetlands of all HGM classes.		Points (only 1 score per box)
HABITAT FUNCTIONS - Indicators that unit functions to provide important habitat		
H 1. Does the wetland unit have the <u>potential</u> to provide habitat for many species?		
H 1.1 Vegetation structure (see p. 72) Check the types of vegetation classes present (as defined by Cowardin)- Size threshold for each class is 1/4 acre or more than 10% of the area if unit is smaller than 2.5 acres. <input type="checkbox"/> Aquatic bed <input checked="" type="checkbox"/> Emergent plants Scrub/shrub (areas where shrubs have >30% cover) <input checked="" type="checkbox"/> Forested (areas where trees have >30% cover) If the unit has a forested class check if: <input type="checkbox"/> The forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the forested polygon Add the number of vegetation structures that qualify. If you have: <div style="float: right; text-align: right;"> 4 structures or more points = 4 3 structures points = 2 2 structures points = 1 1 structure points = 0 </div> Map of Cowardin vegetation classes		Figure ____ 1
H 1.2. Hydroperiods (see p. 73) Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or 1/4 acre to count. (see text for descriptions of hydroperiods) <input type="checkbox"/> Permanently flooded or inundated 4 or more types present points = 3 <input type="checkbox"/> Seasonally flooded or inundated 3 types present points = 2 <input checked="" type="checkbox"/> Occasionally flooded or inundated 2 types present point = 1 <input checked="" type="checkbox"/> Saturated only 1 type present points = 0 <input type="checkbox"/> Permanently flowing stream or river in, or adjacent to, the wetland <input type="checkbox"/> Seasonally flowing stream in, or adjacent to, the wetland Lake-fringe wetland = 2 points <input type="checkbox"/> Freshwater tidal wetland = 2 points Map of hydroperiods		Figure ____ 1
H 1.3. Richness of Plant Species (see p. 75) Count the number of plant species in the wetland that cover at least 10 ft ² . (different patches of the same species can be combined to meet the size threshold) You do not have to name the species. Do not include Eurasian Milfoil, reed canarygrass, purple loosestrife, Canadian Thistle If you counted: <div style="float: right; text-align: right;"> > 19 species points = 2 5 - 19 species points = 1 < 5 species points = 0 </div> List species below if you want to:		1

Total for page 3

<p>H 1.4. Interspersion of habitats (<i>see p. 76</i>)</p> <p>Decide from the diagrams below whether interspersion between Cowardin vegetation classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, medium, low, or none.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>None = 0 points</p> </div> <div style="text-align: center;">  <p>Low = 1 point</p> </div> <div style="text-align: center;">  <p>Moderate = 2 points</p> </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-end; margin-top: 20px;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p>High = 3 points</p> </div> <div style="text-align: center;">  <p>[riparian braided channels]</p> </div> </div> <p>NOTE: If you have four or more classes or three vegetation classes and open water the rating is always "high". Use map of Cowardin vegetation classes</p>	<p>Figure _____</p> <p>2</p>
<p>H 1.5. Special Habitat Features: (<i>see p. 77</i>)</p> <p><i>Check the habitat features that are present in the wetland. The number of checks is the number of points you put into the next column.</i></p> <p><input checked="" type="checkbox"/> Large, downed, woody debris within the wetland (>4in. diameter and 6 ft long).</p> <p><input type="checkbox"/> Standing snags (diameter at the bottom > 4 inches) in the wetland</p> <p><input type="checkbox"/> Undercut banks are present for at least 6.6 ft (2m) and/or overhanging vegetation extends at least 3.3 ft (1m) over a stream (or ditch) in, or contiguous with the unit, for at least 33 ft (10m)</p> <p><input type="checkbox"/> Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30degree slope) OR signs of recent beaver activity are present (<i>cut shrubs or trees that have not yet turned grey/brown</i>)</p> <p><input checked="" type="checkbox"/> At least 1/4 acre of thin-stemmed persistent vegetation or woody branches are present in areas that are permanently or seasonally inundated. (<i>structures for egg-laying by amphibians</i>)</p> <p><input checked="" type="checkbox"/> Invasive plants cover less than 25% of the wetland area in each stratum of plants</p> <p>NOTE: The 20% stated in early printings of the manual on page 78 is an error.</p>	<p>3</p>
<p>H 1. TOTAL Score - potential for providing habitat</p> <p><i>Add the scores from H1.1, H1.2, H1.3, H1.4, H1.5</i></p>	<p>8</p>

Comments

H 2. Does the wetland unit have the opportunity to provide habitat for many species?	
<p>H 2.1 Buffers (<i>see p. 80</i>) <i>Choose the description that best represents condition of buffer of wetland unit. The highest scoring criterion that applies to the wetland is to be used in the rating. See text for definition of "undisturbed."</i></p> <ul style="list-style-type: none"> — 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% of circumference. No structures are within the undisturbed part of buffer. (relatively undisturbed also means no-grazing, no landscaping, no daily human use) Points = 5 <u>X</u> — 100 m (330 ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 50% circumference. Points = 4 — 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% circumference. Points = 4 — 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 25% circumference, Points = 3 — 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water for > 50% circumference. Points = 3 <p style="text-align: center;">If buffer does not meet any of the criteria above</p> <ul style="list-style-type: none"> — No paved areas (except paved trails) or buildings within 25 m (80ft) of wetland > 95% circumference. Light to moderate grazing, or lawns are OK. Points = 2 — No paved areas or buildings within 50m of wetland for >50% circumference. Light to moderate grazing, or lawns are OK. Heavy Points = 2 — grazing in buffer. Points = 1 — Vegetated buffers are <2m wide (6.6ft) for more than 95% of the circumference (e.g. tilled fields, paving, basalt bedrock extend to edge of wetland) Points = 0. — Buffer does not meet any of the criteria above. Points = 1 <p style="text-align: right;">Aerial photo showing buffers</p>	<p>Figure 3 _____</p> <p style="text-align: center;">4</p>
<p>H 2.2 Corridors and Connections (<i>see p. 81</i>)</p> <p>H 2.2.1 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 150 ft wide, has at least 30% cover of shrubs, forest or native undisturbed prairie, that connects to estuaries, other wetlands or undisturbed uplands that are at least 250 acres in size? (<i>dams in riparian corridors, heavily used gravel roads, paved roads, are considered breaks in the corridor</i>).</p> <p style="text-align: center;">YES = 4 points (<i>go to H 2.3</i>) NO = go to H 2.2.2</p> <p>H 2.2.2 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 50ft wide, has at least 30% cover of shrubs or forest, and connects to estuaries, other wetlands or undisturbed uplands that are at least 25 acres in size? OR a Lake-fringe wetland, if it does not have an undisturbed corridor as in the question above?</p> <p style="text-align: center;">YES = 2 points (<i>go to H 2.3</i>) NO = H 2.2.3</p> <p>H 2.2.3 Is the wetland:</p> <ul style="list-style-type: none"> within 5 mi (8km) of a brackish or salt water estuary OR within 3 mi of a large field or pasture (>40 acres) OR within 1 mi of a lake greater than 20 acres? <p style="text-align: center;">YES = 1 point NO = 0 points</p>	<p style="text-align: center;">2</p>

Total for page 6

H 2.3 Near or adjacent to other priority habitats listed by WDFW (see new and complete descriptions of WDFWp riority habitats, and the counties in which they can be found, in the PHS report <http://wdfw.wa.gov/hab/phslist.htm>)

Which of the following priority habitats are within 330ft (100m) of the wetland unit? *NOTE: the connections do not have to be relatively undisturbed.*

Aspen Stands: Pure or mixed stands of aspen greater than 0.4 ha (1 acre).

Biodiversity Areas and Corridors: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report p. 152*).

Herbaceous Balds: Variable size patches of grass and forbs on shallow soils over bedrock.

Old-growth/Mature forests: (Old-growth west of Cascade crest) Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 20 trees/ha (8 trees/acre) > 81 cm (32 in) dbh or > 200 years of age. (Mature forests) Stands with average diameters exceeding 53 cm (21 in) dbh; crown cover may be less that 100%; crown cover may be less that 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80 - 200 years old west of the Cascade crest.

Oregon white Oak: Woodlands Stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158*).

x **Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

Westside Prairies: Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161*).

Instream: The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

Nearshore: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report: pp. 167-169 and glossary in Appendix A*).

Caves: A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

Cliffs: Greater than 7.6 m (25 ft) high and occurring below 5000 ft.

Talus: Homogenous areas of rock rubble ranging in average size 0.15 - 2.0 m (0.5 - 6.5 ft), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

x **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 51 cm (20 in) in western Washington and are > 2 m (6.5 ft) in height. Priority logs are > 30 cm (12 in) in diameter at the largest end, and > 6 m (20 ft) long.

If wetland has **3 or more** priority habitats = **4 points**

If wetland has **2** priority habitats = **3 points** If

wetland has **1** priority habitat = **1 point**

No habitats = 0 points

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list. Nearby wetlands are addressed in question H 2.4)

Wetland name or number _____

<p>H 2.4 <u>Wetland Landscape</u> (<i>choose the one description of the landscape around the wetland that best fits</i>) (<i>see p. 84</i>)</p> <p>There are at least 3 other wetlands within 1/2 mile, and the connections between them are relatively undisturbed (light grazing between wetlands OK, as is lake shore with some boating, but connections should NOT be bisected by paved roads, fill, fields, or other development. points = 5</p> <p>The wetland is Lake-fringe on a lake with little disturbance and there are 3 other lake-fringe wetlands within 1/2 mile points = 5</p> <p>There are at least 3 other wetlands within 1/2 mile, BUT the connections between them are disturbed points = 3</p> <p>The wetland is Lake-fringe on a lake with disturbance and there are 3 other lake-fringe wetland within 1/2 mile points = 3</p> <p>There is at least 1 wetland within 1/2 mile. points = 2</p> <p>There are no wetlands within 1/2 mile. points = 0</p>	2
<p style="text-align: right;">H 2. TOTAL Score - opportunity for providing habitat <i>Add the scores from H2.1, H2.2, H2.3, H2.4</i></p>	11
<p style="text-align: right;">TOTAL for H 1 from page 14</p>	8
<p>Total Score for Habitat Functions – add the points for H 1, H 2 and record the result on p. 1</p>	19

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Please determine if the wetland meets the attributes described below and circle the appropriate answers and Category.

Wetland Type <i>Check off any criteria that apply to the wetland. Circle the Category when the appropriate criteria are met.</i>	Category
SC 1.0 Estuarine wetlands (see p. 86) Does the wetland unit meet the following criteria for Estuarine wetlands? — The dominant water regime is tidal, — Vegetated, and — With a salinity greater than 0.5 ppt. YES = Go to SC 1.1 NO <u>x</u>	
SC 1.1 Is the wetland unit within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? YES = Category I NO go to SC 1.2	Cat. I
SC 1.2 Is the wetland unit at least 1 acre in size and meets at least two of the following three conditions? YES = Category I NO = Category II — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. If the non-native <i>Spartina</i> spp. are the only species that cover more than 10% of the wetland, then the wetland should be given a dual rating (I/II). The area of <i>Spartina</i> would be rated a Category II while the relatively undisturbed upper marsh with native species would be a Category I. Do not, however, exclude the area of <i>Spartina</i> in determining the size threshold of 1 acre. — At least 3/4 of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland has at least 2 of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.	Cat. I Cat. II Dual rating I/II

<p>SC 2.0 Natural Heritage Wetlands (<i>see p. 87</i>) Natural Heritage wetlands have been identified by the Washington Natural Heritage Program/DNR as either high quality undisturbed wetlands or wetlands that support state Threatened, Endangered, or Sensitive plant species.</p> <p>SC 2.1 Is the wetland unit being rated in a Section/Township/Range that contains a Natural Heritage wetland? (<i>this question is used to screen out most sites before you need to contact WNHP/DNR</i>) S/T/R information from Appendix D ____ or accessed from WNHP/DNR web site ____</p> <p>YES ____ – contact WNHP/DNR (see p. 79) and go to SC 2.2 NO <u>x</u></p> <p>SC 2.2 Has DNR identified the wetland as a high quality undisturbed wetland or as or as a site with state threatened or endangered plant species? YES = Category I NO <u>x</u> not a Heritage Wetland</p>	<p>Cat. I</p>
<p>SC 3.0 Bogs (<i>see p. 87</i>) Does the wetland unit (or any part of the unit) meet both the criteria for soils and vegetation in bogs? <i>Use the key below to identify if the wetland is a bog. If you answer yes you will still need to rate the wetland based on its functions.</i></p> <p>1. Does the unit have organic soil horizons (i.e. layers of organic soil), either peats or mucks, that compose 16 inches or more of the first 32 inches of the soil profile? (See Appendix B for a field key to identify organic soils)? Yes - go to Q. 3 No - go to Q. 2</p> <p>2. Does the unit have organic soils, either peats or mucks that are less than 16 inches deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on a lake or pond? Yes - go to Q. 3 No - Is not a bog for purpose of rating</p> <p>3. Does the unit have more than 70% cover of mosses at ground level, AND other plants, if present, consist of the “bog” species listed in Table 3 as a significant component of the vegetation (more than 30% of the total shrub and herbaceous cover consists of species in Table 3)? Yes – Is a bog for purpose of rating No - go to Q. 4</p> <p>NOTE: If you are uncertain about the extent of mosses in the understory you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16” deep. If the pH is less than 5.0 and the “bog” plant species in Table 3 are present, the wetland is a bog.</p> <p>1. Is the unit forested (> 30% cover) with sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Englemann’s spruce, or western white pine, WITH any of the species (or combination of species) on the bog species plant list in Table 3 as a significant component of the ground cover (> 30% coverage of the total shrub/herbaceous cover)?</p> <p>2 YES = Category I No ____ Is not a bog for purpose of rating</p>	<p>Cat. I</p>

<p>SC 4.0 Forested Wetlands (see p. 90)</p> <p>Does the wetland unit have at least 1 acre of forest that meet one of these criteria for the Department of Fish and Wildlife's forests as priority habitats? <i>If you answer yes you will still need to rate the wetland based on its functions.</i></p> <ul style="list-style-type: none"> — Old-growth forests: (west of Cascade crest) Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/acre (20 trees/hectare) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 inches (81 cm) or more. <p>NOTE: The criterion for dbh is based on measurements for upland forests. Two-hundred year old trees in wetlands will often have a smaller dbh because their growth rates are often slower. The DFW criterion is and "OR" so old-growth forests do not necessarily have to have trees of this diameter.</p> <ul style="list-style-type: none"> — Mature forests: (west of the Cascade Crest) Stands where the largest trees are 80 – 200 years old OR have average diameters (dbh) exceeding 21 inches (53cm); crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth. <p>YES = Category I NO <u> x </u> not a forested wetland with special characteristics</p>	<p>Cat. I</p>
<p>SC 5.0 Wetlands in Coastal Lagoons (see p. 91)</p> <p>Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?</p> <ul style="list-style-type: none"> — The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks — The lagoon in which the wetland is located contains surface water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon (<i>needs to be measured near the bottom</i>) <p>YES = Go to SC 5.1 NO <u> x </u> not a wetland in a coastal lagoon</p> <p>SC 5.1 Does the wetland meets all of the following three conditions?</p> <ul style="list-style-type: none"> — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of invasive plant species (see list of invasive species on p. 74). — At least 3/4 of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland is larger than 1/10 acre (4350 square feet) <p>YES = Category I NO = Category II</p>	<p>Cat. I</p> <p>Cat. II</p>

Wetland name or number _____

<p>SC 6.0 Interdunal Wetlands (<i>see p. 93</i>)</p> <p>Is the wetland unit west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)?</p> <p>YES - go to SC 6.1 NO <input checked="" type="checkbox"/> not an interdunal wetland for <i>If you answer yes you will still need to rate the wetland based on its functions.</i></p> <p>In practical terms that means the following geographic areas:</p> <p>Long Beach Peninsula- lands west of SR 103</p> <p>Grayland-Westport- lands west of SR 105</p> <p>Ocean Shores-Copalis- lands west of SR 115 and SR 109</p> <p>SC 6.1 Is the wetland one acre or larger, or is it in a mosaic of wetlands that is once acre or larger?</p> <p>YES = Category II NO – go to SC 6.2</p> <p>SC 6.2 Is the unit between 0.1 and 1 acre, or is it in a mosaic of wetlands that is between 0.1 and 1 acre?</p> <p>YES = Category III</p>	<p>Cat. II</p> <p>Cat. III</p>
<p>Category of wetland based on Special Characteristics</p> <p><i>Choose the “highest” rating if wetland falls into several categories, and record on p. 1.</i></p> <p>If you answered NO for all types enter “Not Applicable” on p.1</p>	<p>N/A</p>