Erick Creek

Habitat Restoration

Preliminary Design Report

SUBMITTED TO
Cowlitz Tribe

September 2016

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SUBMITTED TO
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1 Project Overview

1.1 PURPOSE

This report summarizes preliminary design for aquatic habitat restoration in Erick Creek, a tributary to Abernathy Creek. The purpose of this project is to enhance habitat for steelhead and ESA-listed coho salmon. Projects that result from this effort will be consistent with the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, the Lower Columbia Fish Recovery Board (LCFRB, 2004) 6-Year Habitat Work Schedule, and goals of the Abernathy and Germany Creeks Intensively Monitored Watershed (IMW) Treatment Plan (HDR 2009).

1.2 INTRODUCTION

Erick Creek is a tributary to Abernathy Creek in the Washington coast range. Abernathy Creek provides habitat for Chinook salmon, coho salmon, chum salmon, and steelhead trout, all listed as threatened under the federal Endangered Species Act (ESA), as well as coastal cutthroat trout and other species. Erick Creek is primarily used by coho and steelhead.

Figure 1. Cedar Stump with Western Hemlock Second

Forestry (logging and road building) is the dominant land use and nearly all of the timber in the basin has been harvested at some time in the past. Streams have been impacted by past timber harvest, wood removal, roads and bridges. A fill prism extends into the Erick Creek floodplain near the confluence with an unnamed tributary that is likely an abandoned railroad fill.

The goals of this project are to increase high quality spawning and rearing habitat for steelhead and ESA-listed coho salmon, increase channel complexity, and improve floodplain connectivity.
This report summarizes:

- Goals and objectives
- Site assessment
- Description of proposed project
- Conceptual designs
- Opinions of probable cost

Project Area

The project area is located on Washington Department of Natural Resources land approximately 2200 feet upstream of the confluence with Abernathy Creek and extends over 1 mile upstream (Figure 1).

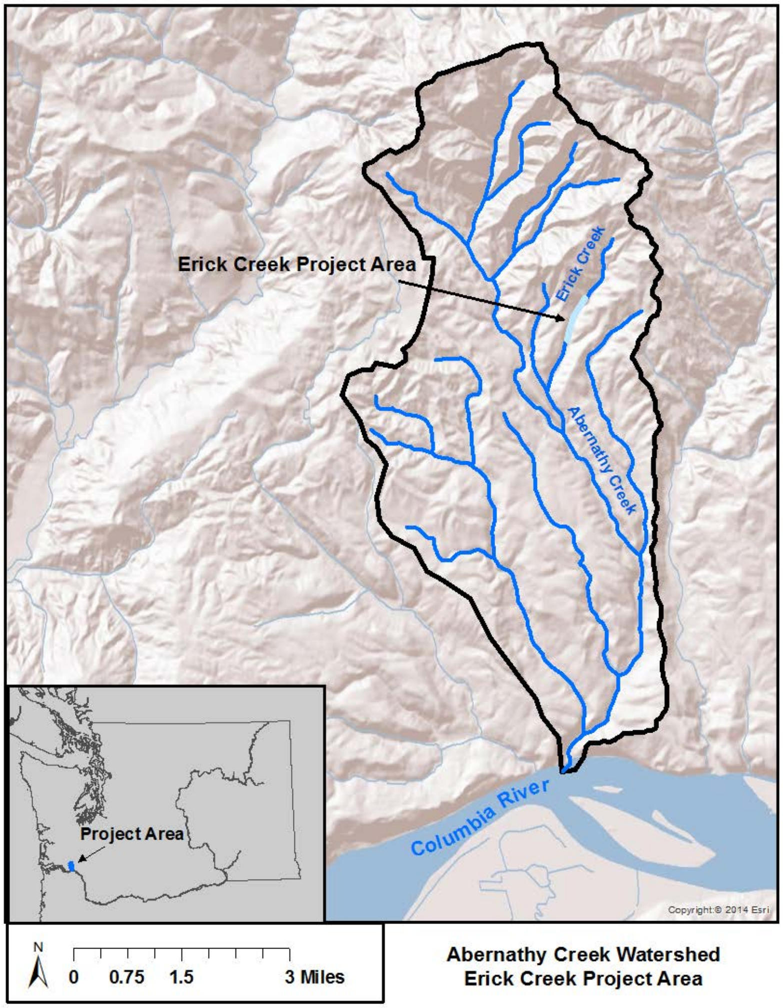

Figure 2 Erick Creek Project Location within Abernathy Creek Watershed.

Site visits were conducted to perform a topographic survey and geomorphic assessment to identify habitat conditions. The field visits serve as the basis to develop a suite of conceptual restoration alternatives, identify key feasibility constraints, and identify access corridors to develop preliminary designs. Inter-Fluve staff performed site reconnaissance to identify concepts for preliminary design.

A design concepts map (Figure 2) was developed based on the site reconnaissance. Conceptual design alternatives were developed and presented to the TOG to develop a preferred alternative for preliminary designs per the requirements of SRFB Manual 18, Appendix D.

This site is geomorphically dynamic with evidence of active gravel transport and bar development. Forest conditions are now dominated by early successional species with few conifers located near the channel margins. Preliminary designs have been developed to optimize site potential for coho salmon and steelhead. Large wood will be utilized to encourage the development of off channel habitat and scour pools with complex rearing cover to improve overall channel complexity. Wood placements will also help to sort substrate and provide deposition areas for fine sediment, functions that improve spawning habitats.

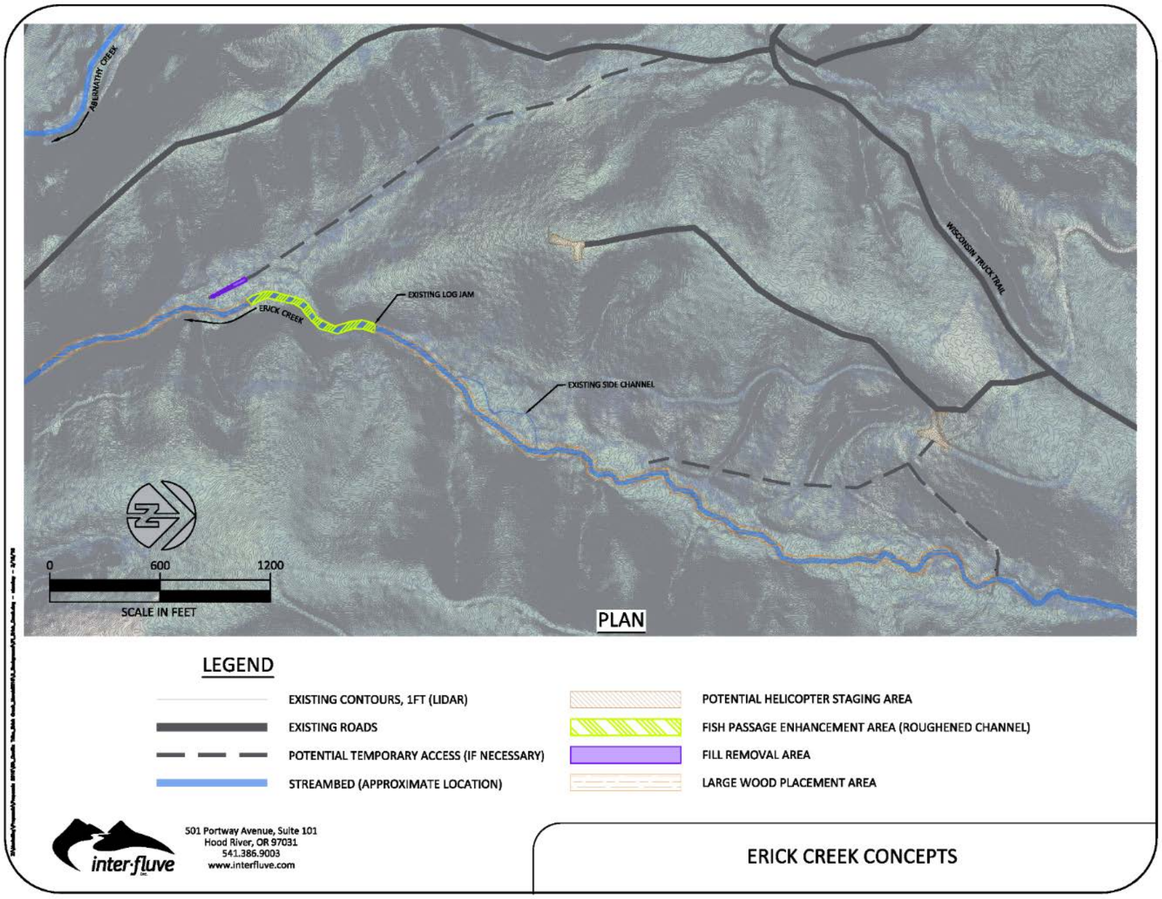

Figure 3. Erick Creek Project Area

1.3 GOALS AND OBJECTIVES

Regional Habitat Goals and Priorities

The Lower Columbia Fish Recovery Board (LCFRB) drafted the *Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan* in 2004 to identify a vision, strategy, and set of actions to recover listed salmonids to healthy levels. This plan identifies key priorities for salmonid recovery in the Abernathy Creek watershed. Priorities relevant to the Erick Creek project area are:

1. Restore lowland floodplain function , riparian function, and stream habitat diversity
2. Address immediate risks with short-term habitat fixes

The *Intensely Monitored Watershed (IMW) Treatment Plan* (HDR 2009) for the Abernathy basin identifies limiting factors for salmonid recovery, and recommends reach specific restoration actions. Limiting factors relevant to salmonid recovery in the Erick Creek project area include:

1. Habitat diversity
2. Key habitat quality and quantity
3. Sediment load
4. Channel stability

Lower Columbia IMW Study Plan Update (2015) summarized primary limiting factors for this IMW unit as channel stability, habitat diversity, key habitat quality, sediment load, water temperature, and flow.

Cramer Fish Sciences (2015) identified appropriately sized gravel and high percentage of fines as limiting factors for spawning capacity, and lack of large wood as limiting factor for rearing capacity in Abernathy Creek.

Goals

The primary goal of this project is to develop restoration designs that will improve spawning and rearing habitat for coho and steelhead by replicating historical conditions and functions that supported robust populations. Specific goals that support this primary goal are based on previous work in this watershed, as cited above. Specific goals for this project include the following, which are closely related and many overlap:

1. Improve lowland floodplain function
2. Improve riparian function
3. Increase stream habitat diversity
4. Improve channel stability
5. Improve overall habitat diversity
6. Improve key habitat quality
7. Store and sort sediments
8. Reduce water temperatures at baseflow
9. Increase baseflow
10. Identify immediate risks to habitat and prescribe treatments

At the basin-scale, the goal of this and other Abernathy Creek Watershed habitat restoration projects is to create enough change in instream habitat to cause measureable increases in salmonid production as defined in the updated monitoring plan for the IMW program.

Objectives

The objectives for the preliminary design address the project goals identified above. Preliminary design objectives have been categorized into geomorphic and habitat objectives, recognizing that they are interdependent and interrelated.

Geomorphic Objectives

- Channel profile – Placement of large wood will encourage aggradation which will lead to measureable changes in local bed slope and more variability in bed slope throughout the reach.

- Channel planform – Lateral channel dynamics will be increased by large wood placements through increases in sinuosity, planform complexity, and the frequency of multi-thread channel segments.

- Bed material – Restoration activities have been designed to encourage the recruitment of gravels and to decrease the average diameter of bed material (D50) across the reach.

- Large wood and log jams – The number of pieces of large wood per unit length will meet or exceed the NMFS standard for Western Cascades streams, which is 80 pieces per mile (>12 inches diameter; >35 feet long). This target meets or exceeds the reference quantities measured by Fox and Bolton (2007). The frequency of log jams will be increased to emulate historical patterns and processes.

- Floodplain inundation – Project elements will be designed to increase side-channel activation at a range of flows and floodplain inundation above the channel-forming flow (Q1-2).

Habitat Objectives

- Increase the quantity and accessibility of juvenile rearing habitat for steelhead and coho salmon.

- Increase the amount of potential steelhead and coho spawning habitat.

- Off-channel habitat complexity – The wetted area of off-channel habitat (either backwater channels or flow through side channels) will increase at a range of flows.

- Pool frequency – The number of pools per unit stream length will increase over the reach. Particular project elements (e.g. log jams) will be designed to encourage and maintain scour conditions and encourage pool formation.

- Cover – Projects will be designed to provide increased aerial extent of cover per unit stream length, primarily through the placement of large wood and log jams.

- Hydraulic refuge – Project will be designed to increase the area available for hydraulic refuge during high flow events. This will be accomplished through increased stream channel structure (i.e. large wood) and increased off-channel habitat availability.

- Riparian conditions – We will work closely with DNR staff to develop silvicultural prescriptions to thin riparian alder stands and establish conifer seedlings, providing long term wood supplies and ample shade for the project reach.

2 Site Conditions

Site visits were conducted to perform the topographic survey, perform geomorphic assessment field work and identify habitat conditions. The field visits serve as the basis to develop a suite of conceptual restoration alternatives, identify key feasibility constraints, and identify access corridors to implement preliminary designs.

2.1 TOPOGRAPHIC SURVEY

Topographic surveys of Erick Creek using RTK GPS and total stations were conducted in March 2016 to support design and hydraulic analysis. The area surveyed includes approximately 6300 feet of Erick Creek upstream of the DNR property boundary. Surveys focused on collecting cross-sections of the channel, channel longitudinal profiles, and topographic features in areas of potential work. The survey data were combined with LiDAR data for hydraulic analysis.

2.2 HABITAT CONDITIONS

Spawning surveys have identified a relatively high incidence of coho spawning in Erick Creek. Spawning habitat to coho and steelhead is currently available within the project area. Fish use in Erick Creek is limited by incised channels, high water velocity, and sparse in-stream habitat where there is a lack of existing large wood. A large log jam, approximately 5-6 feet in height is located within the project area and it is currently degrading. Evidence of head cuts exist upstream of this log jam. Continued degradation of this existing log jam could present an immediate risk to Erick Creek spawning habitat upstream of the log jam if it does not recruit additional key pieces of large wood.

2.3 WATERSHED CHARACTERISTICS

Land Use

The Abernathy Creek watershed is primarily managed for commercial forestry. WDNR manages over one-half of the watershed including all land within the project area. Private timber lands are located downstream of the project area (Sheet 4 of the Preliminary Design Drawings). Past forest practices have impaired fish habitat by modifying stream flow, increasing fine sediment, and removing large conifers from the riparian zones (LCFRB 2004). A prism of fill material from a decommissioned road/rail currently impinges on the floodplain in a portion of the site. An existing culverts at Abernathy Creek Road may limit fish passage and is in the planning phase for replacement.

Geology

The Abernathy Creek watershed is located within the southern portion of the South Cascades geologic province. The geology of the region is complex, resulting from millions of years of volcanic activity. Mountain building by volcanism was the predominant activity from the Oligocene through Quaternary time. Nearshore sediments (to the west), Columbia River basalts, and volcanic center contributions of volcanoclastic lahars, ash beds, and mud flows fill in valleys and depressions, providing geologic diversity. Multiple blocks of unrelated rock types were brought together by this activity and uplift during the late Miocene and Columbia River basalt flows (WDNR 2015).

Bedrock Types

Three primary types of bedrock are located within the contributing watershed of the study area: (1) Miocene volcanic rocks and deposits (2) Eocene volcanic rocks and deposits, and (3) Miocene sedimentary rocks in the upper portion of the study reach. Weathering and fluvial processes have contributed to the erosion of this landscape over time. Volcanic rocks are the protoliths (original lithology types) of Abernathy Creek sediment, and were transformed into the underlying bedrock seen in the watershed today through uplift and erosion (WDNR 2015).

Hydrology

Erick Creek is a tributary to the Abernathy Creek, with a watershed area of 1.8 square miles. Erick Creek contributes 6.3% of the total Abernathy Creek Watershed. Erick Creek drains a portion of the upper Abernathy Creek, from an elevation of approximately 2000 feet above sea level at its headwaters to 400 feet at the confluence with Abernathy Creek. The project area ranges from approximately 490 to 660 feet in elevation. This watershed receives 92.1 inches of rain annually on average. Snowfall is light due to mild winters and the relatively low elevation of this watershed, and rain on snow events are rare. Summers are dry and cool, with the lowest monthly flows occurring in July, August, and September (LCFRB 2004). (Rainfall and basin area were calculated using the USGS StreamStats web interface).

2.4 GEOMORPHIC CONDITIONS

Historic geomorphic conditions

The geomorphic and habitat characteristics of Erick Creek today are very different than they were historically. Variations in valley confinement and slope were a major driver of channel-scale geomorphic processes, and lateral migration of the channel was limited by narrow valley width. A riparian zone of mature conifers provided rot resistant large wood to Erick Creek, stabilizing the bank during flood events, providing channel complexity, and promoting floodplain connectivity (HDR 2009).

Current geomorphic conditions

The project site is geomorphically dynamic with evidence of active gravel transport and bar development. Forest conditions are now dominated by early successional species with few conifers located near the channel margins. Figure 4 displays geomorphic processes that form habitat when wood is introduced to Erick Creek. Sediment sorting and storage results from relatively small, early successional, red alder falling into the stream to form critical habitats. Field observations suggest that the sediments that are crucial to salmon spawning and rearing are moving through Erick Creek in abundance.

Figure 4. Downed Red Alder Providing Sediment Retention

Approximately 6200 feet of Erick creek are contained within the project site at an average gradient of 3.0%. Erick Creek generally flows from North to South through the project reach. The Erick Creek project includes four distinct reaches named as follows: Canyon Reach, Tributary Reach, Bedrock Reach, and Upper Reach. The Upper Reach is located at the upstream end of the project area and has a broad floodplain with a primarily a single thread channel except where large wood accumulations have braided the channel. The Upper Reach ends at a constriction in the floodplain where a large, 5-6 feet high log jam exists. The Bedrock Reach is located downstream of the existing log jam and extends approximately 500 feet. Approximately half the Bedrock Reach floodplain is confined by bedrock outcrops on both sides of the valley. Channel margins at the downstream half of the bedrock reach are comprised of fine sediments approximately 6 feet in height where the floodplain widens into the Confluence Reach. The Confluence Reach includes the confluence with an ephemeral stream that enters Erick Creek from the Northwest direction. The Confluence Reach has a broader floodplain that expands out of the Bedrock Reach and contracts to the Canyon Reach located downstream. The Canyon Reach extends to the DNR property boundary located at the downstream end of the project.

Upper Reach

The upper project reach has a broad alluvial floodplain that is dominated by stands of red alder. Compared to historical conditions, which included old-growth conifers and abundant key pieces in the channel, the existing channel complexity and stability is lower. However, existing channel complexity is relatively high compared to current conditions in other reaches of Erick Creek. The upper project reach is approximately 4100 feet long channel and has an average slope of 2.7%. This reach includes a free-formed alluvial channel with pool-riffle morphology. The channel is predominantly single thread with some mid channel bar formations typically associated with existing large wood that has fallen into the channel. Based on observations of flood scars, vegetation patterns, and sediment deposits, some floodplain terraces appear relatively well connected at low-to-moderate flood events (i.e. 2- to 5-year recurrence interval events). Other areas within this reach display relatively high levels of incision as a result of past watershed land-uses as well as localized impacts.

Figure 5. Existing Log Jam Located in Upper Reach

Substrate is dominated by gravels and small cobbles. Coarse sediment are located in this reach where large wood does not exist. Gravel sized particles are typically located in areas where existing downed wood has sorted sediments. Some bedrock contacts were observed in the streambed in the downstream portion of this reach, which provides evidence of incision that appears to have resulted from degradation of the existing log jam located at the downstream end of this reach.

Bedrock Reach

Bedrock is the dominant substrate in the Bedrock Reach. The existing log jam at the upstream end of the Bedrock Reach impedes fish passage at lower flows and high velocities impede fish passage in this reach at higher flows. Nearly all alluvial sediment has been scoured down to bedrock for approximately 740 feet downstream of the existing log jam. Average slope in the Bedrock Reach is 3.5%.

Figure 6. Fine Sediment Streambanks located at the Downstream End of the Bedrock Reach

Confluence Reach

The floodplain widens downstream of the bedrock reach and an unnamed tributary enters Erick Creek from the northwest. The Confluence Reach is approximately 550 feet long with an average slope of 1.6%. A fill prism from an abandoned logging railroad is located near the confluence with the tributary. The fill prism constricts floodplain flows. The floodplain in the confluence reach has relatively robust native forest vegetation. Similar to the upper project reach, early successional characteristics dominate, and there is a lack of large conifers that likely governed channel and floodplain processes prior to the first timber harvest activities. Although some conifers occur occasionally within the floodplain, alder and big leaf maple dominate canopy cover. Future large wood recruitment will likely only include early successional tree species. Common shrub species include salmonberry, willow, and vine maple. No significant presence of invasive non-native species was observed. The dominant stream substrate size in the reach ranges from fine to coarse gravel.

Figure 7. Confluence Reach

Canyon Reach

The Erick Creek valley constricts again downstream of the Confluence Reach. This reach extends to the downstream end of the project area and is approximately 790 feet long. The dominant channel form in this reach is a single thread channel with an average gradient of 2.7%. The Canyon Reach is similar to the bedrock reach except it has retained cobble and gravel in the streambed. The presence of cobble and gravel substrate results from several channel spanning log sills that accrete sediments in this reach. Habitat in this reach is limited by lack of off-channel habitat.

Figure 8. Canyon Reach

3 Hydrology & Hydraulics

3.1 DESCRIPTION AND OVERVIEW

The U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS 5.0.0) was used for hydraulic modeling. HEC-RAS was used to perform hydraulic computations including estimates of water surface elevations, lateral inundation extent at a cross-section, velocity, and shear stress for discharge values under existing and proposed conditions.

3.2 HEC-RAS MODEL

River Geometry

Existing conditions model geometry was developed using topographic data obtained through surveys completed in March, 2016 combined with LiDAR of the greater area. Hydraulic cross-sections were surveyed perpendicular to the primary flow vector across hydraulic controls such as riffle crests. Out of channel data was collected as lines of points along major slope breaks, or as gridded points covering larger areas of ground. Survey data was supplemented with LiDAR (2010) data (PSLC 2010) laterally from surveyed cross section extents. The LiDAR and survey data were post-processed with AutoCAD software in order to create a 3-dimensional surface of site topography as the basis for the HEC-RAS River geometry.

Manning's Roughness Coefficients and Boundary Conditions

Stream roughness for the three reaches was determined based on several contributing factors including the shape of the channel and degree meander, obstructions within the channel, the type and size of bed material, and vegetation (Arcement Jr. and Schneider, USGS. 1989). Existing conditions modeled roughness coefficient values generally correspond to the values are displayed in Table 1, except where more detail was input such as locations of existing log jams, side channels and high flow channels.

Table 1 Manning values for existing conditions HEC-RAS modeling.

Modeled feature	Mannings Value
Left Bank Floodplain	0.09
In-channel	0.04
Right bank floodplain	0.09

Proposed conditions log jams were modeled with a combination of blocked obstructions and increased roughness. The blocked obstruction generally included raising the channel bed 18 inches where channel spanning log jams are anticipated to aggrade gravel, and at lateral channel margins where proposed log jams are anticipated to obstruct flow. Channel roughness was generally increased to a value of 0.065 for proposed conditions to model increased irregularity of bed forms associated with gravel accretion anticipated to result from proposed large wood placements. In areas where extensive floodplain wood placements are proposed roughness values were generally increased to a value of 0.12.

Peak Flow Analysis

A hydrologic analysis of Erick Creek was conducted in order to estimate the magnitude of peak flow events for several standard recurrence intervals (2-, 5-, 10-, 25-, 50-, and 100-year). A standard method of peak flow estimation for a range of recurrence intervals is a Log-Pearson Type III regression of long-term annual peak flow records, often available from the USGS. Neither Erick Creek nor Abernathy Creek have a long-term peak flow measurement record. Consequently, two alternative methods of peak flow analysis were compared in order to provide multiple lines of evidence to support peak flow estimates on these rivers.

The first method used was regional regression curves that estimate stream discharge for several recurrence intervals based on multiple basin characteristics. The USGS StreamStats web interface was utilized to determine basin characteristics and compute the regression curves. Using the StreamStats program, a downstream flow point was located at the downstream extent of the Erick Creek project site. Peak flow estimates were generated for several recurrence intervals (Table 2).

Table 2 USGS StreamStats Regional Regression calculations

Basin Delineation Location	Basin Area (miles^2)	2-year (ft^3/s)	10-year (ft^3/s)	25-year (ft^3/s)	50-year (ft^3/s)	100-year (ft^3/s)
Erick Creek at downstream end of project site	2.45	125	221	272	314	355

The second method used was the discharge per unit area method. This method uses a comparative-scaling analysis across nearby basins to calculate recurrence interval flows and was used for all reaches. The Chehalis River basin was chosen as the comparison basin, because of similar geographical location and climatic characteristics, and has a long-term record of annual peak discharge. Peak flow records for this river were analyzed with a Log-Pearson Type-III regression to yield estimates of discharge at several recurrence intervals. These discharge values were normalized by the basin area contributing to flow at each gage resulting in values of ft^3/s per mi^2 (Q/A) for each recurrence interval. To estimate discharge values for selected recurrence intervals on Erick Creek, the normalized discharge values for each recurrence interval were multiplied by the contributing drainage area of Erick Creek used in the *StreamStats* analysis. For all recurrence intervals, this method provided higher estimates of flow than the regional regression method.

Peak discharge values for HEC-RAS hydraulic modeling were ultimately produced using the discharge per unit drainage area method. The normalized discharge values for the South Fork of the Chehalis River near Wildwood (Gage #102020800) were used to estimate peak discharges for Erick Creek. Though the record at this gage is short (13 observations), the drainage is very similar to Abernathy Creek in geographic placement and hydrologic patterns. Both drainages are oriented longitudinally, and share a drainage divide at their respective headwaters. An extremely high flow event that occurred in January of 2009 was taken out of the peak flow record for the South Fork Chehalis record prior to analysis. This event was 78% larger than the next highest event on the record and would have skewed the analysis of such a short peak flow record. The gage on the Chehalis River at Doty (12020000) also records this event. The record at the Doty gage extends back 70 years and the January 2009 event is 130% larger than the previous highest recorded discharge on that gage indicating that the high flow event was out of the ordinary and supports the choice to remove the event from a short record. A summary of flow values is presented in Table 3 below:

Table 3 Modeled Flow Values

Basin Delineation Location	Basin Area (miles^2)	2-year (ft^3/s)	5-year (ft^3/s)	10-year (ft^3/s)	25-year (ft^3/s)	50-year (ft^3/s)	100-year (ft^3/s)
Erick Creek at downstream end of project site	2.45	215	319	391	486	558	632

Model Results

HEC-RAS model results have been submitted as an electronic MS Excel file since it includes nearly 800 lines of tabular output data. Model output as related to project stability is address in subsequent design sections by project reach.

4 Vegetation

General Land Office (GLO) surveys from the early 1860s and 1870s provide some representation of historical land character and vegetation communities, calling the "land rolling and high- soil third rate." Timber is called out as hemlock, spruce and white fir, with undergrowth of Huckleberry and Salmonberry. These early surveys also represent the historical size of large wood within the watershed, calling out Hemlock and Fir ranging in size from 18'' to 60'' in diameter. Also of note, by this time the project area was up for sale as forestland as part of the 'Timber Lands Act of June 3, 1878' ("An act for the sale of timber lands in the states of California, Oregon, Nevada, and Washington Territory).

The contemporary vegetative community along Erick Creek varies by elevation and distance from the water table. The forest throughout the reach appears to be largely in the stem exclusion phase, indicating some recent disturbance, likely related to timber harvest. The riparian corridor is made up primarily of alder, big leaf maple, western red cedar, Hemlock, and fir, with an understory of fern, snowberry, huckleberry, and salmonberry. Riparian vegetation is primarily mid-seral stage and though provides good shading, provides limited hydraulic roughness. Intermediate floodplain surfaces (e.g. Q2) were scoured by a flood approximately 40 years ago, which has resulted in a relatively early seral stage alders (30 to 40 years old) canopy along channel margins and mid-channel islands.

5 Conceptual Design Alternatives

A conceptual design that included 3 alternatives and a no action option was submitted in June 2016. The Erick Creek project is a difficult site to access. There are some existing logging roads that allow equipment to get close to the site, but equipment access to the valley bottom is limited and ground equipment access would generally result in significant disturbance. The one exception to the general valley bottom disturbance is the Confluence Reach. Thus, conceptual design alternatives were developed based on access requirements for the project site. The conceptual design alternatives included a helicopter only access option, a ground-based equipment access option, a hybrid helicopter and ground-based equipment option, and a no action alternative. These alternatives were presented to the TOG in July 2016 and the hybrid access option was selected as the preferred alternative. As such, the preliminary design is a refinement of the hybrid access option.

6 Project Design

The restoration treatments included in the preliminary design have been developed based upon 1) regional and site-specific goals (subbasin plan and IMW goals), 2) additional information obtained from site surveys, and 3) coordination and communication with the TOG and project sponsor.

The project site was broken into four treatment reaches described in previous sections based on the opportunities and constraints of each reach. Each restoration treatment will be completed in tandem with riparian planting to promote the long-term recovery of the riparian community and large wood delivery process. In some areas, crews will selectively thin riparian areas to promote stand diversity and allow conifer release. Preliminary design criteria and treatment options are described below.

6.1 PRELIMINARY DESIGN CRITERIA

The following design criteria have been developed to guide the conceptual design process and to ensure that project objectives are achieved and project constraints understood and explicitly addressed. Design criteria are provided below within five sections: Geomorphology, Habitat, Engineering, and Feasibility/Construction.

Geomorphology

Design projects that are consistent with existing log jams in Erick Creek that will enhance channel complexity and habitat quality and quantity in a way that will be geomorphically sustainable given the current and future sediment load, land use, and large wood regime. Existing log jams in the project area that are effectively aggrading sediment and providing channel and flow complexity were used as templates when exploring different large wood installation strategies. The following are characteristics of these existing model log jams that proposed structures seek to emulate:

- One to four 18-22” DBH coniferous logs that provide stability and longevity for the Upper Reach and Confluence Reach.
- Nine to twelve 18-22” DBH coniferous logs that provide stability and longevity for the Canyon Reach.
- A matrix of 18-22” DBH coniferous logs placed in the streambed of the Bedrock Reach to retain sediment over the existing bedrock substrate.
- 18-22” DBH logs that span the entire channel to catch slash, retain sediment, and provide stability
- Intact rootwads that provide stability and create complex pool habitat

Project designs shall seek to emulate existing natural log structures, while considering current and future characteristics including:

- Planform and cross-sectional geometry

- Bed elevation
- Hydrology

The project design include three features specific to the Confluence Reach where ground-based equipment access along an abandoned railroad grade allows for treatments that further increase floodplain function:

- Create two high flow channels within the Confluence Reach.
- Remove abandoned railroad fill impinging the Erick Creek floodplain in the Confluence Reach.

Habitat

Design projects to benefit salmon and coho populations by:

- Improving habitat and complexity
- Providing high flow refuge habitat

Design projects to promote desired in-channel geomorphic processes that:

- Retain spawning gravels
- Recruit large wood
- Aggrade sediment
- Reconnect the channel to the floodplain

Engineering

Design resilient project conditions that:

- Withstand the predicted hydraulic effects of flood events.
- Utilize whole tree large wood resources that have a high probability of being caught within the existing floodplain forest if mobilized during a large flood.
- Assumes that boat use in the project reach is insignificant or non-existent.

Feasibility/Construction

Select installation methods that:

- Minimize negative impacts to target species
- Minimize negative impacts to intact habitat and vegetation
- Utilize existing access where possible

The proposed project consists of large wood installations utilizing both a ground crew with heavy equipment, and a helicopter crew using a Vertol 107 helicopter, chainsaw winches, and come-alongs. Log placement, density, and installation technique will be site-specific to minimize both cost and disturbance to the streambed and riparian zone. The use of heavy (ground based) equipment to the Confluence Reach is dependent upon securing access agreements with DNR. If heavy equipment access is not obtained, large wood will be placed with a helicopter in all areas of the project.

Length of large wood and the use of whole trees with intact rootwads is a primary consideration for stability for this project. Stability will rely on large wood size classified as key pieces as defined by Schett-Hames (1999) and Fox (2001), and referenced in Stream Habitat Restoration Guidelines (Cramer, 2012). The design will also utilize smaller wood size classifications that are anticipated to be pinned down or trapped by larger key pieces. This design acknowledges that wood may move from its placed location, but will not travel far downstream to create an infrastructure problem based on channel widths and large wood length with intact rootwads. The preliminary design assumes that the 2-year recurrence interval flow represents bankfull width. This design assumption will need to be addressed in subsequent design development to refine key piece size specifications according to project reach and field measured bankfull widths.

This project design may potentially be adjusted to replace ground based equipment wood placements with helicopter based large wood placements. A design adjustment to all helicopter large wood placements would include increasing the quantity and size of large wood placements where heavy equipment access is shown. This potential design adjustment also depends upon the project sponsor's ability to secure a large wood source for construction.

6.2 UPPER REACH

Design Overview

Log jam installation in Erick Creek in the Upper Reach will consist of 151 individual logs installed using a helicopter and manipulated with chainsaw winches and come-alongs to achieve the desired positioning. Access to the Upper Reach of Erick Creek is limited due to loose soils in the valley bottom and impacts to existing vegetation that would result from ground-based equipment access. The soft surface conditions would inhibit movement of heavy equipment and make moving equipment through the stream necessary to prevent excessive damage to the riparian zone. Utilizing a helicopter to place logs and hand operated power tools to manipulate them will minimize disturbance to the streambed and riparian zone. The Upper Reach treatments are shown on Sheet 5, upstream of Station 21+50, and Sheet 6 of the preliminary design drawings.

Proposed Features

Individual logs will be placed both in the floodplain and in the channel. Floodplain logs will increase floodplain roughness to prevent future channel incision should the channel avulse and change course into the floodplain. Logs placed in the channel will be both on the channel margins and span the channel to slow water, promote sediment aggradation, and create habitat. In-channel logs will be interwoven at their ends when possible to increase stability during high flows, maximize sediment capture, and minimize spacing between logs.

This is a critical reach from a stability and timing standpoint since it appears that the channel is incising due to degradation of the existing log jam located at the downstream end of the reach. Treatment of this reach should occur as soon as possible to avoid adverse impacts to spawning and rearing habitat in Erick Creek.

Adding key pieces of large wood in the Upper Reach will create instream structure and habitat complexity conditions that mimic the historical conditions to which local fish populations have adapted.

Several opportunities for off channel habitat exist in this reach including wall based channels, backwater alcoves, and side channels. Large wood installations will make the most of these off channel habitat opportunities, as practicable. These measures will likely include encouraging beaver to inhabit this reach to enhance habitat conditions through dam building.

6.3 BEDROCK REACH

Design Overview

The Bedrock Reach can be accessed with ground-based equipment from the upstream end of the Confluence Reach. Access to this reach is shown on Sheets 4, 5, and 7 of the preliminary design drawings. The preliminary design relies on this access and use of ground-based equipment. The use of ground-based equipment to install a matrix consisting of approximately 60 pieces of large wood along the bed and banks of the bedrock reach. Approximately 24 pairs of pilings (44 total) will be used to secure large wood placed along streambanks comprised of fine grained soils in the downstream half of the bedrock reach. A proposed high flow channel will branch off the main stem in this reach and continue through the Confluence reach, downstream. The proposed high flow channel will also provide a corridor for heavy equipment access. The treatment within the Bedrock Reach is provided on Sheet 8 of the preliminary design drawings.

Proposed Features

The matrix of logs placed in the channel bed will be utilized to trap gravel and gradually bring the channel grade up to the top of the existing log jam at the upstream end of the reach. This log matrix will consist of one, two, and three layers of large wood spanning the channel bed at difference locations within the reach, depending on the level of grade adjustment desired. The log matrix also includes rootwads placed along the channel banks that extend down into the channel bed to provide cover and escape habitat. The downstream half of the Bedrock Reach includes sloping bank banks comprised of fine grained soils and placing large wood along the bank to increase streambank roughness to reduce inputs of fine grained soils. The design team is considering screening railroad grade fill from the Confluence Reach and using the screened fill to backfill the downstream portion of the log matrix proposed in the Bedrock Reach.

6.4 CONFLUENCE REACH

Design Overview

The preliminary design utilizes an abandoned railroad grade to access the Confluence Reach and the Bedrock Reach. Approximately 100 lineal feet of the abandoned railroad fill impinges the Erick Creek floodplain and is identified for removal. The removed material appears to be a mixture of alluvium, colluvium, and fine grained soils. If this material is screened to remove fine grained soils, it may be put to beneficial use by backfilling the downstream portion of the log matrix proposed in the Bedrock Reach. The Confluence Reach also includes construction of two high flow channels, as depicted on Sheet 7 of the preliminary design drawings.

Proposed Features

Individual logs will be placed both in the proposed high flow channels and in the main stem of Erick Creek. Large wood placements will increase channel roughness to slow water, promote sediment aggradation, and create habitat. In-channel logs will be interwoven at their ends when possible to increase stability during high flows, maximize sediment capture, and minimize spacing between logs.

6.5 CANYON REACH

Design Overview

Access to the Canyon Reach of Erick Creek is restricted by canyon walls and riparian vegetation growing on the narrow channel margins. The relatively narrow floodplain restricts transport of construction equipment in since it would require traveling up the stream channel or causing excessive riparian vegetation damage. Helicopter placed logs will be used in in the Canyon Reach where ground-based equipment access is considered to be too high an impact. Treatments within the Canyon Reach are shown on Sheet 5 of the design drawings, downstream of Station 8+00. The log placements are anticipated to resemble log jams placed in Cameron Creek earlier this year, as shown below.

Figure 9. Helicopter Placed Log Jam in Cameron Creek

Proposed Features

Log jams will span the channel to slow water, promote sediment aggradation, and create habitat. In-channel logs will be interwoven at their ends when possible to increase stability during high flows, maximize sediment capture, and sort sediments.

6.6 OPINION OF PROBABLE COST FOR ALL REACHES

Costs associated with construction, permitting, and design services for the Erick Creek project have been developed with assumptions for helicopter operations and ground based operations as shown on the drawings. The cost opinion has been submitted as a separate document to the Cowlitz Indian Tribe.

4 References

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