Basis of Design Report: Final (100%)

Bird Track Springs Habitat Improvement Project

June 2020

Cardno®

Document Information

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Table of Contents

1 Introduction 1-1
1.1 Purpose and Use of 100% Document 1-1
1.2 Report Outline and Content Relative to BPA BDR Template Guidance 1-1
2 80% Design RRT Comment Response 2-1
3 100% Design Finalization 3-1
3.1 Design Elements and Rationale 3-1
3.1.1 95% to 100% Surface/Grading 3-1
3.1.2 Hydraulic Modeling 3-1
3.1.3 Channel Bed 3-1
3.1.4 Ice Processes Management 3-7
3.1.5 Revegetation 3-9
4 Risk Assessment 4-1
4.1 Overall Risk Summary and Recommendations 4-1
4.1.1 Large Woody Material Risk Summary 4-1
4.1.2 Discussion of Proposed Conditions and Changes to Hazards 4-1
4.1.3 Recommendations 4-1
5 Contract Documents 5-1
5.1 Quantities 5-1
5.1.1 Large Woody Material 5-1
5.1.2 Earthwork Volumes 5-2
5.1.3 Riprap Quantities 5-2
5.2 Bid Sheet Development 5-2
6 Environmental Compliance and Permitting 6-1
6.1 National Environmental Policy Act Compliance 6-1
6.2 Cultural Resources, NHPA Section 106 Consultation 6-1
6.3 Endangered Species Act, Section 7 Consultation 6-1
6.4 State and Federal Permits 6-2
7 Construction Approach 7-1
8 Implementation Schedule 8-1
9 Monitoring, Maintenance, and Adaptive Management 9-1
10 References Cited 10-1

Appendices

Appendix A 100% Design Drawings
Appendix B 100% Design Engineer's Bid Sheet Development
Appendix C 100% Design Hydraulic Model Report

Appendix D 100% Design Project Permitting Documentation (USACE/JPA/106/ODOT)
Appendix E 100% LWM Risk-Based Design
Appendix F 80% Comment Response Matrix
Appendix G HIP III Authorization
Appendix H Monitoring and Adaptive Management Plan

Tables

Table 1-1 Analogous Sections Summary 1-1
Table 3-1 Dimensionless Shield’s Parameter for Different Particle Sizes 3-3
Table 3-2 Allowable Shear Stress Versus Modeled Shear Stress (SRH2D) at Riffles 3-4
Table 3-3 Riffle Matrix Material Size Classes and Mixing Proportions 3-6
Table 3-4 Point Bar Materials Specifications 3-7
Table 3-5 Glide Materials Specifications 3-7
Table 5-1 LWM Structure Quantities 5-1
Table 5-2 Total Number of Each Size of Wood Piece 5-2
Table 5-3 Earthwork Volumes 5-2
Table 5-4 Earthwork Volumes 5-2
Table 8-1 Implementation Schedule 8-1

Figures

Figure 3-1. Particle size gradation curves for 19 pebble counts within the BTS project reach. 3-4
Figure 3-2. Proposed riffle matrix particle size gradation and site reference pebble count data. 3-6
Figure 3-3. Location of the February 2017 ice jam within BTS project area. 3-8
Figure 3-4. Ice process management under proposed conditions – upstream portion of BTS project area. 3-8
Figure 3-5. Ice process management under proposed conditions – downstream portion of BTS project area. 3-9

Acronyms

2D	two-dimensional
3D	three-dimensional
BDR	basis of design report
BiOp	Biological Opinion
BPA	Bonneville Power Administration
BTS	Bird Track Springs
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
DSL	Department of State Lands
EA	Environmental Assessment
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FONSI	Finding of No Significant Impact
GPDSR	General Project & Data Summary Requirements
HIP III	BPA's Habitat Improvement Program
LWM	large woody material
mm	millimeter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA Fisheries Service	NOAA's National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
Reclamation	U.S. Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
RRT	Restoration Review Team
SHPO	State Historic Preservation Office
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

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1 Introduction

The U.S. Bureau of Reclamation (Reclamation) and Bonneville Power Administration (BPA) contribute to the implementation of salmonid habitat improvement projects in the Grande Ronde subbasin to help meet commitments contained in the 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) (National Oceanic and Atmospheric Administration [NOAA] Fisheries 2008) and the 2010 and 2014 Supplemental BiOps (NOAA Fisheries 2010, 2014). This BiOp includes a Reasonable and Prudent Alternative (RPA), or a suite of actions to protect salmon and steelhead listed under the Endangered Species Act (ESA) across their life cycle. Habitat improvement projects in various Columbia River tributaries are one aspect of this RPA. Reclamation's contributions to habitat improvement are all meant to be within the framework of the FCRPS RPA or related commitments and follow the requirements of the NOAA and U.S. Fish and Wildlife Service (USFWS) BiOp as outlined under BPA's Habitat Improvement Program (HIP III).

The Bird Track Springs (BTS) Habitat Improvement Project (project) is Phase I of the larger Bird Track Reach Project, which includes the BTS and Longley Meadows projects. The "basis of design" set forth in this document provides scientific information on geomorphology and physical processes used to help identify, prioritize, and implement sustainable fish habitat improvement projects focused on addressing key limiting factors to protect and improve survival of listed salmonids, as well as engineering analyses directly reflected in the design.

1.1 Purpose and Use of 100% Document

This iteration of the basis of design report (BDR) reflects the finalization of the BTS design, and the focus of this report is to present and document information that has been developed since the 95% design. For additional project background and early design support see the 15%, 30%, and 95% BDRs. This Final BDR presents new information and is not intended to encompass the entirety of the background information included in previous iterations of the BDR.

1.2 Report Outline and Content Relative to BPA BDR Template Guidance

Table 1-1 provides a cross reference for those reviewers familiar with the specific report template guidance provided by BPA in the HIP III General Project & Data Summary Requirements (GPDSR), Basis of Design Report Template. This table helps facilitate review for HIP compliance. The majority of the relevant sections in this table have been addressed in prior iterations of the BDR. Therefore, this cross-walk table refers to the previous versions of the BTS BDR (15%, 30%, and 95% BDRs).

Table 1-1 Analogous Sections Summary

Basis of Design Report BPA Template		Cardno 100% Design Report[1]	
Section Number	**Section Header**	**Section Number**	**Section Header**
1.1	Name and titles of sponsor, firms and individuals responsible for design	1	Introduction
1.2	List of project elements that have been designed by a licensed Professional Engineer	Final BDR 3.1 95% BDR 3.3	Design Elements and Rationale
1.3	Identification and description of risk to infrastructure or existing resources	Final BDR 4 Appendix E	Risk Assessment

Table 1-1 Analogous Sections Summary

Basis of Design Report BPA Template		Cardno 100% Design Report[1]	
Section Number	**Section Header**	**Section Number**	**Section Header**
		95% BDR 4 95% BDR Appendix G	LWM Risk-Based Design
1.4	Explanation and background on fisheries use (by life stage - period) and limiting factors addressed by project	95% BDR 1.2.5 30% BDR 3.7	Salmonid Habitat and Fish Use Fish Biology
1.5	List of primary project features including constructed or natural elements	95% BDR 3.3 95% BDR Appendix A	Design Elements and Rationale 80% Design Plans
1.6	Description of performance / sustainability criteria for project elements and assessment of risk of failure to perform, potential consequences and compensating analysis to reduce uncertainty	Final BDR 4 Appendix E 95% BDR 4 95% BDR Appendix G	Risk Assessment LWM Risk-Based Design
1.7	Description of disturbance including timing and areal extent and potential impacts associated with implementation of each element	Final BDR Appendix A 95% BDR Appendix A	100% Design Plans 80% Design Plans
2.1	Description of past and present impacts on channel, riparian and floodplain conditions	30% BDR 3	Existing Conditions
2.2	Instream flow management and constraints in the project reach	30% BDR 3.3	Surface Hydrology
2.3	Description of existing geomorphic conditions and constraints on physical processes	95% BDR 1.2.1 30% BDR 3.2	Geomorphology Fluvial Geomorphology
2.4	Description of existing riparian condition and historical riparian impacts	95% BDR 1.2.3 30% BDR 3.2.1	Vegetation Community Historical Conditions
2.5	Description of lateral connectivity to floodplain and historical floodplain impacts	95% BDR 1.2.1 30% BDR 3.2.2	Geomorphology Geomorphic Characterization and Mapping
2.6	Tidal influence in project reach and influence of structural controls (dikes or gates)	N/A	

Table 1-1 Analogous Sections Summary

Basis of Design Report BPA Template		Cardno 100% Design Report[1]	
Section Number	**Section Header**	**Section Number**	**Section Header**
3.1	Incorporation of HIPIII specific Activity Conservation Measures for all included project elements	Final BDR Appendix A	100% Design Plans
3.2	Summary of site information and measurements (survey, bed material, etc.) used to support assessment and design	Final BDR 3 95% BDR 3 Appendix E 30% BDR 3	Design Development BTS Water Temperature Background – Existing Conditions
3.3	Summary of hydrologic analyses conducted, including data sources and period of record including a list of design discharge (Q) and return interval (RI) for each design element	Final BDR 3.1.2 Appendix C 95% BDR 3.3.3 95% BDR Appendix C 30% Appendix C	Hydraulic Modeling 100% Design Hydraulic Model Report 80% Design Hydrologic Model Report Hydrologic Analysis for Bird Track Restoration Project
3.4	Summary of sediment supply and transport analyses conducted, including data sources including sediment size gradation used in streambed design	95% BDR 3.3.3 95% BDR Appendix C	Hydraulic Modeling 80% Design Hydrologic Model Report
3.5	Summary of hydraulic modeling or analyses conducted and outcomes – implications relative to proposed design	95% BDR 3.3.3 95% BDR Appendix C	Hydraulic Modeling 80% Design Hydrologic Model Report
3.7	Stability analyses and computations for project elements, and comprehensive project plan	Final BDR 4.1 Appendix E	Overall Risk Summary LWM Risk-Based Design
3.8	Description of how preceding technical analysis has been incorporated into and integrated with the construction – contract documentation	30% BDR	
3.9	Description of how preceding technical analysis has been incorporated into and integrated with the construction – contract documentation	95% BDR	
3.10	Description of how preceding technical analysis has been incorporated into and integrated with the construction – contract documentation	Final BDR	
3.11	For projects that address profile discontinuities (grade stabilization, small dam and structure removals): A	N/A	

Table 1-1 Analogous Sections Summary

Basis of Design Report BPA Template		Cardno 100% Design Report[1]	
Section Number	**Section Header**	**Section Number**	**Section Header**
	longitudinal profile of the stream channel thalweg for 20 channel widths upstream and downstream of the structure shall be used to determine the potential for channel degradation		
3.12	For projects that address profile discontinuities (grade stabilization, small dam and structure removals): A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment	N/A	
4.1	Incorporation of HIPIII General and Construction Conservation Measures	Final BDR Appendix A	100% Design Plans
4.2	Design – construction plan set including but not limited to plan, profile, section and detail sheets that identify all project elements and construction activities of sufficient detail to govern competent execution of project bidding and implementation	Final BDR Appendix A	100% Design Plans
4.3	List of all proposed project materials and quantities	Final BDR 5.1 Appendix B	Quantities Design Engineer's Bid Sheet
4.4	Description of best management practices that will be implemented and implementation resource plans including: Site Access Staging and Sequencing Plan Work Area Isolation and Dewatering Plan Erosion and Pollution Control Plan Site Reclamation and Restoration Plan List proposed equipment and fuels management plan	Final BDR Appendix A	100% Design Plans
4.5	Calendar schedule for construction/implementation procedures	Final BDR 8	Implementation Schedule
4.6	Site or project specific monitoring to support pollution prevention and/or abatement	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.1	Introduction	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.2	Existing monitoring protocols	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan

Table 1-1 Analogous Sections Summary

Basis of Design Report BPA Template		Cardno 100% Design Report[1]	
Section Number	**Section Header**	**Section Number**	**Section Header**
5.3	Project Effectiveness Monitoring Plan Objective 1 Objective 2	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.4	Project review team triggers	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.5	Monitoring frequency, timing, and duration Baseline survey As-Built survey Monitoring site layout Post-bankfull event survey Future survey (related to flow event)	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.6	Monitoring technique protocols Photo documentation and visual inspection Longitudinal profile Habitat survey Survival plots Channel and floodplain cross-sections Fish passage	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.7	Data storage and analysis	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
5.8	Monitoring Quality Assurance Plan	Final BDR Appendix H	Monitoring, Maintenance, and Adaptive Management Plan
6	References	Final BDR 10	References Cited

[1] If section is in a previous version of BDR the appropriate version is identified with the section number.

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2 80% Design RRT Comment Response

Reclamation gave an 80% Restoration Review Team (RRT) and stakeholder presentation on December 1, 2017, to review the 80% design process. The Draft Final 80% design and Draft Final 95% BDR were submitted to the RRT on December 21, 2017. Formal written RRT comments were provided to the design team on January 18, 2018. Technical comments were received from BPA and National Marine Fisheries Service (NMFS), while Oregon Department of Fish and Wildlife (ODFW) and USFWS did not provide comments on the 80% design. Comments and their associated addressed responses are provided in Appendix F (80% RRT Comment Response Matrix). Final HIP III Biological Opinion Authorization of the project was received on March 22, 2018, and is provided in Appendix G (HIP III Authorization).

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3 100% Design Finalization

3.1 Design Elements and Rationale

The following discussions present design issues and features not fully developed at the 95% design and present updates on the status of other design elements, with methods, rationale, and/or justifications associated with the finalization of the 100% design.

3.1.1 <u>95% to 100% Surface/Grading</u>

Development of the surface between the 95% and 100% final design included the incorporation of large woody material (LWM) into the surface, further enhancing off-channel habitat features, and making finer scale adjustments to channel grading to address areas of high shear stress.

3.1.1.1 Remove of Side Channel 0

Due to funding constraints and after reviewing the cost versus benefit for habitat uplift, this channel (Side Channel 0) was removed from the project. The location of the property boundary at the upstream limits of the project significantly impacted this decision, as the proposed entrance to Side Channel 1 (now called Side Channel 0) was at risk of potentially closing off in the future, limiting its benefits to high-flow conditions only.

3.1.1.2 Modification of Side Channel 1

Modifications were made to the Side Channel 1 entrance to reduce the risk of extending the nose of the Large Ice Crib Jam too far out into the main channel. The grading was modified and a new (smaller) LWM structure—Type D3 - Split Deflector Jam—was created to better fit the site conditions. This decision was mostly based on risk and the high likelihood that this area of the project would continue to experience significant ice impacts. In addition, Side Channel 1 was graded to fit within an existing relic channel scar, which provided for a straighter alignment than previously designed. Due to the straight channel design, additional LWM elements were added to this channel.

3.1.2 <u>Hydraulic Modeling</u>

Four iterations of hydraulic modeling were required to produce the final design topography. This iteration included fine tuning main channel pools, floodplain grading, and a slight simplification to the side channel network due to budget constraints. Iteration 1 edits included increasing the depth in main channel pools to provide more habitat and slow down water velocities. Iteration 2 included reworking/removing side channels to decrease project cost; one side channel (Side Channel 0) was removed while the sinuosity was reduced in another. Modifications were made to the floodplain for the first three iterations; however, most of these modifications occurred during Iteration 3 edits to control floodplain inundation. In some locations, more floodplain inundation was desired to increase habitat availability. In other locations, such as along the railroad, berm heights were increased to prevent inundation. Few edits were made during the final iteration. Beaver dam analog heights were slightly increased within Side Channel 3A. Additional discussion regarding the last round of modeling iterations can be found in Appendix C (100% Design Hydraulic Model Report).

3.1.3 <u>Channel Bed</u>

The design for the channel bed continues to leverage opportunities on the site such as swales, relic channel features, and existing backwaters and ponds, to anticipate the incorporation of in-situ materials in areas that will be reactivated by flow only and to design and construct appropriate features in excavated channels and/or required control points. Vertical stability of channels within the proposed project will be provided by hardened riffles constructed in the channel bed. Riffles will be constructed in the new channel segments by over-excavation of the native materials by 2 feet (approximately twice the D100 material) and replacement with native rock of specific gradation and methods to form a well-graded mixture of compacted alluvium similar to what is found in natural riffles within the upper Grande Ronde River.

An alluvial design process was utilized for this project such that constructed riffles would behave similarly to those found naturally near the project site. This process required evaluation of computed critical shear stresses at proposed riffles along with allowable shear stress of existing material gradations found within and near the project site. Newly constructed riffles are intended to be at least as stable as those found upstream of the project to allow the channel to mature gradually. However, riffles are expected to move and transform during extreme high-flow events. The channel will be stable vertically for varying discharge values dependent upon location. In general, constructed riffles crests will be stable for discharges at and below the 10-year return interval flood, and most riffle faces will be stable through the 2-year return interval. At discharges exceeding the 2-year peak, it is expected that channel substrate at riffle locations may adjust within the project area, similar to natural stream reaches in this setting.

3.1.3.1 Riffle Locations and Design

As mentioned above, riffles are located throughout the proposed project to control the vertical profile of the overall channel (bankfull) water surface slope. Riffles were located at predicted thalweg cross-over locations, split flow locations, and where channel slope breaks occur. The proposed project will have seven slope breaks within the main channel and many others within side channels. In all newly constructed channels, riffles are to be constructed by over-excavation of the existing materials and replacement with a well-graded and compacted mixture of alluvial material of a specific gradation. At existing channel riffle tie-in locations, existing riffles will be inspected for vertical grade and competency and will be altered if necessary to meet both requirements.

The proposed project has been designed to be a naturally functioning stream channel using stream simulation design techniques (U.S. Forest Service [USFS] 2008). The majority of riffles within natural streams are a component of the stream's channel alignment morphology. They are either natural valley hard points (bedrock, colluvium, or other) or they are depositional features that are related to upstream and downstream channel meanders. The hydraulics of stream meandering create a depositional feature at the stream's cross-over location. Riffles associated with stream meandering are not static; they adjust and move as the stream meander adjusts and moves or as physical materials and hydraulics change, such as after alteration to sediment supply. In designing the vertical profile, one must ask "at what point are the riffles allowed to move?" For this project, we have used stream simulation design techniques as outlined in the USFS's *Stream Simulation Design Guidelines* (USFS 2008) to answer that question. The following is a discussion of methods and assumption used in this design process.

Riffle Framework Design

Riffles are constructed of well-graded (poorly sorted) alluvial sediments that all act together as a single structure. Riffle mobilization occurs when the "framework" material is mobilized. This framework material is often defined as the D84 size class and larger. For this project, we have analyzed potential entrainment of the D84 particle sizes within proposed riffles based upon two-dimensional (2D) numerical modeling results of shear stress values. To analyze our proposed riffle framework material, we utilized the modified critical shear stress equation (Andrews 1983; Bathurst 1987; Komar 1987; Komar and Carling 1991; USFS 2008), which allows designers to determine the particle size of interest based upon the D50 particle. This equation is applicable for plane-bed type channels (gradually varied) with bed gradients of 5% or less, and D84 ranging between 10 to 250 millimeters (mm), both of which fit with our proposed riffles.

$$\tau_{ci} = 102.6\ \tau^*_{D50}\ D_i^{\ 0.3}\ D_{50}^{\ 0.7}$$

Where,

τ_{ci} = the critical shear stress at which the sediment particle of interest (D_{84}) begins to move.

τ_{D50} = the dimensionless Shield's parameter for D50 particle size

D_{50} = diameter of the median particle size of riffle gradation

D_i = diameter of the particle size of interest (D_{84})

When utilizing the modified critical shear stress equation for design purposes, the dimensionless Shield's parameter for the D50 particle becomes critical. Table 3-1 lists the dimensionless Shields parameter for various alluvial particle sizes. Based on the site pebble count data the D50 particle size for riffles is assumed to lie within the small cobble (64 to 128 mm) size class; accordingly, a value of 0.052 was used for the design dimensionless Shield's parameter.

Table 3-1 Dimensionless Shield's Parameter for Different Particle Sizes

Particle size classification	*Particle size, D (mm)*	*Angle of repose, ϕ (degrees)*	*Shield's parameter, τ^**	*Critical shear stress, τ_c (lb/ft^2)*
very large boulders	*> 2,048*	*42*	*0.054*	*37.37*
large boulders	*1,024-2,048*	*42*	*0.054*	*18.68*
medium boulders	*512-1,024*	*42*	*0.054*	*9.34*
small boulders	*256-512*	*42*	*0.054*	*4.67*
large cobbles	*128-256*	*42*	*0.054*	*2.34*
small cobbles	*64-128*	*41*	*0.052*	*1.13*
very coarse gravels	*32-64*	*40*	*0.050*	*0.54*
coarse gravels	*16-32*	*38*	*0.047*	*0.25*
medium gravels	*8-16*	*36*	*0.044*	*0.12*
fine gravels	*4-8*	*35*	*0.042*	*0.057*
very fine gravels	*2-4*	*33*	*0.039*	*0.026*

Source: (USFS 2008).

For final proposed conditions design, shear stresses at riffles are generally similar throughout the proposed project. All proposed newly constructed riffles and existing riffles that will remain in the proposed project were evaluated for computed maximum bed shear stresses, which show narrow ranges of expected shear stress during the 1.25-year, 2-year, and 10-year discharge conditions. Therefore, rather than tabulating shear stress results at each riffle, a range of shear stress conditions to be expected at riffle crests and along downstream faces of each riffle have been tabulated for each flow condition (Table 3-2). The highest predicted shear stresses were compared to the allowable shear stress based upon a proposed D50 and D84 particle size. Values of D50 and D84 were iteratively developed until proposed riffles would remain stable throughout the project up to the 2-year discharge; the riffle faces become mobile within some of the riffles, while other riffles remain stable to higher levels of discharge.

Table 3-2 Allowable Shear Stress Versus Modeled Shear Stress (SRH2D) at Riffles

Proposed Riffles	From SRH2-D Model				Design Gradation			
	Bankfull Max Shear	2-Year Max Shear	10-year Max Shear	Channel D50	Channel D84	Dimensionless Shields	Calculated Allowable Shear Stress	Discharge at which mobile
Riffle Crests	1.1 lbs/sqft	1.2 lbs/sqft	1.6 lbs/sqft	3.0 in	8.0 in	0.052	1.8 lbs/sqft	10-year
Riffle Faces	1.7 lbs/sqft	2.0 lbs/sqft	1.9 lbs/sqft	3.0 in	8.0 in	0.052	1.8 lbs/sqft	2-year

Proposed riffles were designed to mimic existing conditions in terms of similar existing D50 particle sizing. Existing D50 particle sizes were identified using pebble count data obtained throughout the project reach. Nineteen pebble counts were performed throughout the project reach at various channel units along and within exposed banks (Figure 3-1). The sediments generally display two groupings of particle size distributions: mobile materials with a smaller median and finer overall particle size range, such as eroding banks, overbank splays, or high flow areas; and, armored layers at riffle and transverse bar features. We theorize that the smaller particle size distribution can be related to active bedload, while the larger size range resembles the armor layer and can be better related to expected riffle framework particle sizes. For the existing riffle and transverse bar particle size distributions, the existing D50 ranges between 2.5 and 4 inches.

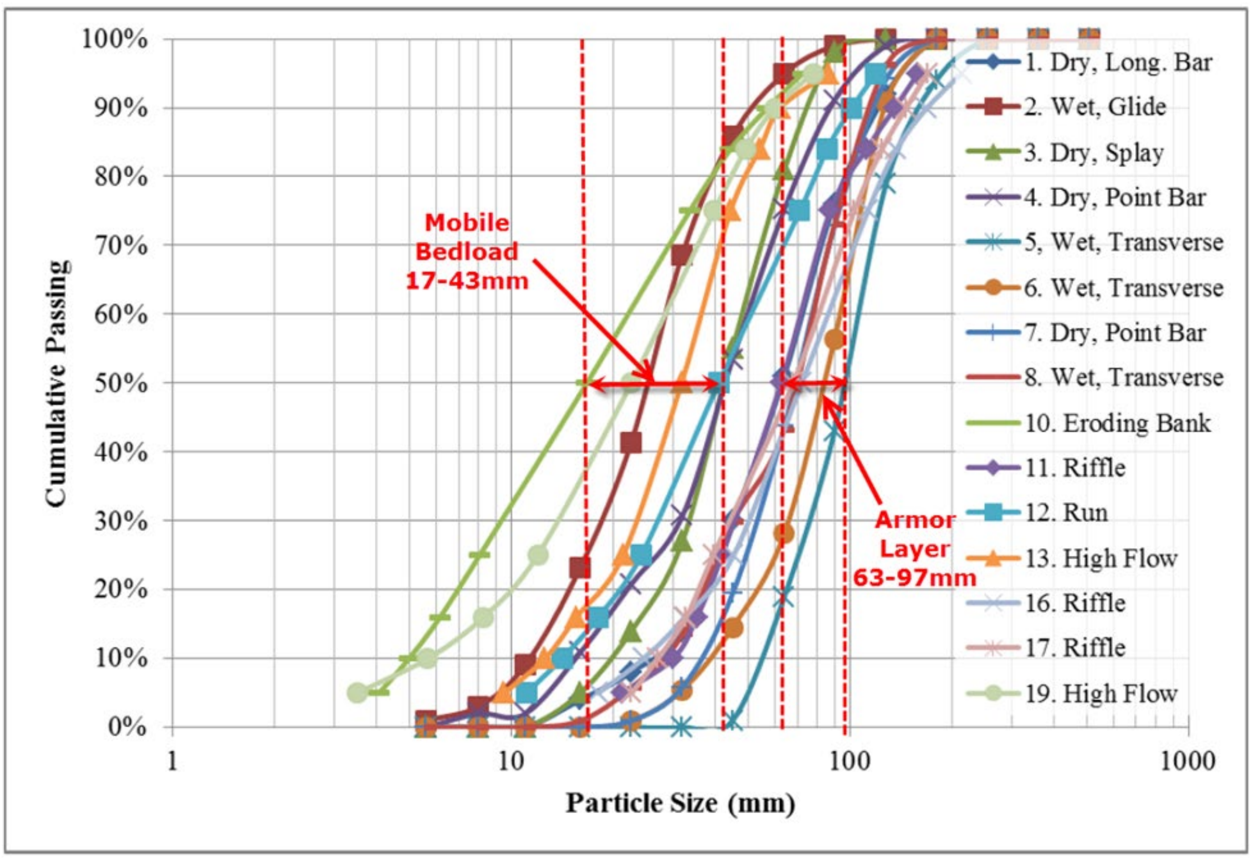

Figure 3-1. Particle size gradation curves for 19 pebble counts within the BTS project reach.

Utilizing 3 inches for the D50 for our proposed riffles, we iterated to achieve an acceptable D84 particle size to maintain stability of riffles at and below the 2-year flood event, which results in a D84 particle size of 8 inches. Our calculated D84 particle size is larger than that found from pebble count data, which is approximately in the 4-inch to 6-inch range. However, pebble count data are from surface deposits only, and we believe that the D84 particle may be higher in the existing channel than indicated by these results.

As a result, the proposed particle framework gradation appears to be similar to what is currently found at the project site.

Riffle Matrix Gradation

Once the framework design defined the larger size particles including the D50 particle size, the lower range of particles were developed. It is very important to have a full range of particle sizes in the riffle gradation as the smaller particle sizes fill void spaces and create an impermeable barrier, which prevents low flows from going subsurface through constructed riffles. To design the full range of particle sizes required to develop this well-graded mixture for riffles, the Fuller-Thompson equation (1907) was used. The Fuller-Thompson equation is:

$$P/100 = \left[\frac{d}{D_{max}} \right]^n$$

Where,

P is the percent of the mixture smaller than d,

Dmax is the largest size material in the mix, and

n is a parameter that determines how fine or coarse the resulting mix is.

An “n” value of 0.5 produces a maximum density mixture when particles are round and was used for design of riffles for this project. The Fuller-Thompson equation was re-arranged to base particle sizes on D50 rather than Dmax, which results in the following equations used to calculate D30, D10, and D5:

$$D_{30} = 0.6^{1/n}\ D_{50}$$

$$D_{10} = 0.2^{1/n}\ D_{50}$$

$$D_5 = 0.1^{1/n}\ D_{50}$$

Based on the design riffle framework gradation of:

D50 = 3.0 inches

The following lower curve values were calculated:

D30 = 1.0 inches

D10 = 0.12 inches

D5 = 0.03 inches

These calculations result in the final design riffle matrix material (Figure 3-2). The proposed riffle matrix design matches the BTS project pebble count data fairly well with the exception that the proposed material finer than D50 will be smaller than that found on the existing, armored surfaces. This is an intentional shift from existing conditions, to better fit with the bedload pebble count data distribution (Figure 3-1).

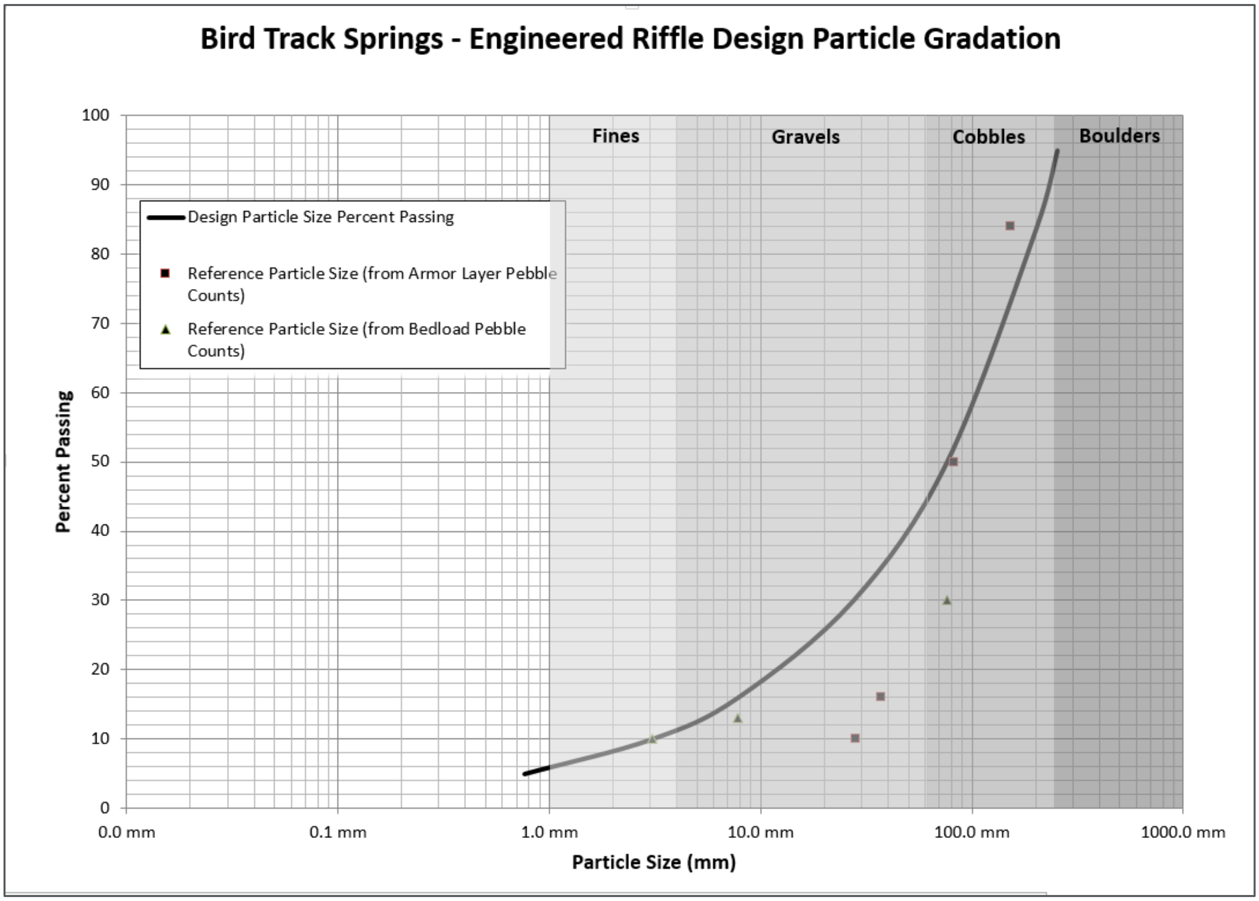

Figure 3-2. Proposed riffle matrix particle size gradation and site reference pebble count data.

Riffle Source Material and Sorting

Materials for riffles will be sorted from excavated materials on-site. Seven size class sorting piles (from small boulders through fines were chosen as the final design matrix to ensure the materials meet the objectives of the design gradation curve. Some simplification of the sorting process may be deemed possible during construction (with fewer sorting units), if materials meet gradation or shear stress requirements upon inspection. Table 3-3 shows the seven size classes of materials required along with each proportion to construct the proposed riffle matrix.

Table 3-3 Riffle Matrix Material Size Classes and Mixing Proportions

Description	Size Class	Mix Percentage (by volume)	Percent Finer	Mix Ratio (by volume)
Large boulders	Greater than 12 inches	NA	NA	See notes
Small boulders	8–12 inch	20%	80%	2 parts
Very large cobble	6–8 inch	10%	70%	1 part
Large cobble	4–6 inch	10%	60%	1 part
Small cobble	3–4 inch	10%	50%	1 part
Large gravel	1.0–3 inch	20%	30%	2 parts

Table 3-3 Riffle Matrix Material Size Classes and Mixing Proportions

Description	Size Class	Mix Percentage (by volume)	Percent Finer	Mix Ratio (by volume)
Small gravel	0.125–1.0 inch	20%	10%	2 parts
Fines	Less than 0.0025 inch	10%	0%	1 part

3.1.3.2 Point Bars and Glide Materials

Sorting for channel bed materials will be limited to the riffle matrix sorting and mixing described above. However, the sorting process may result in excess materials that may be used to form point bars and glides. Point bars and glides will be formed from excavated (un-sorted) alluvium along with excess sorted material that meet material specifications for point bars (Table 3-4) and glides (Table 3-5).

Table 3-4 Point Bar Materials Specifications

Material Gradation	Percent Range Permissible
Small Cobble (3-inch to 4-inch)	20%–50%
Large Gravel (1-inch to 3-inch)	30%–70%
Small Gravel (less than 1-inch)	10%–20%
Fines (less than 0.0025-inch)	10%–20%

Table 3-5 Glide Materials Specifications

Material Gradation	Percent Range Permissible
Small Cobble (3-inch to 4-inch)	10%–20%
Large Gravel (1-inch to 3-inch)	50%–70%
Small Gravel (less than 1-inch)	10%–20%
Fines (less than 0.0025-inch)	0%–10%

3.1.4 Ice Processes Management

Consideration of ice process management has been prominent in design development. Empirical observations of ice processes on-site during the design period and in similar systems have been reviewed to design beneficial ice accumulation reductions through increased floodplain access for ice storage, adequate ice/water flow paths, and floodwater release opportunities through the side channel network. Time lapse photography at multiple stations within the project area facilitated mapping of a major ice jam in February 2017 (Figure 3-3) and understanding of the flood pattern within the project area along with potential for ice rafting. These perspectives were applied as part of optimizing the design of side channels, bank treatments, and LWM structures using iterative hydraulic modeling and geomorphic and engineering principles. We know that in the recent past, large jams and flooding have occurred near the upstream end of BTS and affected Highway 244. Our 2017 data document a major jam in the middle of the reach. We cannot predict the exact location or extent of future jams, but the expansion of the channel network, decrease of channel width/depth ratio, and improved floodplain connectivity will all contribute to improved ice process management. We estimate that multiple areas will provide suitable ice storage, allow for ice movement, and offer water relief conveyance (Figures 3-4 and 3-5).

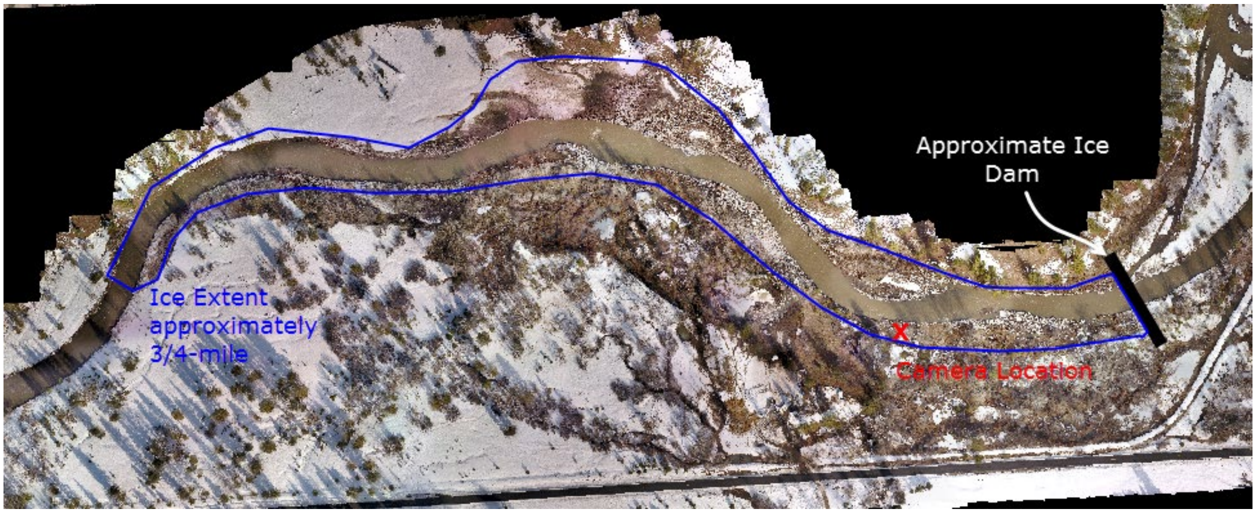

Figure 3-3. Location of the February 2017 ice jam within BTS project area.

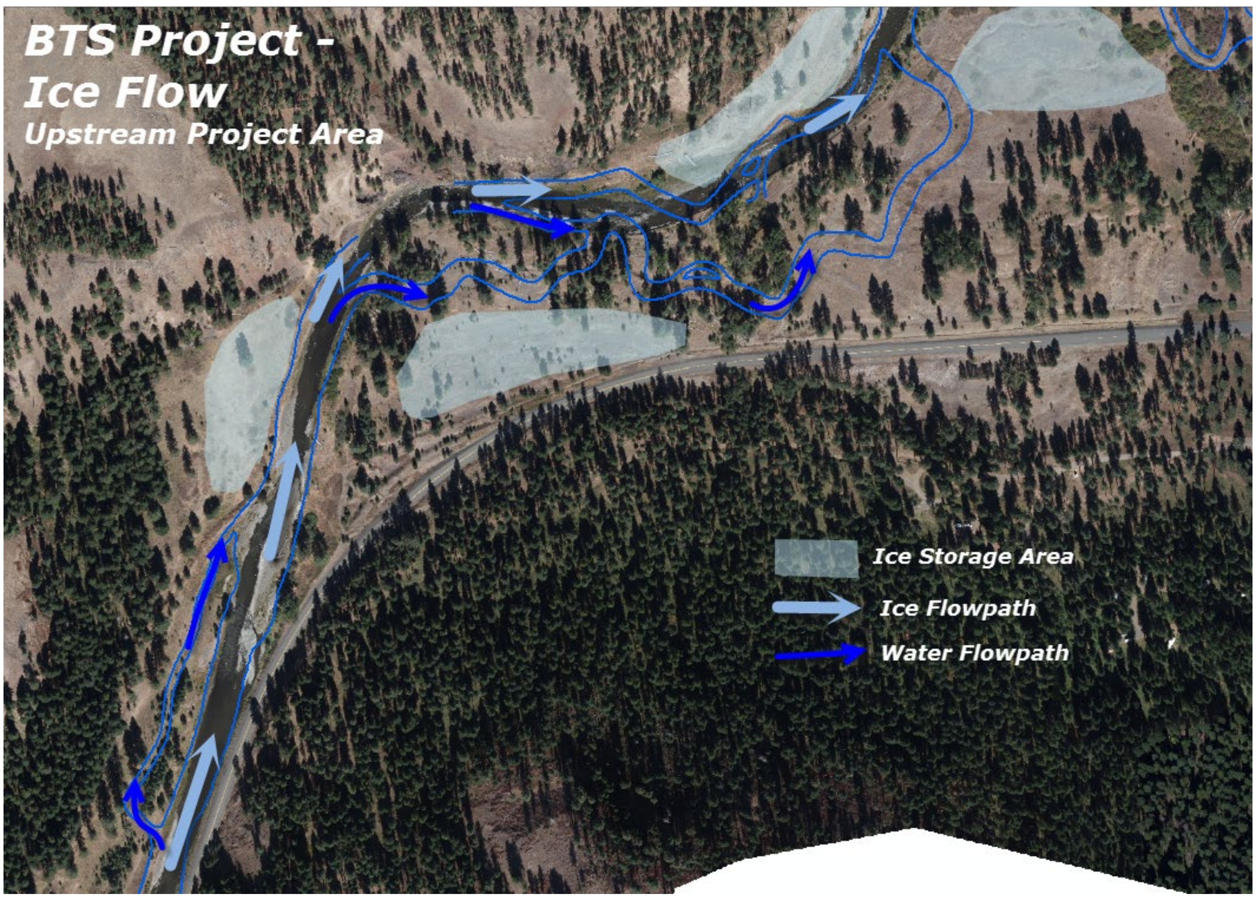

Figure 3-4. Ice process management under proposed conditions – upstream portion of BTS project area.

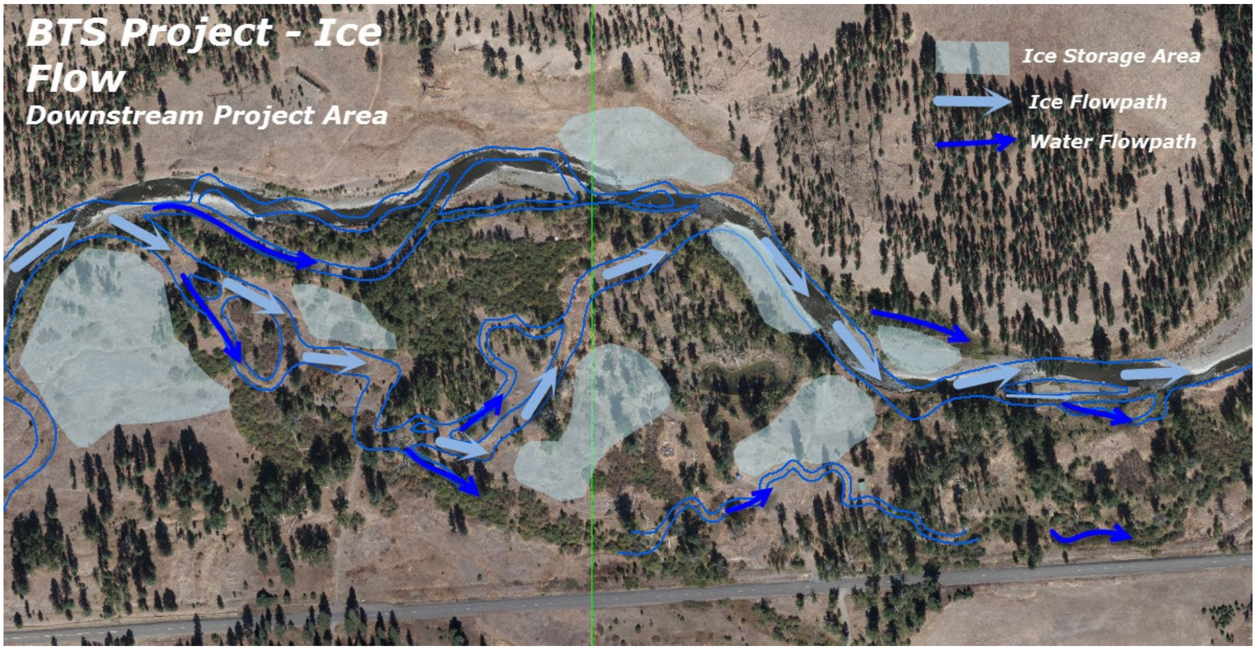

Figure 3-5. Ice process management under proposed conditions – downstream portion of BTS project area.

3.1.5 Revegetation

The revegetation plan has been developed in conjunction with Reclamation, Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and USFS. Successful revegetation of the reconstructed floodplain will prioritize stability of newly constructed waterways and floodplain surfaces, maximize the benefits to salmonid habitat, and maintain and improve the aesthetic value of the site. Revegetation within the project area will be planned and implemented with an emphasis on protection of existing native vegetation, particularly specimen trees, the salvage and reuse of existing native vegetation, and successful plantings and natural regeneration of regionally specific woody and herbaceous riparian species along the channels, in microhabitats of the reactivated floodplain, as well as on the terrace and disturbed upland fringe. Based on monitoring of similar projects implemented in this region, initial recovery of the project area is expected to happen rapidly with extensive vegetation filling-in within 5 to 10 years. Mature trees will understandably take longer, but greatly improved hydrology and sediment sorting would create improved conditions for riparian and wetland vegetation.

Plant community enhancement is integrated within several design elements, particularly the living elements within the LWM structures and bank treatments. The revegetation efforts also specifically address the constructed and modified floodplain surfaces as well as all other disturbed areas. While immediate and short-term stabilization are guiding requirements, long-term improvements in plant community structure, diversity, vigor, and self-sustainability are key considerations. This will be accomplished through implementing a revegetation plan that details: pre-construction planning to maximize salvage and preservation of desirable vegetative species, immediate harvest and redistribution of desirable woody and herbaceous vegetative species, live cutting and/or propagation of cuttings for future planting, purchase and planting, and reseeding.

Salvage of existing woody vegetation will be completed during the active construction phase. Harvest and redistribution of native species into adjacent areas will take place immediately following initial disturbance. Locations where salvaged, rooted plants are a priority for replanting are identified on the planting plan. Live cuttings and seeds will be collected from native species within the Grand Ronde or adjacent drainages and stored, propagated, and/or container grown in a nursery to maximize rates of survival.

Nursery activities for the project were initiated by CTUIR and the USFS in 2017 to produce 1-gallon container stock for a range of the desired native shrub and tree species. Live cuttings, propagated plants, and containerized or purchased woody vegetation will be planted after ground-disturbing activities are completed, or planted in phases as construction activities dictate. Live cuts, propagated plants, and containerized plants and seedlings will be planted in early spring before breaking dormancy, or in fall between September 15 and before November 1.

The final design includes an overall restoration and seeding plan and related summary of the planting zones treatment types, methods, and target seed communities (Appendix A [100% Design Drawings], sheets 149–150). Revegetation that is integrated with the LWM structures and bank treatments is specified in the details and plan view on the habitat sheets, along with special floodplain areas.

Final revegetation plantings and operations were completed by Joe Platz and USFS in coordination with CTUIR. For final design plant species and quantities, please contact Joe Platz.

4 Risk Assessment

4.1 Overall Risk Summary and Recommendations

4.1.1 Large Woody Material Risk Summary

The BTS project received both a “Low” and a “High” Public Safety Risk Rating and a “Moderate” Property Damage Risk Rating. These rankings have previously been discussed in past BDR submittals and are summarized in the LWM Risk Based Design found in Appendix E. Using the Low:Moderate and High:Moderate ratings, LWM structures for this project were designed for 25-year or 50-year flow event. In addition, the High:Moderate ranking required a 2D hydraulic model for LWM structure analysis. The LWM structure analysis led by the design team has met or exceeded the requirements for both the Low:Moderate and High:Moderate ratings.

4.1.2 Discussion of Proposed Conditions and Changes to Hazards

The proposed project will dramatically change the existing river corridor within the 1.9-mile project reach. Floating this section of the Grande Ronde River during moderate to high flows would not be recommended due to hazards posed by improvements to the river’s natural dynamic behavior. The proposed project intends to alter the river corridor from a relatively static condition to a more dynamic condition. It is anticipated that this will create uncertain conditions from season to season that may include fluctuations in main channel location, bar formation, trees falling in the river from within the project site, log capture from upstream sources, and channel-spanning logjams. For these reasons, this reach of the Grande Ronde will likely present new hazards to floaters that they are not currently accustomed to, as the river corridor within this area had been in a degraded, simplified state for so many decades.

The proposed project will present new hazards and may also present conditions that attract increased recreational swimming during low flows. LWM structures (logjams) will be numerous and likely dynamic through processes previously described. Logjams can be an attractive feature for children to explore. Improvements to pools including number and size are intended, which may attract increased swimming within the project site. Most pools within the proposed project will be formed by channel forcing through large wood features and will therefore likely include hazards of wood. During the very low-flow period in the summer months (highest use period), when recreational floating and swimming is likely to occur, the proposed project will contain new hazards for this user group.

4.1.3 Recommendations

The Grande Ronde River has been dramatically altered from historical conditions for as long as current inhabitants of this region can likely remember. The river corridor has been simplified, such that it is a single thread that is wide and shallow. Hazards to recreational floating exist, but are not as prevalent or dynamic as what was likely posed by the historically dynamic river with multiple channels and logjams. The proposed project intends to restore historical conditions to the project reach, which will be a dramatic change to the river corridor. Local residents and potential recreationalists may not be accustomed to this and need information to make informed decisions on recreation within this area. It is therefore recommended that the project sponsor and the land manager (USFS) develop a recreational communication plan with stakeholders and potential recreational groups. Communication tools to consider may include signage at known access points, multi-media postings, newspaper postings, and public meetings or outreach. During final design, the design team expressed the need for the USFS to lead communicating risks from the proposed project to the public with support from CTUIR. The USFS agreed to lead the risk communication effort through multiple avenues to include news publications, the world-wide web, and development and placement of signage.

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5 Contract Documents

5.1 Quantities

Updated project element quantities based on the final design are discussed in detail below.

5.1.1 Large Woody Material

The installation of LWM is proposed as a key element of the design. The design proposes 19 different LWM structure types, located as shown in the final design plans. Each structure type calls for a specific number of logs meeting certain length and diameter criteria. LWM details can be found in the plan set on sheets 98 to 122 in Appendix A. The total numbers of each type of LWM structure are summarized in Table 5-1, and the individual wood piece numbers and sizes for each respective structure type were calculated to arrive at the total number of each size of wood piece (Table 5-2). Boulder quantities required for LWM structure construction have also been included in Table 5-2.

Table 5-1 LWM Structure Quantities

Structure Type	Number of Structures
Type A1 - Apex Jam	18
Type B1 - Meander Jam - Upstream Component	4
Type B2 - Meander Jam - Middle Bend Component	4
Type B3 - Meander Jam - Downstream Component	12
Type B4 - Meander Jam - Mallet Jam	9
Type C1 - Longitudinal Channel Margin Jam	24
Type C2 - Angled Channel Margin Jam	33
Type D1 - Deflector Jam (Small)	8
Type D2 - Deflector Jam (Large)	3
Type D3 - Split Deflector Jam	1
Type E - Single Log Sweeper Jam	32
Type E - Double Log Sweeper Jam	14
Type F - Floodplain Roughness	221
Type G1 - SC Habitat - Single Log	16
Type G2 - SC Habitat - Double Log	7
Type G3 - SC Habitat - Triple Log	19
Type H - Cover Logs	77
Type I1 - Ice Crib Jam	2
Type J - Reinforced Habitat Structure	14

Table 5-2 Total Number of Each Size of Wood Piece

Wood Size Class	Key Member	Medium Log	Racking Logs	Tree Tops & Branches	Large Boulders
Diameter (inches)	**(18+)**	**(12–18)**	**(6–12)**	**(1–6)**	**(>24)**
Quantity	439	499	2,778	3,760	550

5.1.2 Earthwork Volumes

Rough earthwork volumes have been calculated using a comparison between the existing and proposed three-dimensional (3D) surface model generated as part of the final design (Table 5-3). This provides an estimate of cut and fill in cubic yards, as well as the net remainder of soil, but does not include any quantity associated with over-excavation for channel design features, or effects of shrink/swell. It is useful in developing cost as well as general project effort. Year 1 and Year 2 cut and fill are shown on pages 88 and 89 of the plan set in Appendix A with “cut” represented in red, whereas “fill” is represented in green.

Table 5-3 Earthwork Volumes

Earthwork Category	Cut	Fill	Net
Units	**Cubic Yards**	**Cubic Yards**	**Cubic Yards**
Design Volumes	75,389	66,396	8,993 (excess cut)

5.1.3 Riprap Quantities

Discussions with Oregon Department of Transportation (ODOT) subsequent to the 80% RRT meeting greatly reduced the need and quantity of riprap within the project as shown in the 80% plans (Appendix A of previous design report submittal). Additionally, due to removal of Side Channel 0 (formerly Side Channel 1), the upstream extents of the project were reduced and all proposed work on the upstream end of the project at 80% design was removed including work along Highway 244. Therefore, no riprap was required in a traditional sense. Two classes of “riprap” were included in the final design bid sheet to address development of unit costs with the contractor in the event that riffles require supplemental large class material for import as shown in Table 5-4.

Table 5-4 Earthwork Volumes

ODOT Riprap Class	Cubic Yards
Class 200 Riprap	90
Class 700 Riprap	50

5.2 Bid Sheet Development

A Bid Item List based on the final design is included as Appendix B (100% Design Engineer’s Bid Sheet Development) of this report. The bid quantities shown were used to develop the engineering and construction cost estimate. This estimate provided the project sponsor an estimated total dollar amount for adequately funding, constructing, and evaluating bids.

6 Environmental Compliance and Permitting

A review of environmental compliance and permitting associated with the BTS project is provided below. Copies of the approved permits are contained in Appendix D (100% Design Project Permitting Documentation), and BPA's HIP programmatic agreement approval authorization letter is included in Appendix G.

6.1 National Environmental Policy Act Compliance

USFS prepared an Environmental Assessment (EA) for the BTS project, including the non-commercial wood source areas. The Draft EA was published September 2017 (BPA 2017; USFS 2017). Comments were received and responses published October 2017. The objection period closed in early-December 2017, and no objections were received. Following completion of cultural resources and Endangered Species Act (ESA) consultations (discussed in further detail below), USFS published a Final EA, Correction Notice, and Decision Notice in June 2018 to provide National Environmental Policy Act (NEPA) coverage for public lands within the project area. BPA issued a Finding of No Significant Impact (FONSI) in June 2018 to provide NEPA coverage for private lands within the project area. NEPA decision documents can be found in Appendix D.

6.2 Cultural Resources, NHPA Section 106 Consultation

Reclamation and BPA initiated consultation in compliance with Section 106 of the National Historic Preservation Act (NHPA) with the Oregon State Historic Preservation Office (SHPO) in July 2015. BPA updated the area of potential effects for the project in August 2016. Oregon SHPO agreed with the delineation of the area of potential effects in September 2016. On April 17, 2018, BPA submitted the survey report and determination of effects letter to the consulting parties. On April 26, 2018, CTUIR provided comments requesting clarification of eligibility determinations and avoidance measures. BPA, with input from Reclamation and the USFS, submitted a revised determination letter on May 2, 2018 (included in Appendix D). On June 8, 2018, BPA contacted SHPO and the CTUIR to notify them that the 30-day consultation period expired on June 2 and to inform them of BPA's intent to move forward with project implementation. On June 13, 2018, BPA assumed concurrence with the determination of no adverse effect, per 36 Code of Federal Regulations 800.5(c)(1) (email included in Appendix D to document completion of this consultation).

6.3 Endangered Species Act, Section 7 Consultation

Consultation with NMFS and USFWS for threatened and endangered species was completed for this project through the BPA HIP III programmatic agreement.

The BPA initiated programmatic consultation with NMFS (also referred to as NOAA Fisheries in some documents) and the USFWS to comply with the requirements of the ESA and the Magnuson-Stevens Fishery Conservation and Management Act. The original consultation resulted in a BiOp from NOAA Fisheries (reference number 2003/00750) on August 1, 2003. After the relisting of critical habitat for ESA-listed salmon and steelhead, consultation was initiated anew and concluded on January 10, 2008 (reference number 2007/03996). This consultation was initiated due to the expiration of the 2008 BiOp at the end of calendar year 2012.

This consultation now includes green sturgeon, eulachon, bull trout, Oregon chub, and their critical habitats. The action area for this consultation is the Columbia River Basin within the contiguous United States, which is also within the range of ESA-listed fish and their designated critical habitats, as well as within the range of essential fish habitat for many species. BPA funds habitat improvement activities to fulfill its obligations under the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501), and in response to the requirements of various BiOps, including the 2008 BiOp on the Operation of the FCRPS (NOAA Fisheries 2008). BPA and the other Action Agencies, United States Army Corps of Engineers (USACE) and Reclamation, are continuing to implement the habitat improvement actions described in that BiOp.

It is BPA's determination that the HIP III proposed action is likely to adversely affect anadromous salmon and steelhead, and freshwater fish. Based on BPA's determinations under the HIP III biological assessment, the BTS project is likely to adversely affect the following that are present in the Grande Ronde watershed:

> Spring Chinook (*Oncorhynchus tshawytscha*) and critical habitat

> Steelhead (*O. mykiss*) and critical habitat

> Bull trout (*Salvelinus confluentus*) and critical habitat

This project will have short-term construction-related effects, but will greatly benefit the listed species in the long-term.

The BTS project under this HIP III biological assessment and opinion is considered a high risk activity in the River, Stream, Floodplain and Wetland Restoration category, and more specifically the Channel Reconstruction subcategory. High risk projects in the Channel Reconstruction subcategory require review by the RRT and the NMFS Hydro Division. The review process followed the Channel Reconstruction activity Guidelines for Review contained in the HIP III biological assessment and opinion. The RRT provided feedback on 15%, 30%, and 80% design packages. Following receipt and review of the final design package, BPA determined that the project fell within the scope of NMFS' and USFWS' ESA Section 7 Formal Programmatic Opinions for BPA's Habitat Improvement Program III for Spring Chinook, Steelhead and Bull Trout. ESA compliance authorization for the BTS project was issued on March 22, 2018 (Appendix G).

6.4 State and Federal Permits

Following completion of the 80% design drawings, applications were submitted to the USACE for Clean Water Act (CWA) permits, Oregon Department of State Lands (DSL) for the Removal-Fill permit, and ODOT for temporary highway approach permits. On August 6, 2018, the USACE authorized the project for CWA Section 404 coverage under Nationwide Permit #27, Aquatic Habitat Restoration. The Section 401 Water Quality Certification was issued separately on August 7, 2018, by the Department of Environmental Quality. The DSL Removal-Fill permit was issued on June 21, 2018, and four ODOT temporary state highway approach application approvals were granted on April 10, 2018. With approvals processed, additional ODOT permits to construct were issued on May 21, 2018, which concluded all permits needed for construction. All permits referenced above are included in Appendix D.

7 Construction Approach

The phased construction approach was developed at 95% submittal and refined at 100%/final plan set deliverable. Refer to plan set pages 132 to 146 in Appendix A for the proposed 2-year phased construction approach. Ultimately the construction approach will be dictated by the contractor at the direction of the Contracting Officer.

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8 Implementation Schedule

The tentative implementation schedule is provided in Table 8-1. This schedule may change based on permit conditions as well as seasonal fire restrictions.

Table 8-1 Implementation Schedule

Schedule	Dates
CTUIR issues RFP to Prospective Contractors	May 8, 2018
Contractor Bid Submittals Due	May 25, 2018
Selection of Contractor	June 12, 2018
Anticipated Construction to Begin	July 16, 2018
In-Water Work Window	July 1 – October 15, 2018
End Phase 1 Construction	November 30, 2018
Begin Phase 2 Construction	TBD (based on field conditions)
In-Water Work Window	July 1 – October 15, 2019
End Project Construction	November 30, 2019

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9 Monitoring, Maintenance, and Adaptive Management

The Monitoring, Maintenance and Adaptive Management, developed by Cardno and CTUIR, was updated from the 95% BDR submittal to address additional comments from CTUIR's Les Naylor. Additional formatting edits finalized this document, which can be found in Appendix H (Monitoring and Adaptive Management Plan).

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