City of Brookings

MEETING AGENDA

CITY COUNCIL

Monday, Sept. 11, 2023, 7:00pm

City Hall Council Chambers, 898 Elk Drive, Brookings, OR 97415

CITY COUNCIL

A. Call to Order

B. Pledge of Allegiance

C. Roll Call

D. Ceremonies/Appointments/Announcements

1. Yard of the Month for September [Pg. 1]
   a. Residential – 17245 Lumberview Dr – Clayton Morrison
   b. Commercial – Chetco Community Public Library

E. Scheduled Public Appearances

(Informational presentations to Council on non-agenda items – 10 minute limit per person.)

1. Dave Gilmore – Coast Community

F. Oral Requests and Communications from the audience

(*Public Comments on non-agenda items – five (5) minute limit per person, please submit Public Comment Form in advance)

G. Consent Calendar

1. Approve Council minutes for Aug. 28, 2023 [Pg. 2]
2. Accept Planning Commission minutes for Aug. 1, 2023 [Pg. 4]
3. Approve Liquor License for VFW Post 966 [Pg. 6]

H. Staff Reports/Public Hearings/Ordinances/Resolutions/Final Orders

1. Wastewater Treatment Plant – Digester Recirculation Pump Replacement [Pg. 11]
   a. APSCO Quote [Pg. 12]
2. Ferry Creek Dam Removal [Pg. 15]
   a. River Design Group Final Plans [Pg. 17]

I. Informational Non-Action Items

1. August 2023 Vouchers [Pg. 94]

J. Remarks from Mayor, Councilors and City Manager

K. Adjournment

*Public Comment forms and the agenda packet are available on-line at www.Brookings.or.us/PublicCommentForm. Public Brookings City Hall and Chetco Community Public Library. Return completed Public Comment forms to the City Recorder before start of the meeting or during regular business hours.

All public meetings are held in accessible locations. Auxiliary aids will be provided upon request with at least 72 hours advance notification. Please contact 469-1102 if you have any questions regarding this notice.

View the City Council meeting LIVE at the time of the meeting on:

- Television – Charter Channel 181
- Internet – 1. Visit the City of Brookings website at www.brookings.or.us. 2. Click on Government (top tab). 3. Click on City Council (right side). 4. Under Agenda & Meetings click “Watch Meeting Live”. 5. You will need to download the VLC Media Player. Follow directions and links for your device.

SEPTEMBER YARDS OF THE MONTH

Residential Property - 17245 Lumberview Dr – Clayton Morrison, Owner

Commercial Property – Chetco Public Library – Julie Retherford, Director

City of Brookings
CITY COUNCIL MEETING MINUTES
City Hall Council Chambers, 898 Elk Drive, Brookings, OR 97415
Monday, August 28, 2023

Call to Order
Mayor Hedenskog called the meeting to order at 7:02 pm.

Roll Call
Council Present: Mayor Ron Hedenskog, Councilors Ed Schreiber, Isaac Hodges (by phone), Andy Martin, and Michelle Morosky; a quorum present
Staff present: City Manager Janell Howard, PWDS Director Anthony Baron, PWDS Deputy Director Lauri Ziemer, PWDS Admin Assistant Michelle Robidoux, Public Works Supervisor Tim Brush
Media Present: 1
Others Present: 9

Appointments/Announcements
1. Anthony Baron introduced Tim Brush as new Public Works Supervisor.
2. Gordon Clay gave a presentation on Suicide Awareness and Mayor Hedenskog presented Suicide Awareness Proclamation.

Public Appearances
Leslie Wilkinson provided an update for Nature's Coastal Holiday Festival of Lights 2023 Show.

Oral Requests and Communications from the audience
Connie Hunter, 1310 English Ct, Brookings, OR 97415, spoke on suicide prevention through CCSAPC Veterans Task Group.

Jerry W. Law, 98281 S Bank Chetco River Rd, Brookings, OR 97415, introduced himself as new commander of VFW Post 966 and their upcoming plans for renovation.

Consent Calendar
1. Approve City Council meeting minutes for August 14, 2023
2. Receive monthly financial report for July 2023

Mayor Hedenskog moved, Councilor Morosky seconded, and Council voted unanimously to approve the Consent Calendar.

Staff Reports
1. Public Works Backhoe Purchase
Staff report presented by Tony Baron

Councilor Schreiber moved, Councilor Martin seconded, and Council voted unanimously to authorize City Manager to sign an agreement with Central Machinery to purchase a CASE 580SV Backhoe for $129,705.

2. GRI Change Order - Tidewater Reservoir
Staff report presented by Tony Baron

Councilor Morosky moved, Councilor Schreiber seconded, and Council voted unanimously to authorize City Manager to sign Change Order 1 with GRI for the Tidewater Reservoir Replacement Project in the amount of $5,500 for a total of $28,000.

3. Contract for Engineering Construction Management for Airport Apron Taxiway Project
Staff report presented by Tony Baron

Mayor Hedenskog moved, Councilor Morosky seconded, and Council voted unanimously to approve Century West's contract 23-004 in the amount of $63,022 for Engineering Construction Management Service for the Airport Apron Taxiway Project.

Remarks from Mayor, Councilors and City Manager

Mayor Hedenskog provided a reminder that Kidtown Construction begins September 7, 2023. He discussed the need for volunteer skilled carpenters.

Councilor Martin commented on Jerry Law as new post commander and partnering with the VFW Hall. He also mentioned there are studies that could determine the economic impact of both the Azalea Festival and Nature's Coastal Holiday on the Brookings Harbor area.

Adjournment
Mayor Hedenskog adjourned the meeting at 8:06 PM.

Respectfully submitted:	ATTESTED: this 11th day of September, 2023:
Ron Hedenskog, Mayor	Janell K. Howard, City Recorder

BROOKINGS PLANNING COMMISSION MINUTES
August 1, 2023

CALL TO ORDER
The regular meeting of the Brookings Planning Commission was called to order by Chair Watwood at 7:00 pm in the Council Chambers at Brookings City Hall followed by the Pledge of Allegiance.

ROLL CALL
Commissioners Present: Anthony Bond, Sage Bruce, Cody Coons, Skip Hunter, Clayton Malmberg, Gerry Wulkowicz (arrived 7:02), Chair Skip Watwood
Staff Present: PWDS Director Tony Baron, Deputy Director PWDS Lauri Ziemer, City Attorney Lori Cooper by phone
Others Present: APP-1-23 - Applicant's Attorney Allison Reynolds by phone. 25 audience members
Media Present: 2

PLANNING COMMISSION CHAIR PERSON ANNOUNCEMENTS
Commissioner Skip Hunter addressed the Commission concerning his recusing himself at the previous meeting regarding File No. APP-1-23 and leaving the meeting and asking if it was appropriate for him to be included in the continuation of the hearing tonight. **Motion made by Commissioner Wulkowicz to allow Commissioner Hunter to stay for the APP-1-23 continuation hearing but not be able to vote based on the fact that he did not hear all the public testimony presented at the last meeting; motion seconded and by a 5-1 vote with Commissioner Hunter abstaining and Commissioner Bond voting nay the motion carried.**

PUBLIC HEARINGS
4.1 In the matter of File No. CUP-8-23, a request for approval of a Conditional Use Permit to operate a Short Term Rental facility at 211 Marine Drive Spur; Assessors Map & Tax Lot No. 4113-05B-01100.

There was no ex parte contact, bias, personal interest, or conflicts of interest declared and no objection to the jurisdiction of the Planning Commission to hear the matter. The public hearing was opened at 7:17 pm. PWDS Director Tony Baron reviewed the staff report.

Applicant Salomeja Lescinskas, was present to answer any questions.

Barbara Tantare, 16720 Marine Dr, Brookings spoke in opposition of the residence as a short term rental.
Monika Tantare, 16720 Marine Dr, Brookings spoke in opposition of the residence as a short term rental.

No participant requested additional time to submit materials. Public hearing was closed at 7:23 pm.

The Commission deliberated. **Motion made by Commissioner Malmberg to approve File No. CUP-8-23 a request for a Conditional Use Permit to operate a short term rental at 211 Marine Drive Spur based on the findings and conclusions stated in the staff report and subject to the Conditions of Approval; motion seconded and with no further discussion by a 7-0 vote the motion carried.**

Motion made by Commissioner Coons to approve the Final Order regarding file CUP-8-23, based on the findings and conclusions stated in the staff report and subject to the Conditions of Approval; motion seconded and with no further discussion by a 7-0 vote the motion carried.

4.2 In the matter of File No. APP-1-23, continuation of an appeal to the Planning Commission of a Notice of Abatement issued April 14, 2023 to St. Timothy's Episcopal Church, at 401 Fir Street, Assessor's Map & Tax Lot No. 4113-05BC-07300.

Commissioner Hunter remained for the public hearing. The public hearing portion of this matter was closed at the previous meeting, no further public testimony was provided. The public hearing was opened at 7:39 pm. PWDS Director Tony Baron outlined the status of the hearing procedures.

Commissioners discussed and deliberated City authority, church practices and services provided.

Motion made by Commissioner Malmberg to deny File No. APP-1-23, an appeal to the Planning Commission of a Notice of Abatement issued April 14, 2023 to St. Timothy's Episcopal Church, at 401 Fir Street, Assessor's Map & Tax Lot No. 4113-05BC-07300, and direct staff to prepare a Final Order of Denial to be submitted at the September 5, 2023 Planning Commission meeting. Motion seconded. Commission discussion continued. **By a 4-2 vote with Commissioners Wulkowicz and Coons voting nay the motion carried.**

MINUTES FOR APPROVAL

5.1 Minutes of regular Planning Commission meeting of May 2, 2023.

Motion made by Commissioner Wulkowicz to approve the Planning Commission minutes of June 27, 2023; motion seconded and with no further discussion by a 7-0 vote the motion carried.

UNSCHEDULED PUBLIC APPEARANCES –

Dominick Imperatrice, 910 Weaver Lane, Brookings, addressed the Commission regarding Weaver Lane Deferred Improvement Agreements.

Cheryl Kelmar, 914 Marina Heights, Brookings, addressed the Commission regarding good neighbor outdoor lighting.

REPORT FROM THE PLANNING STAFF - None

COMMISSION FINAL COMMENTS - None

ADJOURNMENT

Chair Watwood adjourned the meeting at 8:15 pm.

Respectfully submitted,

Skip Watwood, Brookings Planning Commission Chair
Approved at the September 5, 2023 meeting

CITY OF BROOKINGS
POLICE DEPARTMENT

Kelby McCrae, Chief of Police

To: Brookings City Council through City Manager Janell Howard

From: Lieutenant Donny Dotson

Date: 08/29/23

Subject: Liquor License Application

The Brookings Police Department found no **local** disqualifying information prohibiting **VFW Post 966, Jerry Law or Nelson Sprague** with the attached **Nonprofit Private Club** liquor license application. The club **"VFW Post 966"** is located at 507 Pacific Avenue, Brookings, Oregon. It is the recommendation of the Brookings Police Department the above mentioned applicants be granted their request with final approval coming from the **Oregon Liquor Control Commission.**

Respectfully submitted,

Lieutenant Donny Dotson
Brookings Police Department

LIQUOR LICENSE APPLICATION

Check the appropriate license request option:

☒ New Outlet | ☐ Change of Ownership | ☐ Greater Privilege | ☐ Additional Privilege

Select the license type you are applying for.

More information about all license types is available online.

Full On-Premises

- ☐ Commercial
- ☐ Caterer
- ☐ Public Passenger Carrier
- ☐ Other Public Location
- ☐ For Profit Private Club
- ☒ Nonprofit Private Club

Winery

- ☐ Primary location
- Additional locations: ☐2nd ☐3rd ☐4th ☐5th

Brewery

- ☐ Primary location
- Additional locations: ☐2nd ☐3rd

Brewery-Public House

- ☐ Primary location
- Additional locations: ☐2nd ☐3rd

Grower Sales Privilege

- ☐ Primary location
- Additional locations: ☐2nd ☐3rd

Distillery

- ☐ Primary location
- Additional tasting locations: ☐2nd ☐3rd ☐4th ☐5th ☐6th

☐ **Limited On-Premises**

☐ **Off Premises**

☐ **Warehouse**

☐ **Wholesale Malt Beverage and Wine**

LOCAL GOVERNMENT USE ONLY

LOCAL GOVERNMENT:

After providing your recommendation, return this application to the applicant WITH the recommendation marked below

City/County name:

Brookings/Curry

(Please specify city or county)

Date application received:

Optional: Date Stamp Received Below

☐ Recommend this license be granted

☐ Recommend this license be denied

Printed Name ______ Date ______

VFW Post 966

Trade Name

LIQUOR LICENSE APPLICATION

VFW POST 966

APPLICANT INFORMATION

Identify the applicants applying for the license. This is the entity (example: corporation or LLC) or individual(s) applying for the license. Please add an additional page if more space is needed.

Name of entity or individual applicant #1: CURRY COUNTY POST NO. 966 VETERANS OF FOREIGN WARS OF THE UNITED STATES, INC	Name of entity or individual applicant #2:
Name of entity or individual applicant #3:	Name of entity or individual applicant #4:

BUSINESS INFORMATION

Trade Name of the Business (name customers will see):
VFW Post 966

Premises street address (The physical location of the business and where the liquor license will be posted):
507 Pacific Avenue

City:	Zip Code:	County:
Brookings	97415	Curry

Business phone number:	Business email:
[redacted]	[redacted]

Business mailing address (where we will send any items by mail as described in OAR 845-004-0065[1].):
507 Pacific Avenue

City:	State:	Zip Code:
Brookings	OR	97415

Does the business address currently have an OLCC liquor license? ☐Yes ☒No	Does the business address currently have an OLCC marijuana license? ☐Yes ☒ No

AUTHORIZED REPRESENTATIVE – A liquor applicant or licensee may give a representative authorization to make changes to the license or application on behalf of the licensee or to receive information about a license or application.

I give permission for the below named representative to:

☒Make changes regarding this license/application on my behalf.
☒Sign application forms regarding this license/application on my behalf.
☒Receive information about the status of this application, including information about pending compliance action or communications between OLCC and the licensee/applicant.

Representative Name:
Jerry W. Law

Phone number:	Email:
[redacted]	[redacted]

Mailing address:
[redacted]

City:	State:	Zip Code:
Brookings	OR	97415

LIQUOR LICENSE APPLICATION

APPLICATION CONTACT INFORMATON – Provide the point of contact for this application. If this individual is not an applicant or licensee, the Authorized Representative section must be filled in and the appropriate permission(s) must be selected.	
Application Contact Name: Jerry W. Law	
Phone number: [redacted]	Email: [redacted]

TERMS

- "Real property" means the real estate (land) and generally whatever is erected or affixed to the land (for example, the building) at the business address.
- "Common area" is a privately owned area where two or more parties (property tenants) have permission to use the area in common. Examples include the walking areas between stores at a shopping center, lobbies, hallways, patios, parking lots, etc. An area's designation as a "common area" is typically identified in the lease or rental agreement.

ATTESTATION – OWNERSHIP AND CONTROL OF THE BUSINESS AND PREMISES

- Each applicant listed in the "Application Information" section of this form has read and understands OAR 845-005-0311 and attests that:

1. At least one applicant listed in the "Application Information" section of this form has the legal right to occupy and control the real property proposed to be licensed as shown by a property deed, lease, rental agreement, or similar document.

2. No person not listed as an applicant in the "Application Information" section of this form has an ownership interest in the business proposed to be licensed, unless the person qualifies to have that ownership interest waived under OAR 845-005-0311.

3. The licensed premises at the premises street address proposed to be licensed either:
   a. Does not include any common areas; or
   b. Does include one or more common areas; however, only the applicant(s) have the exclusive right to engage in alcohol sales and service in the area to be included as part of the licensed premises.
      - In this circumstance, the applicant(s) acknowledges responsibility for ensuring compliance with liquor laws within and in the immediate vicinity of the licensed premises, including in portions of the premises that are situated in "common areas" and that this requirement applies at all times, even when the business is closed.

4. The licensed premises at the premises street address either:
   a. Has no area on property controlled by a public entity (like a city, county, or state); or
   b. Has one or more areas on property controlled by a public entity (like a city, county, or state) and the public entity has given at least one of the applicant(s) permission to exercise the privileges of the license in the area.

VFW Post 966

VFW POST 966

- Each applicant listed in the "Application Information" section of this form has read and understands OAR 845-006-0362 and attests that:

1. Upon licensure, each licensee is responsible for the conduct of others on the licensed premises, including in outdoor areas.
2. The licensed premises will be controlled to promote public safety and prevent problems and violations, with particular emphasis on preventing minors from obtaining or consuming alcoholic beverages, preventing over-service of alcoholic beverages, preventing open containers of alcoholic beverages from leaving the licensed premises unless allowed by OLCC rules, and preventing noisy, disorderly, and unlawful activity on the licensed premises.

I attest that all answers on all forms and documents, and all information provided to the OLCC as a part of this application, are true and complete.

Print name	Signature	Date	Atty. Bar Info (if applicable)
Jerry W. Law	Jerry W. Law	8/28/2023	
NELSON J. SPRAGUE	Nelson Sprague	8/20/2023	

CITY OF BROOKINGS

COUNCIL AGENDA REPORT

Meeting Date: September 11, 2023

Signature (submitted by)

Originating Dept: PW/DS

City Manager Approval

Subject:

Wastewater Treatment Plant – Digester Recirculation Pump Replacement

Recommended Motion:

Authorize City Manager to purchase two recirculation pumps from APSCOP for $53,486.

Financial Impact:

$53,486 from the Wastewater SRF Fund.

Background/Discussion:

Staff met with Jacobs to discuss CIP projects at the Wastewater Treatment Plant (WWTP) for the 2023-24 fiscal year. The replacement of the digester recirculation pumps is a high priority project for this fiscal year. The replacement of these pumps unfortunately is not part of the USDA-RD projects at the WWTP.

They solicited a quote from a sole source provider (APSCO) back in March of 2022 (not available at that time) who has all the intellectual property on the system we currently have. The pumps are now available and Jacobs would like to move forward with the project.

The proposal submitted by APSCO estimates the cost of the pumps to be $51,786 and shipping is estimated at $1,700 for a total of $53,486 to be funded from the Wastewater SRF fund.

Attachment:

a. APSCO Quote

APSCO, LLC
PO Box 2639 • Kirkland, WA 98083-2639
PH: (425) 822-3335 • FAX: (425) 827-6171
EMAIL: apsco@apsco-llc.com
www.apsco-llc.com

Quote

Date	Quote #
3/28/2022	6974

Invoice/Bill To	Ship To
Operations Management International, INC. 125 Broadway Avenue Oak Ridge, TN 37830	Jacobs 905 Wharf Street Brookings, OR 97415

Payment Terms	FOB	Contact
Net 30	Factory	Leo Rainwater

Number	Item	Description	Qty	Lead Time	Cost	Total
1	Bare Pump Replac...	4" Model C Bare Pump Replacement for S/N: 99W21741 & 99W21742 Pump Options - Clockwise rotation (CW) - Steel pump hardware - Oil lubricated bearings - Nitrile elastomers Case Assembly - 4x4 Case - Vertical Top - Ni-Hard case (650+ BHN hardness) - No case vent & drain - Standard suction connection Rotating Assembly - Ni-Hard impeller (650+ BHN hardness) - Static balance - Steel shaft - Steel impeller bolt Pump sealing - Seal Type: Packing - GFO fiber packing - 440C SST shaft sleeve - Cast iron gland housing/backplate - Bronze gland Driver	2	30-32 Weeks	25,892.645	51,785.29T

Subtotal	
Sales Tax (0.0%)	
Total	

****ALL CREDIT PAYMENTS WILL BE CHARGED A 3% SURCHARGE****
All prices noted on quotation are valid 30 days from the date of the quotation unless otherwise specified.

APSCO

APSCO, LLC
PO Box 2639 • Kirkland, WA 98083-2639
PH: (425) 822-3335 • FAX: (425) 827-6171
EMAIL: apsco@apsco-llc.com
www.apsco-llc.com

Quote

Date	Quote #
3/28/2022	6974

Invoice/Bill To	Ship To
Operations Management International, INC. 125 Broadway Avenue Oak Ridge, TN 37830	Jacobs 905 Wharf Street Brookings, OR 97415

Payment Terms	FOB	Contact
Net 30	Factory	Leo Rainwater

Number	Item	Description	Qty	Lead Time	Cost	Total
		- No Motor Supplied - No Baseplate Paint type - Epoxy 2 Coat Paint - Blue (Prime and Top Coat) Testing - 5 Point Performance Test, Single Speed - Performance Test: Bare Pump Test				
2	Freight	Freight>>>>PENDING-PREPAY AND ADD Estimate - $750 total Replacements for SN: 99W21741 & 99W21742	2			0.00T

Subtotal	$51,785.29
Sales Tax (0.0%)	$0.00
Total	$51,785.29

****ALL CREDIT PAYMENTS WILL BE CHARGED A 3% SURCHARGE****
All prices noted on quotation are valid 30 days from the date of the quotation unless otherwise specified.

TRILLIUM
FLOW TECHNOLOGIES™

March 31, 2022

Attn: To Whom it May Concern

Trillium Pumps USA SLC LLC, an unincorporated division of EnviroTech Pumpsystems, Inc., is the manufacturer of WEMCO®, Roto-Jet®, and WSP™ proprietary pumping equipment and is owned by Trillium Flow Control. We are located in Salt Lake City, Utah, and our federal I.D. number is 87-052-9231.

Trillium Pumps USA SLC LLC, is the sole source for WEMCO® Torque-Flow® recessed impeller pumps; WEMCO® Hydrogritter® grit separation systems; WEMCO® Screw Centrifugal pumps; Weir Specialty Pumps (WSP™) Chop-Flow™ chopper pumps, Self-Primer pumps, and Non-Clog pumps; and parts for all the aforementioned pumping equipment.

Our product distribution channel is structured on an exclusive geographic basis. For municipal projects in the Alaska, Washington, Oregon, Northern Idaho (counties north of and including Nez Perce, Lewis and Clearwater), and Montana, our exclusive representative and distributor for all products listed in the second paragraph is:

APSCO LLC
PO Box 2639
Kirkland, WA 98083
Tel 425-822-3335, Fax 425-827-6171
www.apsco-llc.com

Please contact APSCO LLC for additional product information or pricing for any of these products.

Thank you for the opportunity to serve you, and please do not hesitate to contact me if you have any questions.

Best regards,

Ryan Heath

Ryan Heath
Municipal Regional Manager – Western US
Trillium Flow Control
(801) 608-8709
Ryan.Heath@TrilliumFlow.com

CITY OF BROOKINGS

COUNCIL AGENDA REPORT

Meeting Date: September 11, 2023

Signature (submitted by)

Originating Dept: PWDS

City Manager Approval

Subject:

Ferry Creek Dam Removal

Recommended Motion:

Adopt River Design Group plan for the removal of Ferry Creek Dam, authorize the City Manager to apply for FEMA grant, and direct the City Manager to seek additional funding for the removal project.

Financial Impact:

None at this time. Future potential cost up to $1,540,000.

Background/Discussion:

Ferry Creek Dam is located on Ferry Creek, a tributary to the Chetco River. The earthen dam is 45 feet tall and forms a reservoir that historically served as a drinking water source for the City of Brookings. The reservoir has not been used in the last 30 years and the Oregon Water Resources Department (OWRD) designated the dam as a HIGH HAZARD in 2015 due to the potential impacts to downstream landowners and the likelihood of failure.

Staff brought to City Council on April 24, 2023, where they directed staff to pursue the removal of Ferry Creek Dam as proposed by River Design Group (RDG). Proceeding with RDG allowed the City to make this project shovel ready, and more likely eligible for grant funding.

RDG was retained by OWRD to develop a dam removal plan, cost estimate, and documents to provide the City of Brookings if they desire to remove the dam. The attached dam removal plan has been developed using standard construction techniques and equipment that are routinely utilized for similar projects. The dam removal plan keeps all materials on site and creates a stable, natural channel and safe area for future access and users.

The cost to design the dam removal project by RGD was funded through the Oregon Water Resources Department (OWRD). OWRD intends to apply for FEMA High Hazard Potential Dam

(HHPD) grant funding in the next few weeks to fund the Ferry Creek Dam removal project. The grant will require a 35% match from the City. Other potential funding sources include ODFW Fish Passage Fund as well as Fish Acclimation Fund. ODFW will put out a request for proposal in the 2024-25 FY cycle for which we can respond with a request. It is unknown at this time how much is available through these State funds.

River Design Group (RDG) estimate the cost for full removal of Ferry Creek Dam to be $1,540,000. The match required from the FEMA grant of 35% match would equal $539,000. The City would continue seeking State grants and other eligible funds to offset the match.

Attachments:

a. River Design Group Final Plans

Design and Management Plan for

Ferry Creek Dam Removal Project

Prepared for

Oregon Water Resources Department

Tony Janicek, PhD, PE

OREGON WATER RESOURCES DEPARTMENT

Prepared by

RDG RIVER DESIGN GROUP

June 30, 2023

www.riverdesigngroup.com

Ferry Creek Dam Removal Project
Design and Management Plan

Prepared for

Oregon Water Resources Department

Tony Janicek, PhD, PE
State Engineer for Water Resources
Dam Safety Program Manager
725 Summer St NE, Suite A
Salem, Oregon 97301

OREGON
WATER RESOURCES
DEPARTMENT

Prepared by

River Design Group, Inc.

Contact: Scott Wright, PE, PMP, D.WRE
Jack Zunka, PhD, PG & Jenna Walsh, EIT
311 SW Jefferson Avenue
Corvallis, Oregon 97333
www.riverdesigngroup.com

RDG
RIVER DESIGN GROUP

June 30, 2023

REGISTERED PROFESSIONAL ENGINEER
19693PE
OREGON
MARCH 10, 1998
SCOTT A. WRIGHT
Renewal 6/30/2024

EXECUTIVE SUMMARY

River Design Group, Inc. (RDG) was retained by the Oregon Water Resources Department (OWRD) to develop a plan for the removal of Ferry Creek Dam near Brookings, Oregon. The original timber crib dam was constructed around 1913 and was reconstructed as the existing earthen embankment between 1945 and 1953, with some construction activities continuing until 1966. The dam consists of an approximately 45-ft-high earth embankment spanning 300 feet across Ferry Creek and impounds a 4-acre reservoir. The dam no longer serves its historical purpose as water supply for the City of Brookings, who owns the dam. Ferry Creek Dam was designated as a "high hazard" dam in "unsatisfactory condition" by OWRD in 2015 following inspections and dam breach inundation analysis.

RDG developed a set of plans for the various aspects of the Ferry Creek Dam removal Project. These plans and the accompanying 90% design drawings (Appendix A) provide the information needed to execute the removal of Ferry Creek Dam in a safe and effective manner. The Project proposes to excavate a notch and pilot channel into the river-left side of Ferry Creek Dam to allow flow of Ferry Creek through its approximate historical alignment and downstream channel. The Plan also entails notching a constructed berm at the upstream end of the reservoir to realign a river-left tributary to its historical alignment. The Project will remove the flooding hazards associated with the existing dam and provide additional benefits, including a natural flow condition and free passage for aquatic species through the dam and former reservoir.

This report provides a description of existing site conditions and background information, analytical methods, predicted outcomes, and an overall plan for the Ferry Creek Dam removal project (Project). The Reservoir Sediment Management Plan describes the steps and rationale for managing stored reservoir sediments during and after dam removal and provides a description of expected geomorphic impacts of removal. The Dam Removal and Water Management Plan describes the goals for design and methods for physical removal of Ferry Creek Dam and a description of how water will be safely and effectively managed during reservoir drawdown and during construction. The Fish Passage Plan provides an overview of the dam removal plan and strategy for fish passage during and following construction activities and for fish salvage during construction. The Restoration Plan describes the expected site conditions post-removal, the design of post-removal site elements, and revegetation design and methods. The Permitting Plan describes the permitting pathway at the Federal, state, and county level to execute the Ferry Creek Dam Removal. The Plan describes the Sediment Evaluation Framework (SEF), which is part of the Federal Section 401/404 permit process and included in the report as Appendix B. An Opinion of Probable Cost for Project implementation is $1.54M based on the design drawings, construction approach, and similar dam removal projects.

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Appendix A – Design Drawings

Appendix B – Sediment Evaluation Framework (SEF) Level 1 Evaluation

1 Introduction

River Design Group, Inc. (RDG) was retained by Oregon Water Resources Department (OWRD) to develop a dam removal plan for the removal of Ferry Creek Dam on Ferry Creek, a tributary to the Chetco River near Brookings, Oregon (Figure 1-1). The dam, which is owned by the City of Brookings, is a 45-ft-tall, 300-ft-wide earthen dam that impounds a 4-acre reservoir. Originally constructed as a smaller structure in 1913 by C&O Lumber, the dam (historically known as Bankus Dam) was rebuilt by Brookings Water Company between 1945 and 1953, with some construction activities continuing until 1966 (Rohde, 1966). The dam was last used as a water supply for the City of Brookings but is no longer connected to the City's water supply system and is not being used for any purpose at this time.

Following OWRD field inspection in 2015, Ferry Creek Dam was given an "unsatisfactory condition" designation based on spillway condition, multiple non-functional conduits, and location in high-seismic shaking zone among other factors (OWRD, 2016). The dam was designated as high hazard by OWRD in 2016 based on results of dam breach inundation analysis and the presence of homes downstream of the dam. The dam is also a barrier to non-anadromous fish movement in Ferry Creek. Following the designation, the City of Brookings evaluated the feasibility of alternatives for rehabilitation or removal of Ferry Creek Dam (Dyer, 2018). The geotechnical investigation conducted as part of the feasibility study revealed that the dam would experience severe deformation in a Cascadian Subduction Zone (CSZ) earthquake, and a resulting dam failure is expected to result in loss of life downstream. Therefore, OWRD is contracting the development of this dam removal plan to present to the City of Brookings for their consideration.

This report provides a description of existing site conditions, analytical methods, predicted outcomes, and plans for the Ferry Creek Dam removal project (Project). The plans include reservoir sediment management, dam removal and water management, fish passage, restoration, and permitting. A schedule and cost estimate for the Project are included. This report and plans within are provided to show the methods and predicted outcomes for the dam removal Project. They are not meant to be an exhaustive compilation of the design and analysis that went into the Project but rather a summary of the information that was used to make decisions and develop the Project design to reduce impacts on the surrounding environment while increasing the ecological function of the site.

Figure 1-1. Project vicinity map for the Ferry Creek Dam removal project.

2 Site Conditions

This section describes existing and historical conditions at the site as determined from field efforts, literature, previous investigations, and desktop analyses.

2.1 Previous Investigations and Literature

This report utilizes information from several previous investigations and literature specific to Ferry Creek Dam, and we summarize these key resources below.

- "Report on condition of Bankus Dam, Ferry Creek Reservoir" (Rohde, 1966) provides an overview of the dam following its reconstruction, which began in 1945 with most work being performed between 1952 and 1953. This report includes geotechnical measurements of the dam materials and a stability analysis. A 1961 soils laboratory report for earthen dam materials is appended and cited herein as part of Rohde (1966).
- Two sets of historical photos from approximately 1960 document the dam and reservoir area near the end of reconstruction and provide important information about construction activities, materials, and modification to the surrounding area.
- The "Ferry Creek Feasibility Study" (Feasibility Study, hereafter; Dyer, 2018) completed by Dyer Partnership for the City of Brookings provides background information and analysis to understand the risks associated with Ferry Creek Dam and to support exploration of alternatives to remove, rehabilitate, or replace the dam. The Feasibility Study was prompted by the City's decision to assess the suitability of the reservoir as a redundant water supply, an assessment which required an inspection of the dam by OWRD in 2015 that resulted in the dam's designation as "unsatisfactory condition." The Feasibility Study incorporates several independent studies and reports that are either included as sections in the document or as appendices.
- A "Geotechnical Investigation: Ferry Creek Dam" (FEI, 2018) was prepared by Foundation Engineering, Inc (FEI) for the Dyer Partnership Feasibility Study and is included as a section therein and cited separately herein. The FEI report includes an overview of local and regional geologic conditions and hazards, a description of existing dam materials and geotechnical issues, and analysis of dam slope stability under existing and seismic loading conditions.
- "Preliminary geotechnical investigation and data report" (GRI, 2016) describes the results of GRI's 2016 geotechnical exploration of the dam using two boreholes and provides geologic background information. These data are used in FEI (2018).
- OWRD began Ferry Creek Dam inspections on October 6, 2015, and their annual inspection reports (e.g., OWRD, 2016) provide important information on existing conditions and issues at the dam.

2.2 Site Investigation and Survey

A combination of field surveys and remote sensing were used to develop the existing ground (EG) surface for the Project and to establish baseline information to create and evaluate the plan for dam removal. Watershed Sciences, Inc. collected Light Detection and Ranging (Lidar) data for the project area in April 2008. RDG completed detailed field data collection in May and July 2022 to characterize and survey the existing site conditions at the dam along with conditions upstream in the reservoir area and the channel downstream of Ferry Creek Dam. Data collection included a topographic survey of the existing embankment dam and surrounding structures and a bathymetric survey of Ferry Creek Reservoir with a single beam sonar. Water surface elevations were collected to calibrate the hydraulic model. RDG survey utilized a total station (Topcon 211d) and a survey-grade RTK GPS system. RDG established horizontal and vertical control benchmarks for use throughout the Project area. RDG integrated both Lidar and topo-bathymetric surveys into seamless models of terrestrial bare earth and submerged bathymetry in AutoCAD Civil3D 2022. The resulting EG surface elevation model of the Project site facilitates estimation of sediment volumes, hydraulic modeling, and prediction of likely outcomes after dam removal.

2.3 Ferry Creek Dam Overview and History

Ferry Creek Dam is a 45-ft-tall, 300-ft-wide, 15-ft-crest length earthen dam that impounds a 4-acre reservoir. Ferry Creek Dam (42.0737N, -124.2714W) is located in Curry County on Ferry Creek approximately 4000 ft upstream of the Chetco River confluence, which is approximately 1.5 mi upstream of the Pacific Ocean. The Ferry Creek watershed is 0.86 mi^2 in the rugged, steep, high relief Klamath Mountains of the southern Oregon Coast and located just to the northeast of the Brookings city limits and directly east of the Brookings Airport. Direct access to the dam is via Marine Drive. There are 1.8 mi of minor roads in the 0.57 mi^2 contributing watershed upstream of the dam. There are no improved roads through the middle of the contributing watershed, but County Route 776 / Old Country Rd is located approximately along the drainage divide upstream of the dam. One unimproved road off Old Country Rd provides access to powerlines that cross the upper watershed. The Ferry Creek watershed is mostly undeveloped. Upstream of the dam was logged historically and is currently 90% forested under private timberlands ownership. Downstream of the dam, the watershed is a mix of low-density urban development and forestland.

The dam was originally built as a 3-ft-tall timber crib structure without reservoir storage in 1913 by C&O Lumber Company for use at their mill and lumberyard (OWRD, 2023). The dam was first rebuilt as a larger 12-ft-tall earthen structure with storage in 1917 and a 27-ft-tall earthen structure with storage in 1918 to provide water for manufacturing and domestic supply and for fire protection (OWRD, 2023). Water from Joe Hall Creek in the adjacent drainage basin to the northeast was diverted to the Ferry Creek reservoir in 1920 (OWRD, 2023). The dam was torn down and reconstructed as the current earthen dam with modern reservoir storage by Brookings Water Company between 1945 and 1953, with some work continuing until 1966, to provide drinking water to the City of Brookings (Rohde, 1966). Most of the work was performed in 1952 – 1953. The dam was referred to as the Bankus Dam at this time after the owner of the Brookings Water Company, Elmer Bankus. A 36 in diameter concrete pipe conduit is located at the bottom of the fill to pass stream flows during the time the reservoir is empty. The dam crest is at an elevation of 404.0 ft. A 150-ft-long concrete spillway on the river-left side of the dam keeps the maximum reservoir water surface elevation at approximately 399.5 ft. The maximum reservoir water storage capacity is approximately 3.8M ft^3 or 87.2 acre-ft. The dam is composed of material sourced on site, including from a rock quarry that Bankus opened on the river-left side of the dam (Rohde, 1967) and from the ditch that parallels the river-left side of the channel (Wilson, 1966). A detailed description of the composition of the dam is provided in FEI (2018).

Dam reconstruction in the mid-20th century had a significant impact on the Project area. The dam was reconstructed by excavating the original dam core down to bedrock (Rohde, 1966), although borings in the dam embankment by FEI (2018) indicate that the existing dam may be built on top of a layer of colluvium / landslide debris. Earth was extracted from the hillslopes adjacent to the reservoir to be used as fill for the dam, resulting in deforestation and modified topography (Figure 2-8 and Figure 2-9). The adjacent hillslopes have irregular topography derived from construction roads and quarry pits around the perimeter of the reservoir and skid roads from logging operations (GRI, 2016).

Part of the topographic modification involved construction of berm and ditch (Figure 2-6 and Figure 2-7) that reroutes the river-left upstream tributary (T-RL2) along the river-left side of the reservoir until its confluence with the next river-left tributary downstream (T-RL1) near the dam site (Figure 2-4). The berm that separates the ditch from the reservoir appears to be composed of coarse angular boulders (Figure 2-6), and the ditch is lined with concrete just upstream of the confluence with T-RL1 tributary. The ditch was used as a flow by-pass for Ferry Creek and as a seasonal access road during construction (GRI, 2016). Other modifications include the weir / concrete drop structure, which was located approximately 400 ft upstream of the reservoir and was used to divert Ferry Creek flow into a river-right (southwest) pipe for water supply during dam reconstruction. Road construction on the river-right side of the reservoir included placement of fill and a culvert on the downstream river-right tributary (T-RR1). The exact date of culvert installation is unknown. The culvert outlet is located just below the maximum reservoir water surface elevation, so detailed measurements on its characteristics were not possible.

For a period following completion of reconstruction in 1966, the reservoir was operated in the following sequence. The reservoir was filled in the spring (Wilson, 1966) to provide water during the dry summer months. The reservoir was slowly drawn down by usage throughout the summer and fall, and then seasonally drawn down with the outlet pipe left open to pass winter stream flow (Rohde, 1966). This sequence would have led to seasonal flushing of material from within the reservoir footprint. The time when this practice was no longer implemented is unknown but has implications for accumulated reservoir sediment quantities.

The Ferry Creek Dam is being considered for removal for several reasons. The dam is a fish passage barrier; no longer serves its use as part of the City of Brookings water supply; and was designated by OWRD as unsatisfactory condition and high hazard. OWRD inspected the dam on October 6, 2015, and gave the dam an "unsatisfactory condition" designation (OWRD, 2016). The report cited several issues, including:

- Insufficient freeboard between the maximum reservoir water surface elevation and the dam crest.
- Spillway has defects in the concrete and damage from encroaching landslide, vegetation growth, and is too narrow for passage of a probable maximum flood.
- Multiple pipes have the potential for leakage and failure.

- The low-level outlet is leaking 15 to 20 gpm.
- Dam lacks a functional valve to drain the dam during an emergency.
- Soil settling within the dam embankment creates a low spot that lowers storage by 2.4 ft.

Most of these issues relate to dam design and condition, and they impact dam integrity and the risk of failure and downstream flooding. The hazard rating for the dam was changed to "high" in February 2016 following completion of dam breach inundation analysis, which demonstrated significant flood risk to the homes off North Bank Chetco Road. Furthermore, the FEI (2018) geotechnical analysis showed that the dam is expected to experience severe deformation and failure during a CSZ earthquake that would result in loss of life from significant flooding downstream. CSZ hazards are discussed further in Section 2.5.

Figure 2-1. View looking upstream at dam, bimrock, and reservoir with truck for scale. Oblique aerial photo taken July 6, 2022.

Figure 2-2. View looking downstream at spillway showing cracks in concrete and support struts used to resist landslide creep-induced damage. Photo taken May 9, 2022.

Figure 2-3. View looking upstream at the downstream face and toe of Ferry Creek Dam and the downstream end of the spillway. The metal struts in the spillway are marked with a red circle. The large moss-covered, outlet pipe is visible in the foreground, and additional pipe infrastructure is circled in white. The bimrock is visible on top left. Photo taken May 9, 2022.

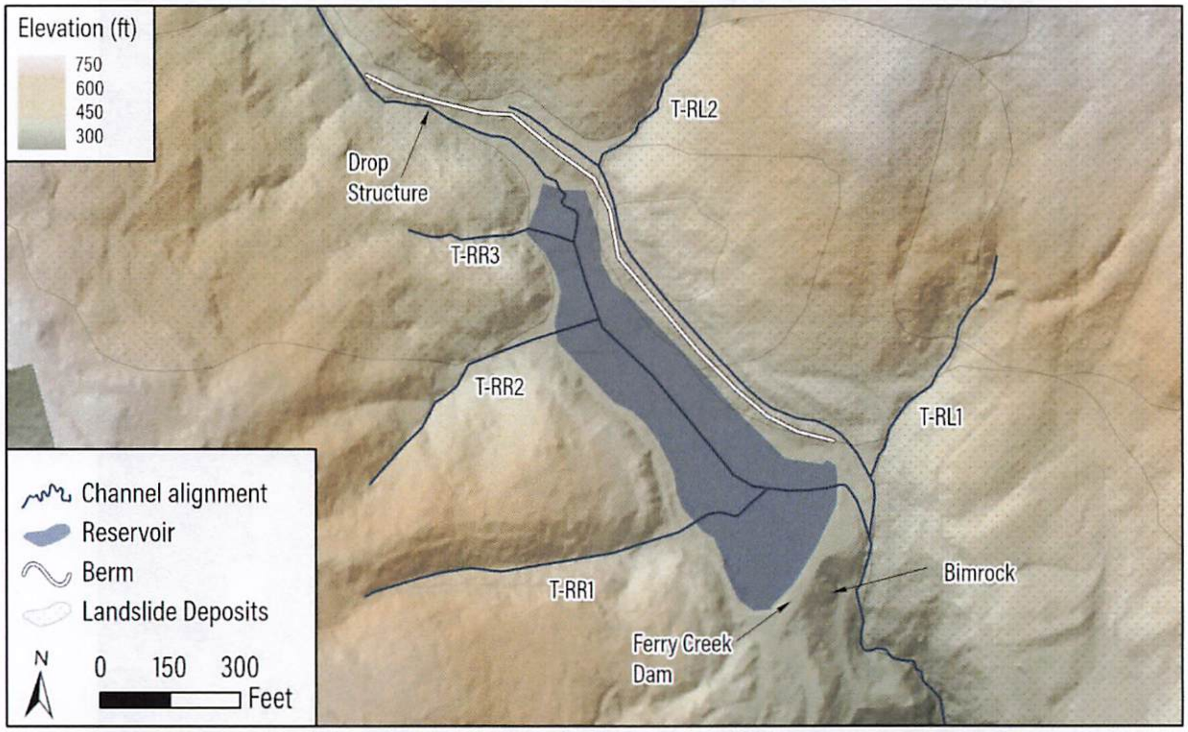

Figure 2-4. Project features overview map. Elevation tinted Lidar hillshade with location of river-right and river-left tributaries (T-RR and T-RL, respectively) and other features labeled.

Figure 2-5. View looking downstream at Ferry Creek dam and reservoir. Oblique aerial photo taken July 6, 2022.

Figure 2-6. Historical photo looking upstream at construction of the berm and ditch on the river-left side of reservoir. Photo taken some time between 1945 and 1960.

Figure 2-7. Historical photo looking upstream at river-left berm at the upstream portion of the reservoir. Photo taken some time between 1945 and 1960.

Figure 2-8. Historical photo looking at disturbed and modified hillslope on southeast corner of the reservoir. Photo taken some time between 1945 and 1960.

Figure 2-9. Historical photo from 1960 looking at the southwest corner of reservoir.

2.4 Hydrology

Hydrology in the Ferry Creek watershed is classified as Marine West Coast-Mediterranean, which is typical of the Oregon Coast. Conditions are moderated by the Pacific Ocean and generally mild and wet with precipitation occurring primarily as rainfall between October and May (Table 2-1). Summers are dry and cool with frequent fog and wind. Mean annual precipitation for the Ferry Creek watershed upstream of the dam is 93.6 in with maximum 24-hour precipitation that occurs once in 2 years of 3.99 in (US Geological Survey (USGS) StreamStats, 2022).

Streamflow on Ferry Creek is flashy, characterized by rapid response to event-driven storms during the wet season followed by quick return to baseflow. Ferry Creek and its tributaries are dry to nearly dry each summer. Due to the presence of Ferry Creek Reservoir, streamflow transmission downstream of the dam is a function of flow over the spillway, which includes the two tributaries on the river-left side of the reservoir, and groundwater flux. No major tributaries enter Ferry Creek downstream of the dam.

Table 2-1. Climate data from Brookings 2 SE, Oregon (351055; 42.02, -124.15) for period from 1912/05/01 to 2003/06/23. Data from Western Regional Climate Center.

	Average max. temperature (F)	Average min. temperature (F)	Average total precipitation (in)	Average total snowfall (in)
Jan	54.1	40.6	12.18	0.4
Feb	55.7	41.4	9.85	0.2
Mar	56.9	41.6	9.19	0
Apr	59.2	43.0	5.74	0
May	62.6	45.9	3.74	0
Jun	66	48.9	2.02	0
Jul	67.2	50.8	0.57	0
Aug	67.1	51.4	0.85	0
Sep	68.0	50.6	2.20	0
Oct	64.2	47.7	6.22	0
Nov	58.5	44.3	11.21	0
Dec	54.8	41.4	12.58	0
Annual	61.2	45.6	76.34	0.7

Ferry Creek is ungauged, so a combination of methods was used to estimate stream flows. Average monthly streamflow was calculated using the Soil Conservation Service (SCS) Curve

Number method, in combination with local rain gage data to estimate the existing monthly creek flows (Dyer, 2018). Methods for determining peak flows and fish passage and bypass flows are presented in subsequent sections.

2.4.1 Peak Flows

Peak flows are used in hydraulic modeling to evaluate approximate Ordinary High Water (OHW) elevations, restoration design stability, and floodplain impacts. Ferry Creek is ungauged, so peak flows were evaluated from two sources: USGS StreamStats regression equations (Cooper, 2005), and a regionalized gage flood frequency analysis (described below).

We used regionalization of peak flow records method (Bras, 1990) and a power law regression between drainage area and mean annual flood (MAF) to estimate peak flows for the Ferry Creek watershed. A regional peak flood series was constructed following the method in Bras (2002) for the southern Oregon Coast Range in the Klamath Mountains geologic terrane using four USGS gages (#s 14400000, 11533000, 14378900, 14378800) with similar geology to Ferry Creek (i.e., marine sedimentary rocks) and with drainage areas ranging from 0.74 to 271 mi^2. Three of the basins in the dataset are small coastal watersheds similar in size to Ferry Creek (approximately 1 mi^2) with similar mean annual precipitation (80 – 90 in). Two of these sites (Harris and Ransom creeks) share a drainage divide with Ferry Creek (Figure 2-10) and are thereby estimated to have similar characteristics. The three smaller basins have shorter gage records (i.e., less than 30 years) and have correspondingly large uncertainties regarding the flood magnitudes for a given recurrence interval (RI). It is easier (i.e., fewer datapoints required) to get a robust estimate of the mean annual flood (MAF) than for a RI flood magnitude.

For each gage in the dataset, we normalized each annual peak flood by the MAF at that gage to generate dimensionless flood magnitudes. The dimensionless flood series for each of the four gages in the region were combined into a single flood series (N = 103 flood events). The USGS 17B Flood Frequency Analysis was then completed on the compiled list of dimensionless floods to generate a robust estimate of the flood distribution with tight confidence intervals. The dimensionless flood distribution is multiplied by a gage's MAF to return the dimensional flood magnitudes.

We used a power law regression between drainage area and MAF for the four gages to estimate the MAF for Ferry Creek. The regression was robust ($R^2 = 0.99$) across three orders of magnitude in drainage area, although data were unavailable for intermediate-sized basins (2 to 200 mi^2) and there were no basins available smaller than the Ferry Creek basin. The 119.6 cfs MAF for the 0.59 mi^2 Ferry Creek watershed upstream of the dam calculated from the regression was then multiplied by the dimensionless flood distribution to generate the flood frequency analysis in Table 2-2.

The results of the regionalization method (Bras, 1990) are used over the regression method (Cooper, 2005) because the regionalization gages include sites that are similar in size, lithology, and precipitation, and two basins share a drainage divide with Ferry Creek. Therefore, we expect the data used in the regionalization to be more like conditions at the site than the broader scale regression equations. The peak flow values from the regionalization are 57% higher on average relative to values from the regression, and the confidence intervals are smaller. The confidence interval from the regionalization overlaps that from the regression for all but the 2-year event.

Table 2-2. Flood frequency analysis for Ferry Creek watershed upstream of Ferry Creek Dam.

	Regionalization			Cooper (2005)		
RI (yrs)	Q (cfs)	Q lower	Q upper	Q (cfs)	Q lower	Q upper
1.25	68.0	61.2	74.7			
2	108	99.1	118	64.0	43.1	95.0
5	165	150	183	100	63.9	156
10	202	182	229	126	78.2	203
25	249	221	288	161	85.2	304
50	284	249	332	189	126	284
100	317	276	376	218	167	285

2.4.2 Fish Passage and Bypass Flows

USGS StreamStats was used to evaluate flow duration exceedances for fish passage and temporary bypass during construction. Flow duration refers to the percent of time that the creek conveys a given flow (or as) over a given time period. For example, the 95% probability flow duration exceedance value occurs or is exceeded at least 95% of the time (approximately 30 days out of a 31-day month) and is a relatively low flow rate. The 5% probability flow duration exceedance occurs infrequently (approximately two days during a 31-day month) and is a relatively high flow rate.

Fish passage is required through a range of flows, and the requirements are described in Section 3 of the Anadromous Salmonid Fish Passage Facility Design (NMFS, 2022). The pilot channel may be considered a temporary roughened channel until flows in Ferry Creek disperse the sediment stored in the reservoir. The low flow condition for roughened channels is the mean daily average flow that is exceeded 95% of the time during periods when migrating fish are normally present. High flow for fish passage is determined in a similar procedure and consists of the mean daily average flow that is exceeded 5% of the time during fish migration. Fish are present year-round in Ferry Creek, and the full period of record was used to develop fish passage flow estimates reported in Table 2-3. Because the 95% flow duration exceedance probability flow was 0 cfs, the 50% flow of 0.515 cfs was used for fish passage flow design.

Table 2-3. Summary of flow duration and fish passage flows at Ferry Creek Dam on Ferry Creek from StreamStats (Risley et al., 2008).

Duration Exceedance Probability (%)	Flow (cfs)	Comments
5	10.3	High fish passage flow
10	6.79	
25	2.44	
50	0.515	Modeled low fish passage flow
95	0	Low fish passage flow

Temporary water management during construction includes bypassing flow around the active work area to prevent sediment discharge into Ferry Creek. The bypassed volume of water may vary during the anticipated in-water work window (IWW) of July 15 to September 30 (ODFW, 2022). Monthly flow duration exceedances were determined from USGS StreamStats regressions (Risley et al., 2008), and an average flow was calculated for the IWW, weighted by respective monthly flow's proportion of the IWW. Table 2-4 summarizes the anticipated flows during the IWW. Because the 95% flow duration exceedance value is 0 cfs, we select that the bypass system should have a minimum conveyance capacity of the 50% flow duration exceedance probability during the IWW of 0.03 cfs or approximately 10 GPM.

Table 2-4. Flow duration exceedance during in-water work window months (July - September inclusive).

Flow Duration Exceedance Probability	July (cfs) / (GPM)	August (cfs) / (GPM)	September (cfs) / (GPM)	Weighted Average Flow During IWW (cfs) / (GPM)	Anticipated Days of Flow Exceedance in a 31-Day Month
95%	0 / 0	0 / 0	0 / 0	0 / 0	30
50%	0.05 / 20	0.05 / 20	0.01 / 0	0.03 / 10	16
25%	0.08 / 40	0.09 / 40	0.03 / 10	0.07 / 30	8
10%	0.14 / 60	0.25 / 110	0.22 / 100	0.2 / 100	4
5%	0.17 / 80	0.34 / 150	0.39 / 180	0.3 / 150	2

2.5 Geology and Geomorphology

Ferry Creek watershed is in the high relief coastal mountains of the Klamath Mountains terrane outside of Brookings, OR. The Klamath Mountains terrane in southwest Oregon consists of a faulted and folded mix of accreted blocks of sedimentary, igneous, and metamorphic rocks. The Klamath Terrane was formed by tectonic accretion of exotic terranes and oceanic rocks from ongoing convergence over several hundred million years since the Paleozoic (Snoke & Barnes, 2006) and are therefore some of the oldest (150-250 million years old) rocks along the West Coast. The steep, rugged Klamath Mountains were formed by a complex sequence of regional compression, thrust faulting, and metamorphism with periods of extensional tectonics with emplacement of plutonic bodies (Snoke & Barnes, 2006). Tectonic-scale shearing during subduction and accretion caused fragments and blocks of harder rock to become mixed within the matrix of softer rock (GRI, 2016). These processes have resulted in the development of a regional- and outcrop-scale bimrocks, which are variable-sized blocks of more resistant rock in a finer-grained matrix host rock. Steep terrain, significant mass wasting, and high sediment yields characterize the Klamath terrane due to the intense deformation history (O'Connor, et al., 2014).

Ferry Creek's 0.59 mi^2 contributing watershed upstream of the dam is underlain by the Jurassic/Cretaceous age Dothan Formation, a mixture of marine sedimentary rocks (primarily sandstone and siltstone) with lenses of more resistant chert, basalt, conglomerate, and limestone (Ramp, et al, 1977; Beaulieu and Hughes, 1976) and with sporadic bimrocks (Figure 2-10). The Ferry Creek Dam is built around a large bimrock, which protrudes from the middle of the downstream face of the dam (Figure 2-1 and Figure 2-11). Typical weathering products from the Dothan Formation are silts and clayey silt colluvium with coarse clastic material (FEI, 2018).

Ferry Creek Dam is located approximately 55 miles east of the surface expression of the Cascadia Subduction Zone (CSZ), and this proximity makes the site susceptible to potentially high seismic activity and associated hazards (FEI, 2018). The CSZ is the active convergent margin off of the west coast of the Pacific Northwest and Vancouver Island, where the Juan de Fuca, Gorda, and Explorer Plates, are subducting beneath the North American Plate, a process that generates powerful subduction zone earthquakes on approximately 250- to 500-year timescales. The last CSZ earthquake, a magnitude 8.7-9.2, occurred in 1700. CSZ earthquakes generate intense and long duration shaking and ground motions that can destabilize hillslopes, landslide deposits, and earthen fill such as the Ferry Creek Dam. CSZ earthquake can cause rupturing of existing crustal faults, of which there are several in the Project area with Quaternary activity (FEI, 2018). CSZ earthquakes generate tsunamis, which would impact the Chetco River upstream past the confluence with Ferry Creek, but the Project area is above the tsunami inundation zone. Risk of ground amplification is low at the Project site, but shaking will be severe (FEI, 2018). FEI (2018) estimates the liquefaction risk of the earthen dam during a CSZ earthquake to be low, but dam failure during a CSZ earthquake could occur if the bimrock within the dam embankment was separated from the earthen fill (FEI, 2018) or if the event triggered landslide activity that either destabilized the dam or rapidly displaced reservoir water to overtop and erode the dam. See FEI (2018) for detailed analysis of seismic hazards.

Background metal concentrations, including chromium and nickel, are naturally elevated in the Klamath Mountains (ODEQ, 2013). The Klamath Mountain background values are influenced by a range of high-metal content igneous and metamorphic rock units, and it is unlikely that the sedimentary Dothan Formation that underlies the Ferry Creek watershed has metal concentrations as high as the rest of the region. Two soil samples from the Smith et al. (2013) dataset were collected in forested upland locations approximately 9 and 12 miles from the dam (Figure 2-10). These samples are underlain by similar sedimentary lithology and may provide a potential comparison to concentrations expected at the Project site (Figure 2-10).

Table 2-5. C-horizon metal concentrations (Smith et al., 2013) from sample locations shown in Figure 2-10.

Metals - mg/kg	**C-353404**	**C-353460**
Arsenic	4.20	6.60
Cadmium	0.10	0.10
Chromium	30	39
Copper	15.7	23.2
Lead	11.9	11.2
Nickel	30.7	25.7
Selenium	0.4	0.3
Silver	1.00	1.00
Zinc	72	75
Mercury	0.09	0.2

The geology of the material surrounding the dam was characterized by FEI (2018). The material Ferry Creek Dam is built on top of is 5 to 15 ft of what was judged to be colluvium or landslide debris, although the layer could be placed dam fill with different characteristics than the 40 ft of overlying dam fill (FEI, 2018). The two FEI (2018) boreholes encountered alternating layers of sandstone and siltstone in the 30 ft of drilling below the colluvium/landslide debris layer. This bedrock was decomposed to moderately weathered and was extremely soft to very soft with some harder gravel-sized sandstone fragments (FEI, 2018). The eastern slopes above the spillway (in the mapped deep-seated landslide) are composed of angular sandstone cobbles and boulders and colluvium from weathered sandstone (FEI, 2018). The bimrock exposed in the south-central slope of the dam is erosionally-resistant quartz diorite (FEI, 2018).

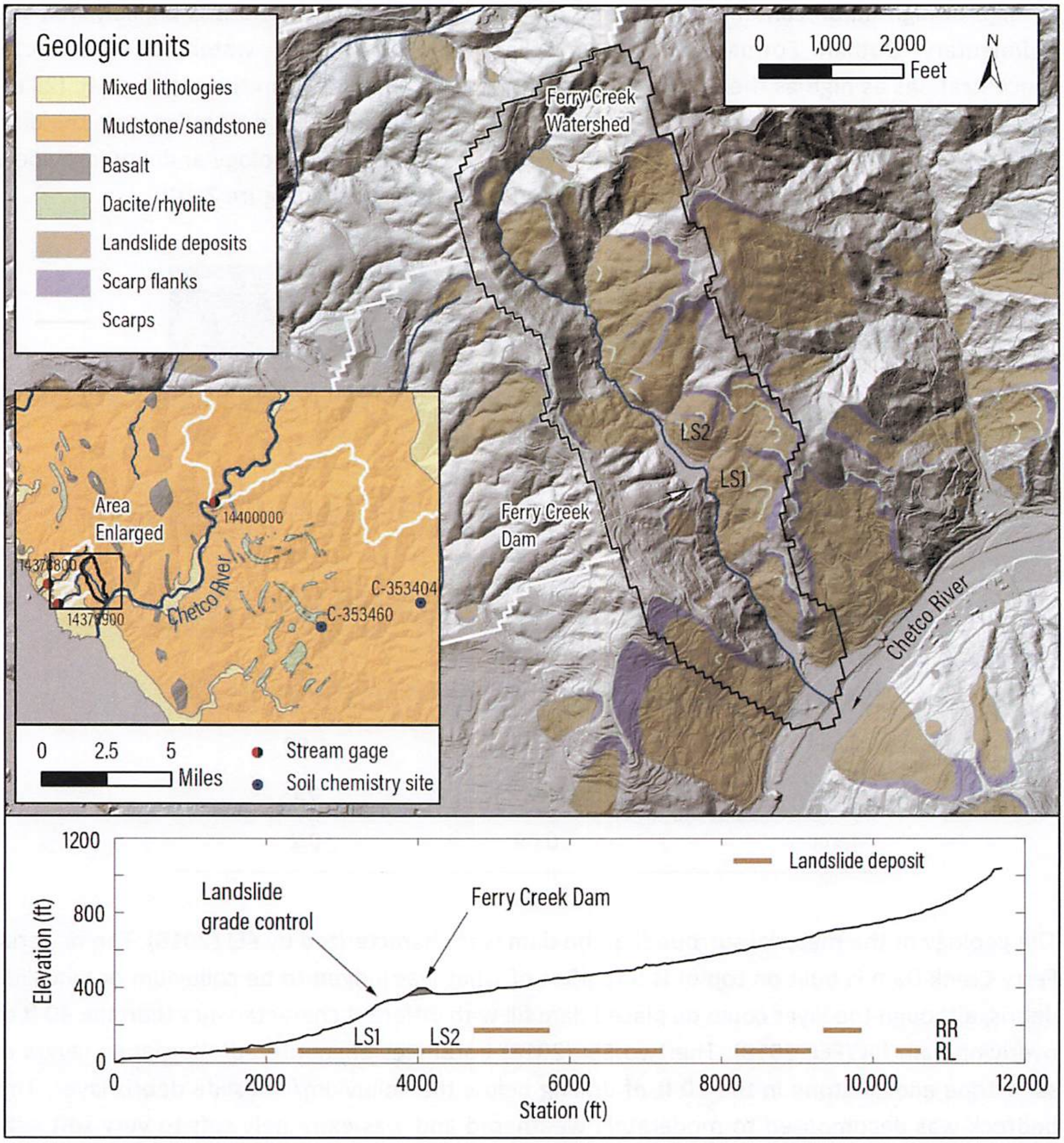

Figure 2-10. Geology of the Ferry Creek Project area. Top: DOGAMI Lidar hillshade and mapped landslide features. Two landslides, LS1 and LS2, are labeled for reference. Inset: DOGAMI mapped geologic units. Stream gages (USGS gage numbers labeled) and basin outlines (white) correspond to gage records used in hydrologic analyses. USGS soil chemistry sites are from Smith et al. (2013) dataset and labeled with sample ID number. Bottom: Longitudinal profile of Ferry Creek with approximate distribution of landslide deposits along the river-left (RL) and river-right (RR) sides of Ferry Creek.

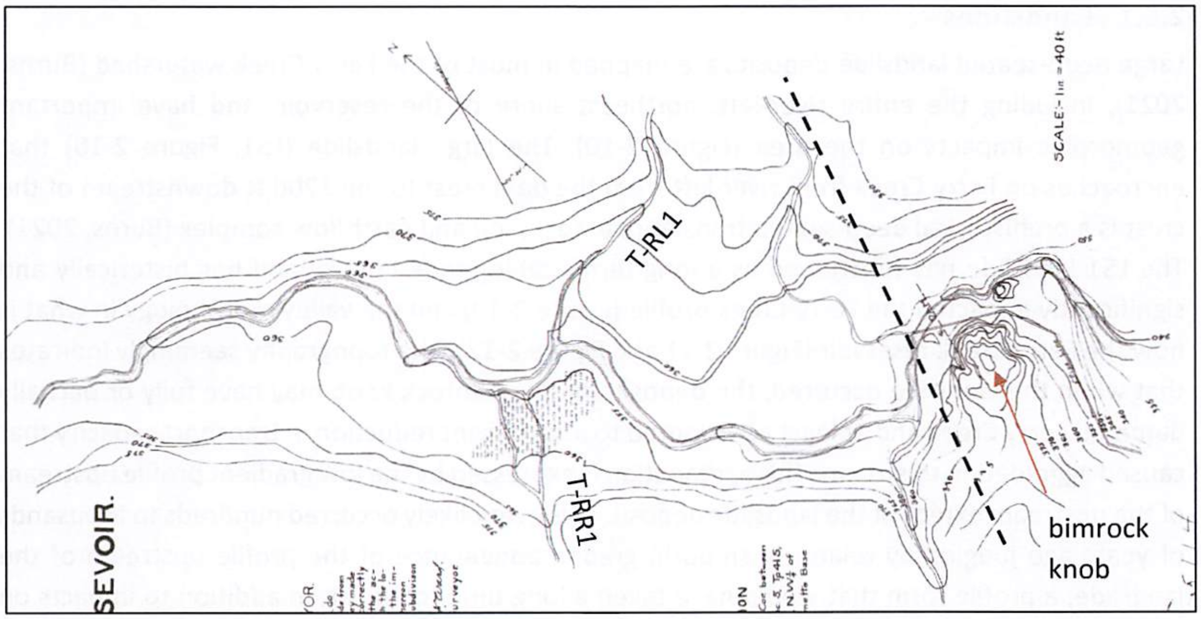

Figure 2-11. Topographic map of the Ferry Creek reservoir area surveyed by W.J. Ward in August 1913 prior to dam construction. Flow is left to right. Contour interval is 5 ft. Approximate alignment of the existing Ferry Creek Dam shown with black dashed line. Tributaries and the bimrock incorporated into the dam are labeled. Map from water rights documentation (OWRD, 2023).

Figure 2-12. Historical photo looking upstream at the unfilled reservoir area during dam reconstruction period.

2.5.1 Landslides

Large deep-seated landslide deposits are mapped in most of the Ferry Creek watershed (Burns, 2021), including the entire river-left, northeast shore of the reservoir, and have important geomorphic impacts on the area (Figure 2-10). The large landslide (LS1, Figure 2-10) that encroaches on Ferry Creek from river left from the dam crest to the 1200 ft downstream of the crest is a prehistorical deep-seated translational rockslide and earthflow complex (Burns, 2021). The LS1 landslide has functioned as a long-term stable grade control and has historically and significantly impacted the Ferry Creek profile (Figure 2-10) and the valley morphology in what is now the Ferry Creek reservoir (Figure 2-11 and Figure 2-12). The topography seemingly indicates that when the landslide occurred, the deposit and the bimrock knob may have fully or partially dammed Ferry Creek and at least contributed to a significant reduction in transport capacity that caused aggradation upstream. This aggradation is expressed by the low gradient profile upstream of the upstream extent of the landslide deposit. This event likely occurred hundreds to thousands of years ago judging by relatively smooth, graded appearance of the profile upstream of the landslide, a profile form that would have taken a long time to adjust. In addition to impacts on the profile, the aggradation would have filled and effectively widened the upstream valley bottom. Indeed, the valley bottom width is widest upstream of the bimrock knob within the dam (Figure 2-11) and decreases with distance upstream to narrow more V-shaped morphology upstream on the reservoir. The dam was built at the upstream extent of the grade-controlling landslide deposit and the bimrock knob and has impounded sediment in an area that has historically already been accumulating material as a result of the landslide. The grade-controlling LS1 landslide deposit is considered stable under existing conditions on centennial to millennial timescales based on its history of impacts to the profile and based on the boulder-dominated character in the channel downstream of the spillway that runs through the toe of the deposit (Figure 2-14).

Recent shallow landslide activity continues to impact Ferry Creek channel and dam infrastructure and demonstrates some of the landscape instability currently at the site. Several large slides are actively creeping and encroaching upon Ferry Creek and reservoir and supply a mix of sediment sizes ranging from silt and clayey silt weathering products to large boulders (Figure 2-13). Active shallow creep was observed within the large grade-controlling LS1 landslide deposit and results in sediment contributions to Ferry Creek (Figure 2-13) and damage to the existing spillway, which required installation of a support strut to resist concrete deformation (Figure 2-2). The landslide mapped on river-left of the reservoir (LS2, Figure 2-10) is a pre-historical deep-seated translational rockslide (Burns, 2021) and has not shown significant recent creep or downslope movement in response to recent manipulation at the toe of the deposit, i.e., the excavation of the ditch, routing of additional tributary flow, and temporary bypass flow of Ferry Creek. However, some of the width variations in the ditch indicate some downslope movement of the LS2 deposit. Currently, the berm buffers a portion of the toe of the deposit from reservoir water level fluctuations.

Potential future landslide hazards are high, and landslide activity of various styles and scales is possible as a result of reservoir drawdown and dam removal, or in response to earthquake-induced shaking (high ground accelerations and long duration of a CSZ earthquake), in addition to regular meteorologically-driven activity. A large slide movement into the reservoir could potentially displace water that overtops the dam causing flooding or dam failure. A CSZ earthquake poses the most significant risk to landslide and dam stability in the Ferry Creek watershed. The observed evidence of landslide instability under existing conditions (e.g., sediment inputs from landslide toe to Ferry Creek, spillway deformation) suggests greater instability under the long duration and high ground accelerations of a CSZ earthquake (FEI, 2018). Some of the landslides that are currently inactive could be destabilized during a CSZ event. The deep-seated LS1 and LS2 landslides are less likely to be fully destabilized and fail catastrophically than some of the smaller, shallow landslides on their surfaces because the prehistorical age of the deep-seated deposits (> 1000 years) suggests that the landslides have likely already been through multiple CSZ earthquakes and wet meteorological extremes without completely failing. The shallower slides actively creeping within the deep-seated landslide deposit would be more likely to fail or increase their activity.

2.5.2 Fluvial Geomorphology

Existing geomorphic conditions of Ferry Creek and its tributaries were characterized in the field and with remote analysis by a RDG Geomorphologist.

2.5.2.1 Pre-Dam Reservoir Area

The 1913 topographic survey depicts geomorphic conditions in the pre-dam reservoir area (Figure 2-11). Ferry Creek has a low gradient (~4%), low-moderate sinuosity single thread planform. Planform irregularity in the form of bends at right-angles are present as the Ferry Creek flows around the erosionally-resistant bimrock knob that protrudes from river-right into the valley bottom. Channel gradient increases as Ferry Creek flows between the bimrock and the river-left landslide deposit. The tributary confluences enter orthogonally to Ferry Creek. The valley bottom is relatively wide and flat, indicative of aggradation in response to the grade control and damming effect of river-left LS-1 landslide impinging upon the resistant bimrock. The presence of 5- to 10-ft-tall terrace on river-left (355 and 360 ft contours) suggests that post-landslide aggradation in the reservoir area may have concluded and that Ferry Creek was now incising into the sediment impounded by the landslide grade control, likely as it downcuts slowly through the landslide dam. The river-left terrace/floodplain of Ferry Creek adjacent to the bimrock has a width of 10+ channel widths, and the toe of the LS1 landslide is steep and set back from the channel. A wetland complex is mapped at the distributary confluence of the T-RR1 tributary.

2.5.2.2 Downstream of Ferry Creek Dam and Chetco River

The reach downstream of the Ferry Creek Dam and spillway is steep (average gradient of 20 to 30% in 1000 ft downstream of dam) and canyonized with boulder-dominated character influenced by encroaching landslide deposits. Channel position and form is influenced by mixed size sediment contributions from active landslide creep (Figure 2-13) and large (e.g., 2 to 20 ft diameter), mixed lithology bedrock, boulders, and bimrocks (Figure 2-14). Channel form is poorly defined in the boulder cascade character, and there is no floodplain development. Substrate is coarse, angular, and poorly sorted indicating local hillslope sources. Few bedforms or discrete sand/gravel deposits were observed. Low flow channel widths are 5 to 10 ft, although poorly defined amongst the large-scale boulder roughness. A 20 ft waterfall that is a barrier to anadromous fish is located more than 1000 ft downstream of the dam (Dyer, 2018; appendices therein), but it was not observed directly in the field. The riparian canopy consists of small and medium sized trees and shrubs except where their growth is excluded by bare exposed bedrock (e.g., bimrocks).

Average gradient decreases with distance downstream until the Chetco River confluence. At the confluence, there is occasionally a small delta deposit with maximum observed dimensions of 75 ft by 35 ft, but this deposit is often not present or subsumed as part of significantly larger mobile point bars on the Chetco River. Chetco River channel width in the reach around the Ferry Creek confluence is 300 to 500 ft. Conditions at the confluence indicate the relative insignificance of Ferry Creek sediment delivery to the Chetco River. The average bed material sediment flux in the lower Chetco River is 65,584 cubic yards (CY) to 94,858 CY depending on whether the Parker (1990) or Wilcock and Crowe (2003) equation, respectively, are used (Wallick et al., 2010; Wallick and O'Connor, 2011). Lower annual sediment fluxes occurred in the 2009 and 2010 water years, where average sediment fluxes of 63,591 CY and 47,802 CY were calculated, respectively (Wallick et al., 2010; Wallick and O'Connor, 2011).

Figure 2-13. View looking to river-left at active slope failure at the toe of a landslide contributing sediment to Ferry Creek downstream of the dam at approximately STA -6+00. Photo taken July 6, 2022.

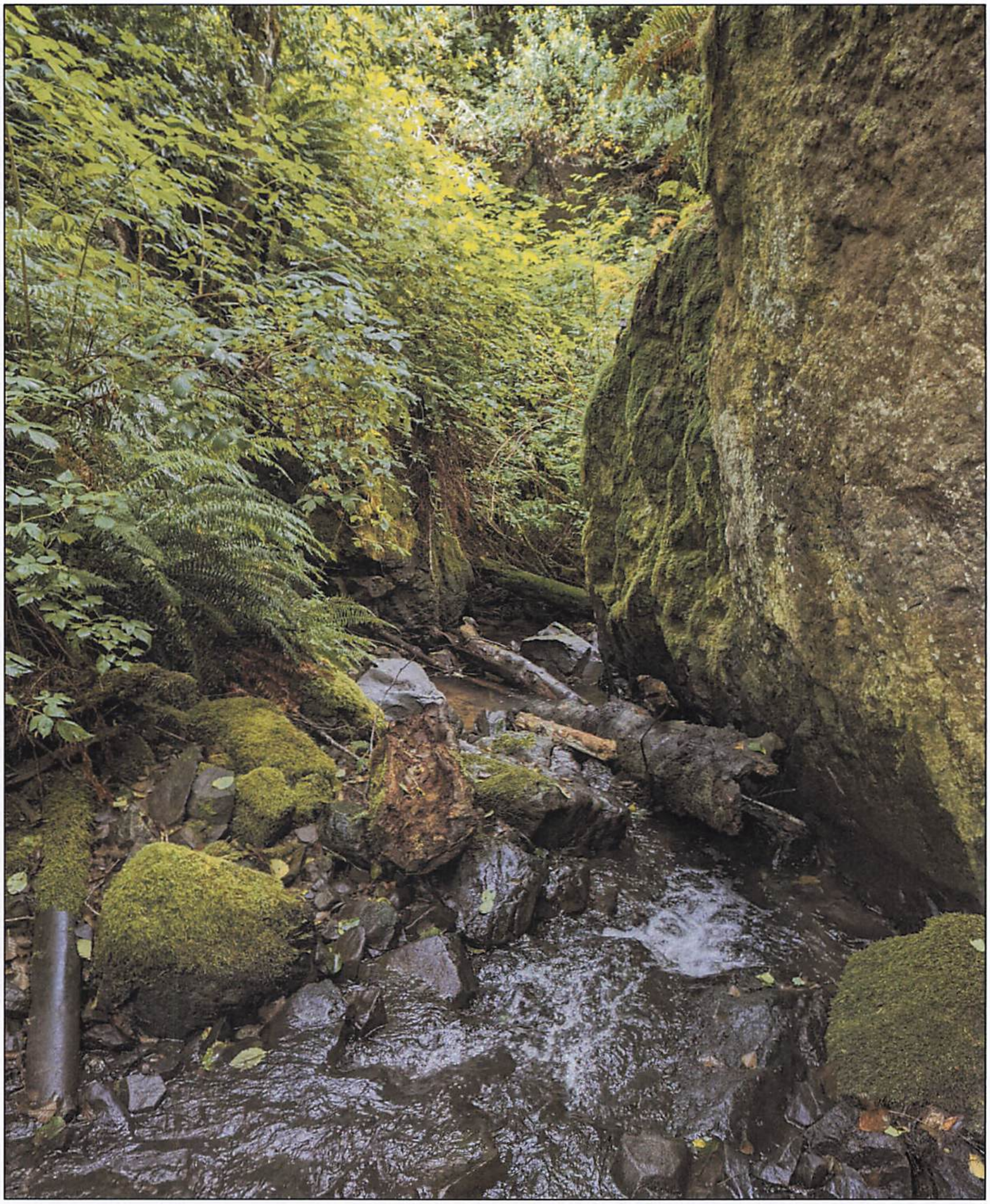

Figure 2-14. View looking downstream at Ferry Creek downstream of the dam near STA -5+00. Landslide deposits (left bank), boulders, and large bimrocks (top right) impinge upon the channel. Photo taken July 6, 2022.

2.5.2.3 Upstream of Reservoir

Reconnaissance of Ferry Creek upstream of the reservoir included the delta reach from STA 9+00 to the concrete weir near STA 13+00 and an additional 200 ft of Ferry Creek upstream from the weir. In the 2000-ft-long reach upstream of the reservoir, the average gradient is nearly 20% and as the channel transitions from a low gradient delta to a narrow valley, lacking floodplain development and confined by impinging landslides.

The Ferry Creek delta is a 300- to 400-ft-long, 130-ft-wide at its downstream end, vegetated deposit with one primary channel and a small secondary distributary channel with estimated maximum sediment thicknesses of 12 ft (Figure 2-20). The primary delta channel has a bankfull width of 12 ft and 1- to 2-ft-tall banks are carved into the delta deposit, which comprises unconsolidated sub-angular to sub-rounded large gravel with small cobbles, small gravel, and sand (Figure 2-15). Delta sediments fine with distance towards reservoir, and the sub-aqueous portion of the deposit is a fine-grained mixture of sands, silts, and clays. The secondary channel has a fine-grained sand-silt-clay materials and receives groundwater input from the berm.

A concrete weir / drop structure located 400 ft upstream of the reservoir provides the first grade control upstream of the reservoir and is likely a partial fish passage barrier (Figure 2-16). The weir marks the upstream extent of the delta deposits and of the limit to where the channel and valley morphology and processes are impacted by the reservoir. Approximately 200 ft upstream of the concrete weir, a 3+ ft tall drop occurs in Ferry Creek formed by 3 ft diameter boulders coincident with the location where mapped landslides from both river-left and river-right impinge upon the channel (Figure 2-17). This boulder drop is estimated to be a stable feature over decadal timescales. In the 200-ft-long reach observed between the weir and the boulder drop, the channel was narrow, confined by landslides on both sides, with coarse cobble boulder substrate, some pool drop character, and overhead vegetation. There are two waterfalls upstream of the boulder drop (Dyer, 2018, appendices therein). The riparian canopy consists of small and medium sized trees and shrubs with near complete overhead coverage of the channel.

Figure 2-15. Ferry Creek delta. Photos taken July 6, 2022. Top left: View looking downstream at fine-grained secondary delta channel. Flow is from groundwater. Top right: View looking downstream at primary Ferry Creek delta channel. Bottom left: View looking upstream at primary delta channel. Bottom right: River-right bank of the primary channel showing delta deposit characteristics.

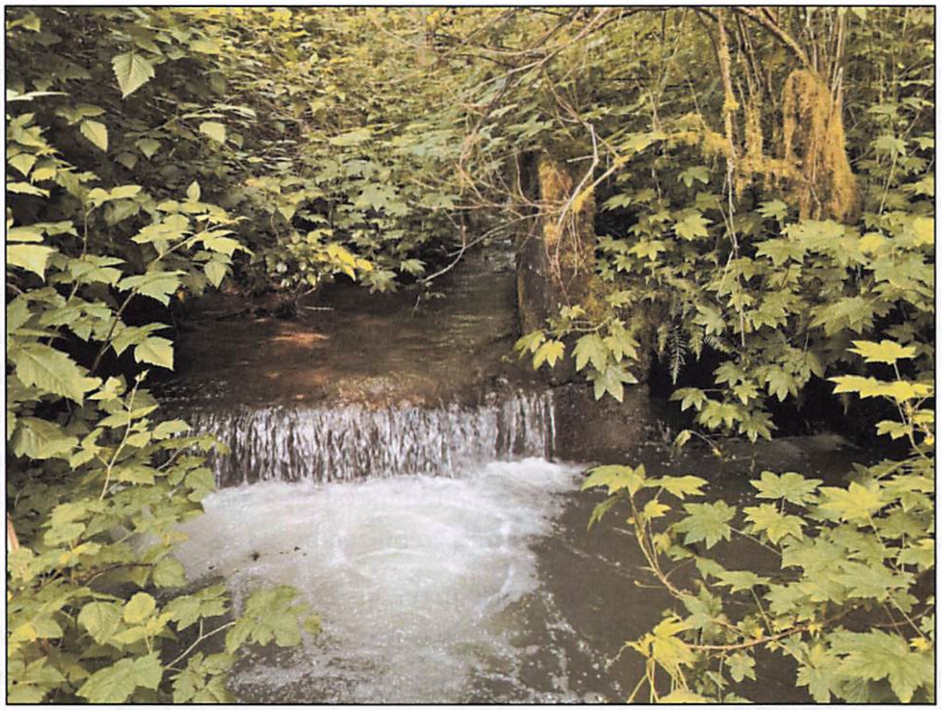

Figure 2-16. View looking upstream at concrete weir / drop structure located on Ferry Creek 400 ft upstream of the reservoir.

Figure 2-17. View looking upstream at upstream extent of Ferry Creek channel survey at STA 15+00 showing the boulder-dominated character of the channel at this location where landslides impinge upon the channel from both sides of the valley. Photo taken July 6, 2022.

2.5.2.4 *Tributaries in the Project Area*

The Ferry Creek tributaries are generally steep (>20% average gradient) and narrow (wetted width < 5 ft) with complete overhead canopy. The sand-gravel substrate lacks bedforms. Tributary stream flow was much less than 1 cfs in each tributary during field reconnaissance on July 6, 2022.

The river-right tributaries (T-RR2, T-RR3) form heavily vegetated deltas at the reservoir confluences where the 1- to 4-ft-wide active channel substrates grade from gravel to sand. These delta confluences are expressed as valley fill in the tributaries and do not extend far into the reservoir. Scour pools are maintained at the connection point between T-RR2 and T-RR3 and the reservoir, and a deposit of fine-grained (< 2 mm) sediment has formed within the reservoir that has been colonized with skunk cabbage. A road berm crosses the T-RR1 delta, and flow is routed through the fill prism via a 12 in diameter corrugated metal pipe the outlets in the reservoir 1 to 3 ft below full-pool water level. The road prism is colonized by alders.

The river-left tributaries were modified during dam reconstruction. The T-RL2 tributary alignment was modified by construction of the berm to flow down a ditch parallel to the reservoir (Figure 2-18; Section 2.3). The berm crest is approximately 10 and 30 ft above the tributary and reservoir level, respectively. The T-RL2 channel in the ditch is 2 to 4 ft wide, lacks bedforms, and has a mix of small gravel and sporadic large angular gravel and small cobble, which is estimated to be from the adjacent hillslope / LS2 landslide deposit. The downstream portion of the ditch is lined with concrete until its confluence with the T-RL1 tributary approximately adjacent to the dam. The combined tributary flow drains over a concrete slab into the spillway.

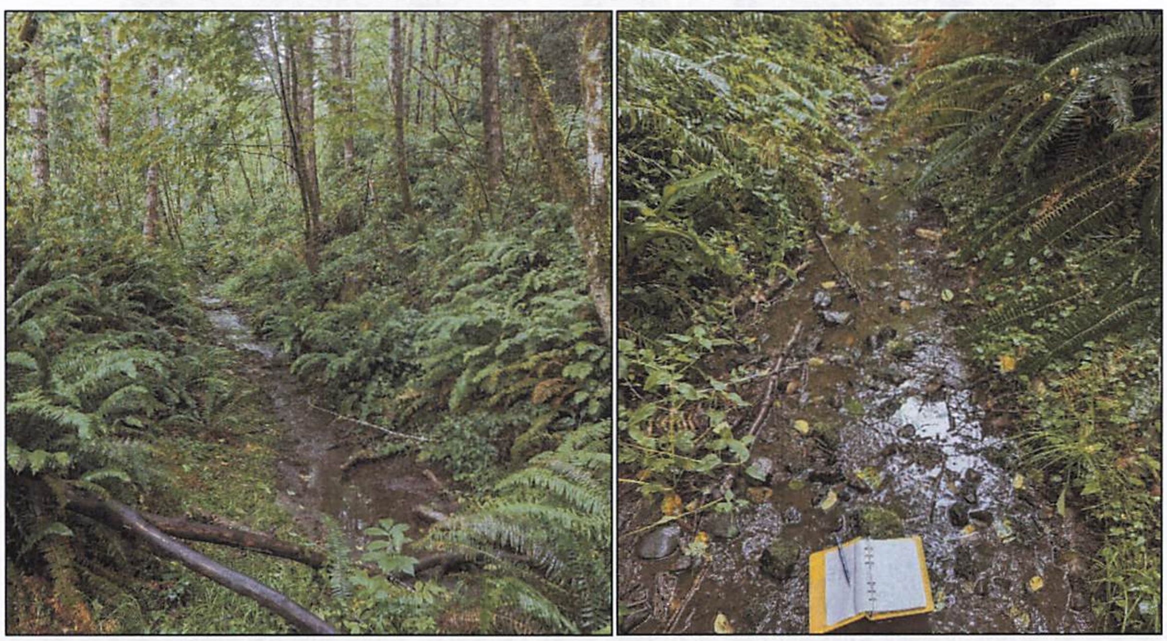

Figure 2-18. Left: View looking upstream at altered channel alignment of the T-RL2 tributary. Right: View looking downstream at T-RL2 tributary from farther north. Photos taken July 6, 2022.

2.6 Pre-Dam Topography and Stored Reservoir Sediments

This section describes the methods and results for estimating the pre-dam topography and the volume and characteristics of the reservoir sediment deposits.

2.6.1 Reservoir Sediment Volume and Pre-Dam Topography

Reservoir sediment volume was estimated using two methods: regional erosion rates and a DEM of Difference (DoD). First, an estimate was derived using measured regional erosion rates applied over the drainage area contributing to the reservoir. In the Brookings area, catchment averaged denudation (CAD) rates are 0.25 mm/yr, and rock uplift rates from marine terraces are approximately 0.25 mm/yr with a range from 0.1 to 0.9 mm/yr (Balco et al., 2013). We apply the 0.25 mm/yr CAD rate over the contributing area at the dam (0.59 mi^2) since original dam construction in 1913 (109 years) to calculate the total volume eroded from the landscape. A fraction of the eroded volume leaves the system as dissolved load that does not contribute to reservoir sediment volume. Dietrich and Dunne (1978) show dissolved load is 50% of the total load in the Oregon Coast Range (OCR), and it is estimated that 2/3 of all eroded material in the OCR leaves as dissolved or suspended load (J. O'Connor, *pers. comm.*). We assume that the suspended sediment, in addition to sand and gravel size fractions, is largely trapped by the reservoir, so 50% of the total eroded volume is stored. **This results in an estimated 27,200 CY of stored sediment in the reservoir.** Low and high estimates of 7100 CY and 129,400 CY can be estimated using erosion rates of 0.1 mm/yr and 0.9 mm/yr and fractions of eroded volume stored in the reservoir of 33% and 66%. Sediment volumes may be lower than estimated because sediment was likely not accumulating significantly in the reservoir during the dam reconstruction period (1945 to 1966), and, following reconstruction, the reservoir was seasonally drawn down by use in the summer such that it was passing flow and excavating some sediment during the winter.

Second, reservoir sediment volume was estimated using a DoD, whereby a surface model of the estimated pre-dam topography is subtracted from the surveyed bathymetric surface to generate sediment thicknesses. Pre-dam topography was developed using an estimated pre-dam longitudinal profile (LP) and several reference valley sections. The pre-dam topography is shown in Figure 2-11 and guides the development of the pre-dam surface model but was not high enough accuracy to be used directly for surface creation.

The LP was estimated between long-term stable features in the profile observed in the field. The upstream stable feature is the concrete weir structure (Figure 2-16), which is located at the head of the delta where the valley narrows upstream of the reservoir. The downstream tie-in point is located near the pipe outlet at the downstream end of the spillway. In this location, the channel comprises large boulders sourced from the grade-controlling, LS1 landslide deposit, and we assume these boulders are relatively stable on decadal timescales given their angularity and the relatively small size of the channel (e.g., Figure 2-14). The profile is drawn at a lower gradient immediately upstream of the dam with gradient increasing upstream from STA 4+00. This is because the valley-damming landslide deposit likely reduced gradient via sediment trapping immediately upstream from the deposit.

Three reference sections upstream of the reservoir and one section from an adjacent drainage of comparable size were used to develop a typical pre-dam valley cross-section. Estimations of reservoir valley morphology were informed by historical photos taken during dam reconstruction (Figure 2-19), by as-built drawings from dam reconstruction, and the pre-dam topography survey (Figure 2-11). These sections were scaled to tie into existing hillslopes in the EG surface and superimposed onto six sections within the reservoir. The resulting valley bottom elevations were projected onto the estimated Ferry Creek pre-dam LP, and the pre-dam surface interpolated between them. A similar process was applied to two tributaries on river right. Several reference sections upstream of the extent of reservoir influence were used to create a typical section, which was applied to sections within the area of influence to estimate the pre-dam linear profile. **The DoD results in an estimated sediment storage volume of 27,000 CY.**

The reservoir sediment thicknesses associated with the DoD are in Figure 2-20. Sediment thicknesses follow typical spatial distributions of most reservoirs with thickest accumulations in the deepest portion of the reservoir near the dam and at deltas located at the head of the reservoir and river-right tributary junctions. The thickest deposits are between 6 ft and 12 ft in the downstream half of the reservoir and at the two upstream-most deltas. The downstream river-right delta is calculated as over 20 ft thick, but this value is influenced by the construction of a road and fill placement over the tributary. No sediment cores were collected in the reservoir sediments to inform or constrain the estimated sediment thicknesses.

Figure 2-19. Historical photo looking upstream at the unfilled reservoir area during dam reconstruction period.

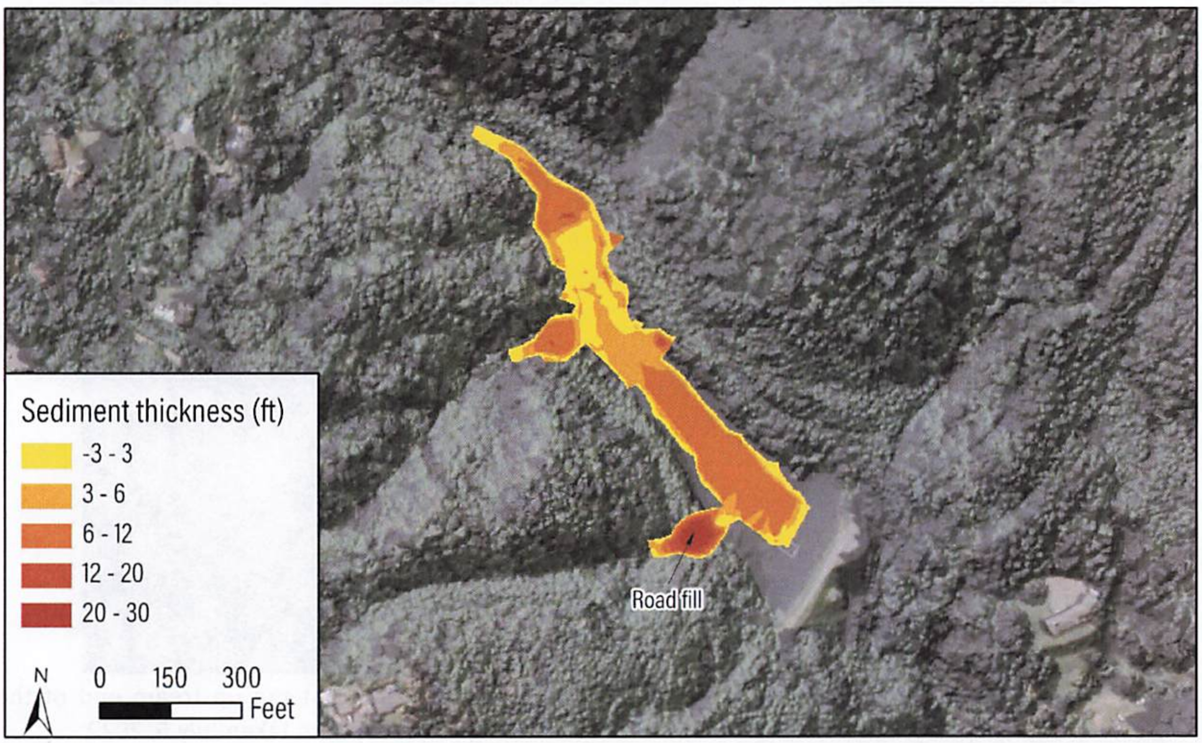

Figure 2-20. Ferry Creek estimated reservoir sediment thickness. The location of the road fill on the T-RR1 tributary is noted.

2.6.2 Sediment Characteristics

Direct observation and characterization of the full reservoir deposit was not possible, but several observations and inferences provide a partial characterization. No sediment cores were collected in the reservoir sediments, so sediment characteristics are inferred from typical reservoir sedimentation processes, geology in the contributing basin, and observed sediment in channels and hillslopes in the contributing basin. The Dothan Formation composes the surficial geology of much of the basin, and although a diverse set of lithologies are found within the Dothan Formation mélange, typical weathering products are silts and clayey silt with coarse clastic material (FEI, 2018). The slow settling velocities of the silts and clayey silts suggest that much of the central and downstream portion of the reservoir consists of these fine-grained size classes, rather than sand. These deposits are likely stratified with both background deposition and event-driven sediment emplacement.

The delta deposits for Ferry Creek and its tributaries provide an indication of the characteristics of the coarser marginal deposits. As described in Section 2.5.2, the delta deposits comprise a range of sediment sizes ranging from large gravel in the Ferry Creek delta to sand, silt, and clay in the more downstream portions of each delta.

Figure 2-21. View looking upstream at the vegetated Ferry Creek delta at the upstream end of the reservoir. Inflatable kayak in bottom left corner for scale. Oblique aerial photo taken July 6, 2022.

2.7 Fish Passage

There are several fish passage barriers along Ferry Creek that preclude fish access into and through the watershed. The downstream-most barrier is a naturally occurring 20 ft waterfall located approximately 1000 ft downstream of Ferry Creek Dam and prevents fish from the Chetco River from accessing the middle and upper portions of the Ferry Creek watershed. The channel directly downstream of Ferry Creek Dam contains slopes up to ~30%, likely limiting fish passage.

The Ferry Creek Dam is the largest fish passage barrier on Ferry Creek, although its impact is relatively minor given the waterfall downstream and the relatively short reach separating them. The 250-ft-long spillway is the only route around the dam, and it is steep with high velocities making it a complete passage barrier. The weir upstream of the reservoir may be a partial fish passage barrier, particularly at low flows. There are reportedly two waterfalls upstream of the weir that may limit fish movement within the watershed upstream of Ferry Creek Dam.

2.8 Fisheries

Recent sampling conducted in Ferry Creek by ODFW fish biologists in January 2018 found resident coastal cutthroat trout present both upstream and downstream of the dam and other non-game species are also found in the project reach (Dyer, 2018). These species are expected to be present at the site year-round, and both juveniles and adults may be present during construction. No anadromous fish are present at the dam site due to a natural passage barrier located 1000 ft downstream of the dam (Figure 2-21). Review of ODFW's fish distribution database (https://nrimp.dfw.state.or.us/FHD_FPB_Viewer/index.html) shows Ferry Creek as used by coastal cutthroat trout only. While it's possible that there could be limited use of lower Ferry Creek by juvenile steelhead and coho salmon during periods of high water, it's highly unlikely that these fish would be present during the Project IWW (July 15 – September 30) when streamflows are significantly less than 1 cfs (Table 2-4).

The Chetco River and many of its tributary streams contain runs of fall Chinook salmon, coho salmon (*Oncorhynchus kisutch*), winter steelhead (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarkii*), and Pacific lamprey (*Entosphenus tridentatus*). The Southern Oregon and Northern California Coastal (SONCC) Evolutionarily Significant Unit (ESU) of coho salmon is listed as threatened under the Endangered Species Act (ESA), and a recent 90-day finding on a petition to list SONCC Chinook salmon has initially been ruled as warranted by National Marine Fisheries Service (NMFS). No designated critical habitat for listed species was found in the vicinity of the project area after a review of the NMFS critical habitat spatial dataset (https://noaa.maps.arcgis.com/home/item.html?id=f66c1e33f91d480db7d1b1c1336223c3). The mainstem Chetco in the vicinity of Ferry Creek is mapped as Essential Fish Habitat (EFH) for both Chinook and coho salmon.

Adult salmonids typically use the Chetco River for migration and spawning during periods of elevated flows (October – April) and are unlikely to be present during the summer IWW, although a few adult chinook salmon may be present in the estuary during late summer and early fall.

Juvenile coho salmon are expected to be rearing in natal tributary streams during the IWW. Depending on water temperatures and other water quality conditions, juvenile Chinook salmon, steelhead, and cutthroat trout could be present in the lower Chetco near Ferry Creek during Project construction.

Impacts on fish from reservoir drawdown and dam removal construction activities are expected to be minor due to the low volume of flow in Ferry Creek during the IWW, and the location of anadromous salmonids in the lower Checto River, estuary, or tributary streams. Fish located immediately adjacent to the dam site will be captured and relocated as described in section 5.3. The greatest impacts are likely to be experienced by coastal cutthroat trout and other fish species residing between the dam and the natural downstream barrier. Anadromous species residing in the lower Chetco River near the mouth of Ferry Creek would be able to relocate to avoid degraded water quality or increased turbidity from construction activities.

Project benefits to fisheries resources include reconnecting isolated populations of coastal cutthroat located upstream and downstream of the dam and providing flow and sediment continuity in Ferry Creek and the lower Chetco River.

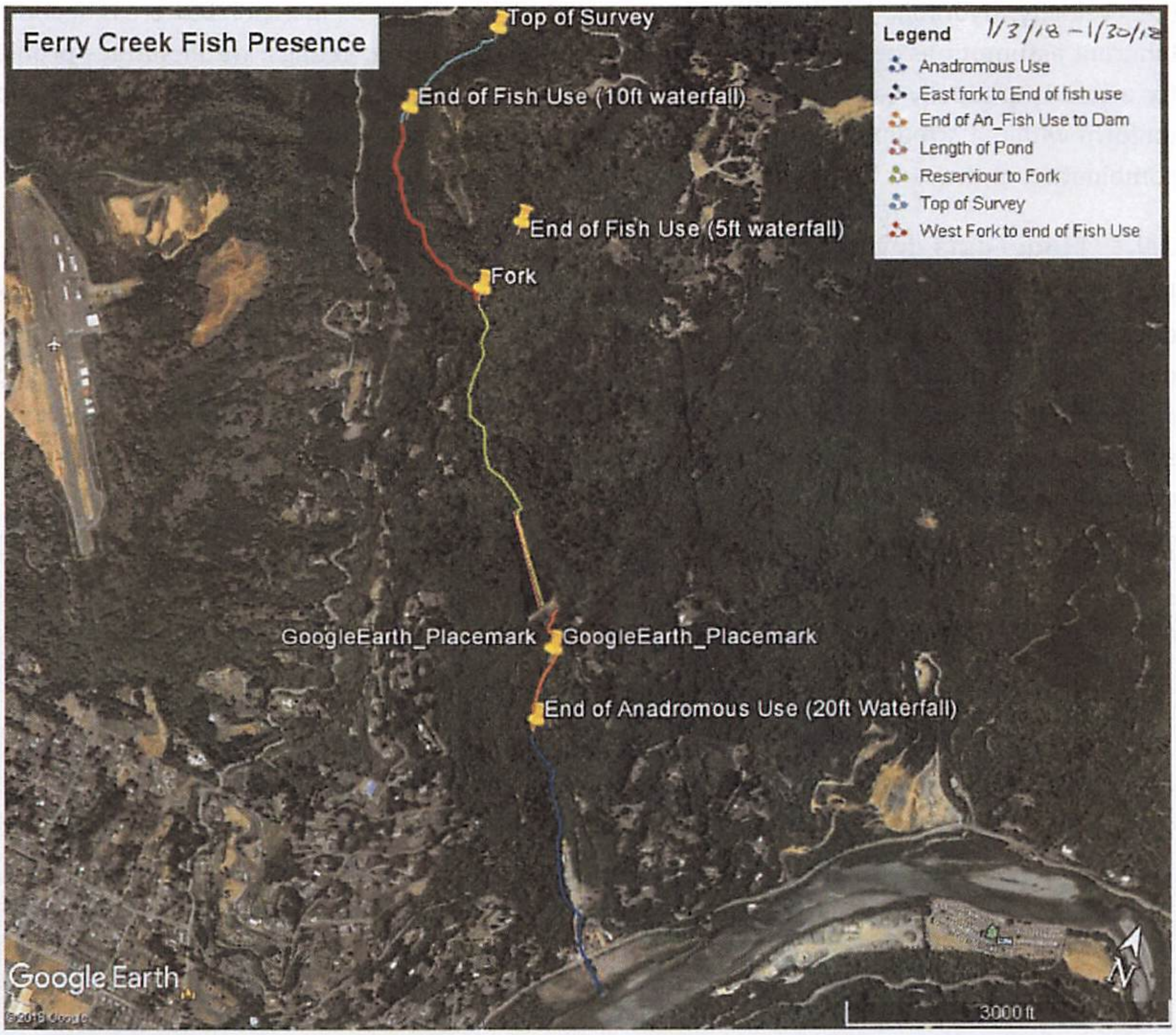

Figure 2-22. Ferry Creek fish presence determined from January 2018 surveys by ODFW (Dyer, 2018 Appendix D).

2.9 Hydraulic Modeling

Hydraulic modeling for the fish passage plan was performed using HEC-RAS 6.3.1 (Army Corp of Engineers, 2022). A one-dimensional (1-D), steady-state hydraulic model was developed to evaluate the performance of the proposed ~380 ft long pilot channel and the immediately downstream ~140 ft long existing channel through a range of flows for proposed project conditions. Results are presented in Section 5.4.

Additional hydraulic modeling was performed to determine OHW under proposed conditions.

2.9.1 Model Capabilities

The HEC-RAS 1-D model solves the energy equation using an iterative technique for a given hydraulic condition. This technique results in a solution to all variables in the energy equation (i.e., velocity, hydraulic head, friction losses, etc.) at any given or interpolated cross-section. Inherent assumptions of the model are: that the simulation is calculating a water surface profile for a steady gradually varied flow; channel slopes are less than 10 percent; and flow is 1-D and uniform within a streamline. The model can simulate subcritical flow, supercritical flow, and a combination of the two for open channels.

2.9.2 Model data development

Project geometry was developed for pre- and post-project conditions. A pre-project was developed for the existing channel downstream of the dam. The existing terrain surface model described in Section 2.2 was used for pre-project terrain development. This terrain was sampled at cross-sections every 20 ft throughout the model extents, with additional interpolated cross-sections generated every 5 ft. Figure 2-23 shows the hydraulic model layout with cross-section distribution within the project area.

Figure 2-23. Plan view of existing conditions hydraulic model layout showing cross-sections distribution. Interpolated cross-sections are not shown.

The existing terrain model was combined with proposed design surfaces developed in AutoCAD Civil 3D 2023 to develop a post-project terrain model representing the existing ground and pilot channel development through the dam. This terrain was sampled at cross-sections every 20 ft throughout the model extents, with additional interpolated cross-sections generated every 5 ft. Ineffective flow areas were applied to sections where the model resulted in flow in hydraulically disconnected areas. Figure 2-24 shows the hydraulic model layout with cross-section distribution within the project area.

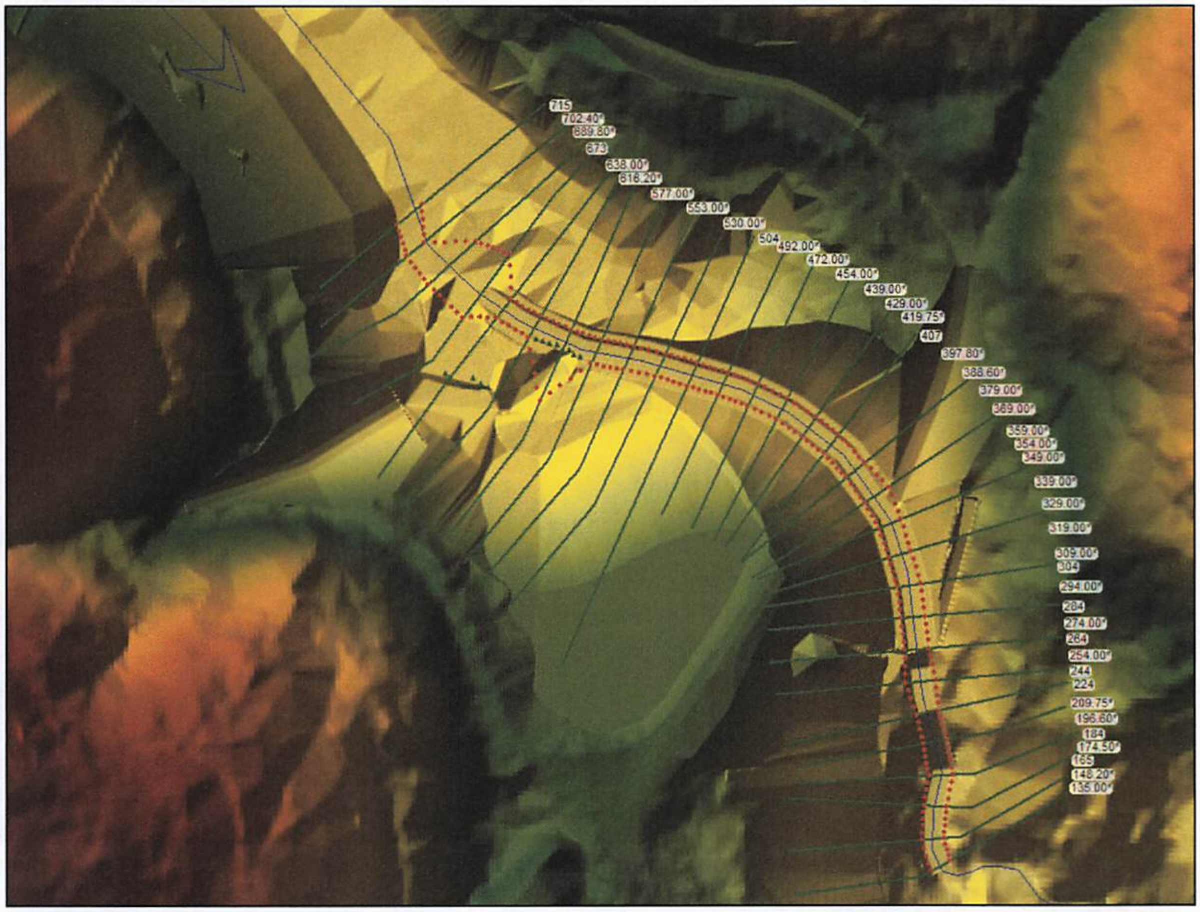

Figure 2-24. Plan view of proposed conditions hydraulic model layout showing cross-section distribution. Interpolated cross-sections are not shown.

A third model was developed to determine OHW throughout the project area under proposed conditions. The proposed conditions model described above was modified with additional cross-sections extending further upstream through the reservoir. Cross-sections were located every 20 feet throughout the model extents and ineffective flow areas were applied where appropriate. The hydraulic model layout is shown in Figure 2-25.

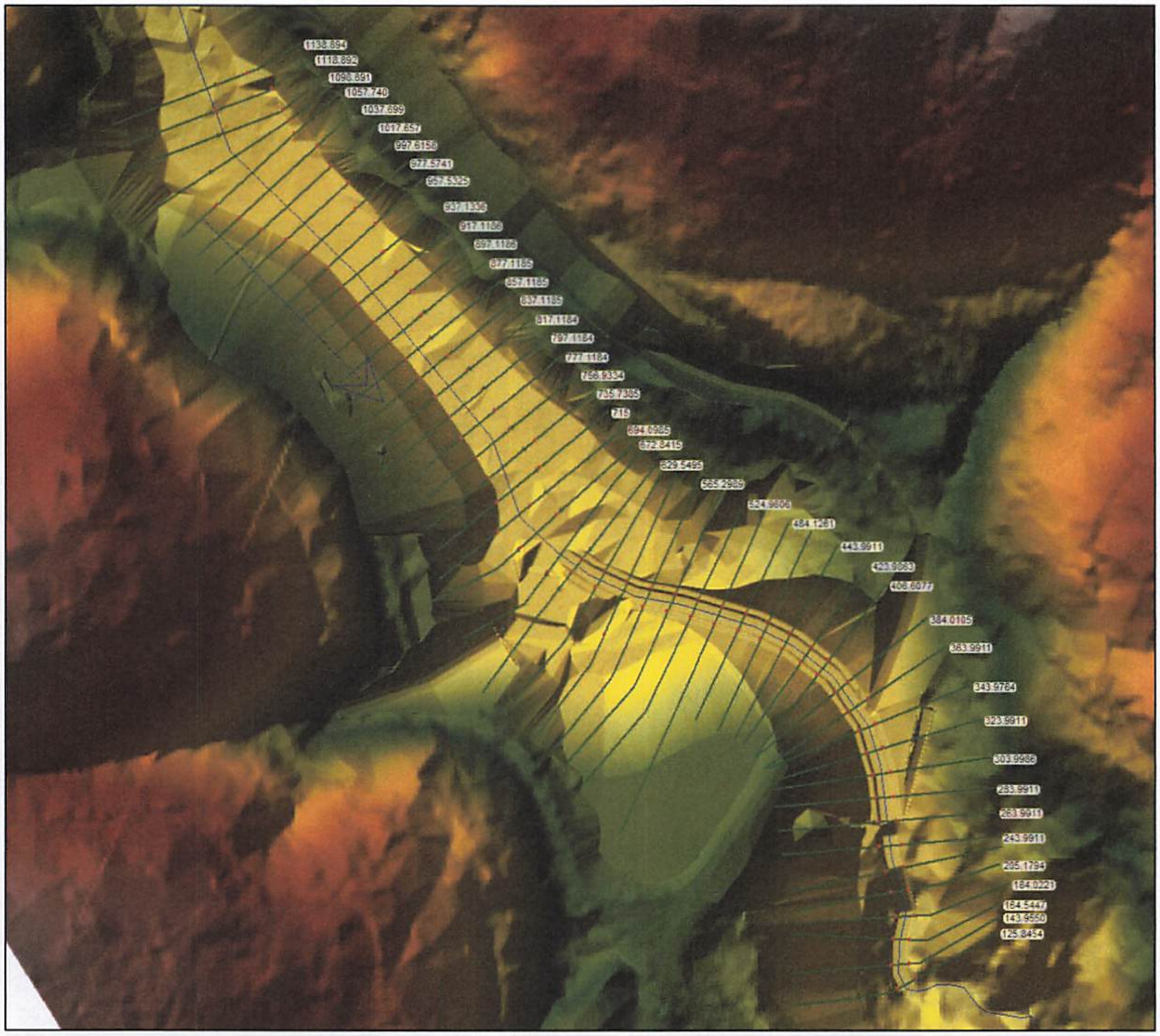

Figure 2-25. Plan view of extended proposed conditions hydraulic model layout for OHW modeling showing cross-sections distribution.

Manning's roughness coefficients were selected for the existing and proposed channels and overbank areas (Table 2-6). These values were selected based on photographic guidance (Yochum, 2014), tabular guidance (Chow, 1959), and empirical equations (Jarrett, 1985). A sensitivity analysis was performed, varying the selected roughness values by ±20%.

Table 2-6. Roughness values used in hydraulic model simulations.

Surface Type	Roughness Value
Existing downstream channel	0.090
Existing overbank	0.150
Proposed pilot channel	0.070
Proposed overbank	0.050

The high and low fish passage flows were analyzed for pre- and post-project conditions (Table 2-3). While low fish passage flow is defined as the mean daily average flow that is exceeded 95% of the time during migratory fish presence, that value was determined to be 0 cfs. Thus the 50% annual exceedance flow (0.515 cfs) was used to calculate low flow conditions instead. OHW was defined as the 2-year peak flow (Table 2-3).

The models were run for a mixed flow regime due to the relatively low flows analyzed and steep slopes found downstream of the dam within the model extents. The downstream steady state boundary condition for the models was set to normal depth (slope-area method) based on the existing channel slope within the vicinity of the downstream model extent. The upstream boundary condition was set to critical depth.

3 Reservoir Sediment Management Plan

This Reservoir Sediment Management Plan describes the plan for managing stored reservoir sediments during and after dam removal and provides a description of expected geomorphic impacts of removal. Part of the Plan addresses sediment contamination concerns and permitting via the Sediment Evaluation Framework (SEF) (RSET, 2018), which is discussed in greater detail in Section 7.4.2.

3.1 Sediment Management Plan

The proposed Sediment Management Plan is for partial removal of Ferry Creek Dam via excavation of a notch on the river-left side of the embankment and a combination of channel grading and natural erosion of stored reservoir sediments. The goals of the Sediment Management Plan are 1) to not cause significant adverse impacts or hazards to water quality, biological resources, geomorphologic conditions, or human safety; 2) not negatively impact short- or long-term stability in the Project area and downstream portions of Ferry Creek; and 3) and to minimize construction efforts where safe and practical.

Meeting these goals requires attention to several important site conditions and constraints. Stability of existing landslides, the remnant embankment and bimrock, remnant reservoir deposits, and placed earthen fill excavated from the dam are important considerations for design of notch location and the pilot channel and post-removal planform alignments. Stability is less impacted if channel flow does not impinge upon these features. Maximizing sediment evacuation is not a high priority as there are not significant adverse impacts if reservoir sediments persist in the reservoir footprint, which was heavily manipulated during dam construction. The sediment deposit is not thick enough to pose significant risks of subsequent failure within the deposit itself that could impact post-removal water quality or planform geometry. The risk of sediment contamination is low (see Section 7.4.2), so toxicity is not a major concern with respect to sediment management strategy. Elevated suspended sediment concentrations (SSCs) can negatively impact downstream aquatic resources, e.g., in Ferry Creek and the Chetco River. Given the volume, geometry, and composition of the sediment deposit, a moderate to slow-paced natural release of sediments is not anticipated to cause peak potential SSC that would significantly impair downstream ecosystems. This is in contrast to a rapid drawdown strategy to maximize sediment evacuation, which would concentrate SSC impacts in a shorter time period with higher SSCs. A rapid drawdown strategy conflicts with goal of stability of landscape site features (see Section 4.3). A natural release of sediment is less expensive than dredging and outhauling the reservoir sediments.

The sediment management sequence is presented below with a more detailed description of anticipated responses provided in Section 3.2. Reservoir sediment evacuation would begin during drawdown with fine-grained sediments being mobilized and transported through the outlet pipe. Some reservoir sediment deposits may slough and slump upon aerial exposure during drawdown depending on cohesion, thickness, and slope, among other factors. Flows in Ferry Creek are expected to be low during the summer IWW (July 15 – September 30) during construction, so minimal sediment excavation is expected except in the footprint of the free-flowing channels at the bottom of the reservoir. Upland reservoir sediments outside of the wetted channels are expected to harden and stabilize over a period of weeks, after which point the dam area will be isolated from any active flow, and the notch in the dam will be excavated. A pilot channel through the notch in the dam will be excavated an additional 100 ft upstream into reservoir sediments. Grading will also occur in the lower reaches of three tributaries (T-RL1, T-RL2, T-RR1, Figure 2-4). Excavated earthen materials from the dam and pilot channel (16,000 to 18,000 CY), and tributaries (4500 to 5400 CY) will total 20,500 to 23,400 CY (Appendix A, DWG 4.0) and will be placed in the four upland storage areas, two of which are in the reservoir footprint. In these locations, any remaining reservoir sediments will be effectively encapsulated by the placed material. Remaining reservoir sediments will be allowed to freely evolve *in situ*.

3.2 Reservoir Sediment Evolution and Downstream Impacts

Under a dam removal alternative with natural sediment erosion and distribution, the fate of the impounded reservoir sediments after removal is an important consideration that can impact project timeline, design, and channel form and processes. In a natural release removal alternative, the timescales and spatial distribution of sediment evacuation and transport vary with grain size, reservoir position, hydrologic forcing, and drawdown/removal design. In this section, we describe the expected patterns in reservoir sediment evolution and any downstream impacts of the proposed dam removal design. Reservoir drawdown and dam removal is planned for the beginning of the IWW when Ferry Creek flow is expected to be low (i.e., < 1 cfs, Table 2-4). The maximum outflow rate from the dam during drawdown will be 3.8 cfs at the outset of drawdown (see Section 4.3), which is between a 25% and 12% duration exceedance flow (Table 2-4).

We estimated that Ferry Creek Reservoir stores a potential 27,000± CY of sediment, which varies in size from fine-grained silts and clays in the main body of the deposit to coarser sand and gravels in the marginal delta deposits. Fine-grained reservoir sediments will be readily mobilized by stream flow during reservoir drawdown and transported downstream in suspension and either be deposited on channel margins in small quantities that will be revegetated naturally or be transported to the Chetco River and to the Pacific Ocean. Fine-grained sediment evacuation will occur mostly in and adjacent to the path of the free-flowing Ferry Creek and its tributaries. Transport of fine-grained sediments will not have significant morphological impacts but will increase SSCs in Ferry Creek and, to a lesser extent, the Chetco River. SSC increases will be greatest during drawdown when fine-grained sediments first begin to be evacuated with elevated drawdown flows and with subsequent meteorological events, when SSCs may be naturally higher in the Chetco River.

Coarse-grained reservoir sediments (i.e., sand and gravel) are concentrated primarily in vegetated, marginal delta deposits, which are located 150 ft to 1000 ft from the notch that will be excavated through the former dam. The coarser clasts and thick vegetation provide stability to these deposits, and sediment will be evacuated more gradually than the fine-grained deposits as the channels incise into the delta deposits. The coarser deposits will not flush as readily as fine-grained deposits, and most will be redeposited in Ferry Creek, particularly in the low gradient reach in the former reservoir. Coarser grained sediments may be deposited as relatively mobile, short-lived bedforms that are limited in spatial extent and thickness. Event-based mobilization and deposition of coarser grained deposits will distribute these sediments along the downstream channel over a period of years such that deposit thicknesses are relatively minor and geomorphic impacts are limited. Little planform modification or geomorphic impact is expected when coarse-grained deposits eventually enter the steep, boulder-laden reach of Ferry Creek immediately downstream of the dam.

Reservoir sediment deposits, including the placed earthen dam materials, that persist in uplands outside of the post-removal inundation extents are expected to be stable long-term features, become fully vegetated, and undergo soil development processes. More than 99% of the placed fill is above the modeled post-removal OHW inundation extents. These inundation extents were modeled on the existing reservoir sediment topography prior to natural sediment evacuation during removal, so inundation extents will likely be lower once reservoir sediments are evacuated by Ferry Creek. As a result, the fill sites may be completely isolated from OHW flows in the long term.

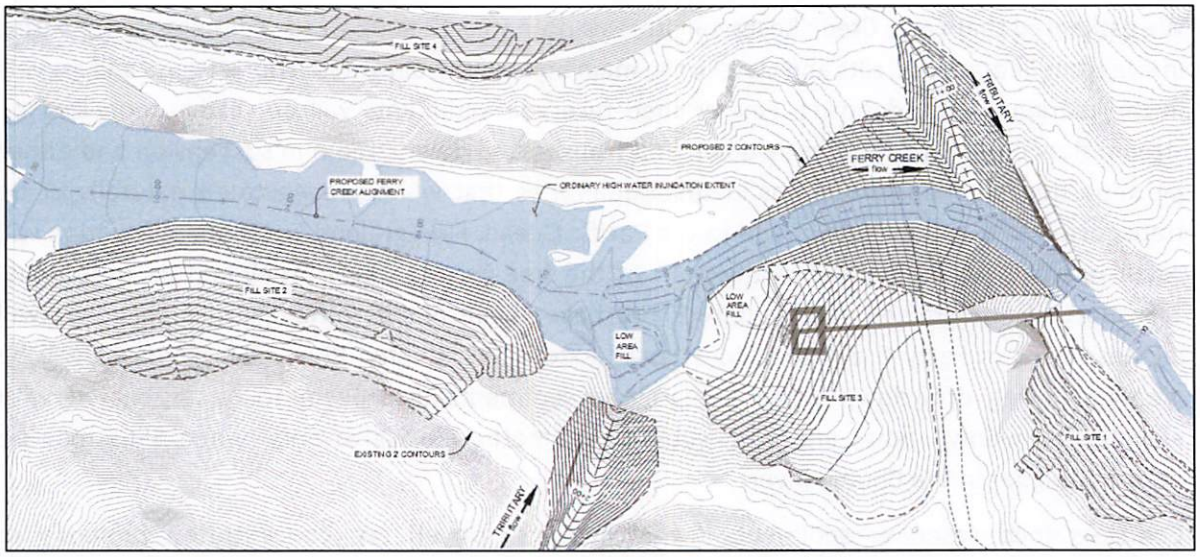

Figure 3-1. Site grading and post-removal OHW inundation extents in the former reservoir area.

No significant geomorphic impacts are expected in the Chetco River, although water quality could be temporarily, but not significantly, impaired by increased SSCs during drawdown. The average bed material sediment flux in the lower Chetco River is 65,584 CY to 94,858 CY depending on whether the Parker (1990) or Wilcock and Crowe (2003) equation, respectively, are used (Wallick et al., 2010; Wallick and O'Connor, 2011). Lower annual sediment fluxes occurred in the 2009 and 2010 water years, where average sediment fluxes of 63,591 CY and 47,802 CY were calculated, respectively (Wallick et al., 2010; Wallick and O'Connor, 2011). These values are much greater than the estimated total volume of reservoir sediments (27,000 CY), only a portion of which are expected to reach the Chetco River and likely distributed over a period of many years. Of the coarse-grained reservoir sediments, only sand-sized material would be expected to reach the Chetco River in the first few years following removal, and gravel is generally expected to take longer to travel the 4000+ ft from the former dam to the Chetco River confluence. There isn't a significant defined delta at the existing Ferry Creek – Chetco River confluence, and the greatest geomorphic impacts of released reservoir sediment could be a temporary increase in sediment stored at the confluence. The Chetco River is 300 to 500 ft wide at the confluence and impacts to hydraulics or morphology are likely to be negligible. Flows in the Chetco River are typically 50 to 200 cfs during the IWW, so elevated SSCs associated with peak Ferry Creek drawdown flows (i.e., < 4 cfs) will be readily diluted.

4 Dam Removal and Water Management Plan

This Dam Removal and Water Management Plan describes the goals for design and methods for physical removal of Ferry Creek Dam and a description of how water will be safely and effectively managed during reservoir drawdown and during construction. Detailed depiction of the Dam Removal and Water Management Plan is in the Design Drawings (Appendix A).

This Plan creates a design focused on effective removal of the dam while reducing risks. It creates a controlled environment that is isolated from moving water to reduce the potential for disturbance of aquatic resources. The plan allows for a controlled drawdown of the reservoir. It will be critical that the drawdown of the reservoir area be completed in a controlled manner for slope stability.

4.1 Goals and Considerations

Development of the Dam Removal and Water Management Plan was guided by several goals, site constraints, and hazard considerations. Long-term site stability is an important consideration for dam removal and water management during many stages of the project. Stability of the dam embankment and bimrock and the reservoir-adjacent hillslopes during drawdown of the reservoir are critical, and we describe the reservoir drawdown analysis in detail in Section 4.3. Short and long-term stability of the dam embankment during and after construction, respectively, is another priority, and the design considers the location and side-slope grading of the notch in the dam and in pilot channel alignments for Ferry Creek and tributaries (T-RR1 and T-RL1).

The stability of the post-removal Ferry Creek alignment is an important design consideration. The pre-dam alignment is likely to be the most stable condition depending on the degree of valley modification during dam reconstruction. We infer the pre-dam alignment from reservoir bathymetry and the pre-dam topographic map (Figure 2-11), which suggest that Ferry Creek flowed between the two bimrocks (i.e., in the downstream face of the dam and at STA 5+00) and the river-left landslide deposit. The Ferry Creek alignment through the left side of the dam bows out towards river-left to decrease the curvature as the post-removal channel passed between the dam/bimrock and the actively creeping river-left landslide deposit. This should reduce the hydraulic forces on the landslide/hillslope toe at this location. The elevation of the downstream end of the pilot channel was set to fall at the upstream-most extent of the existing Ferry Creek channel near the end of the spillway. The existing channel is located on a boulder-dominated portion of the landslide deposit that has historically maintained grade for the upstream reach. The T-RL1 tributary currently enters the top of the spillway via a concrete slab. The plan is to remove the concrete slab, so the post-removal tributary alignment is shifted towards river-right farther from the actively creeping landslide toe to reduce the chances of accelerated post-removal landslide movement.

The timing and duration of reservoir drawdown has important implications for aquatic species, particularly due to the release of fine-grained reservoir sediment that can increase SSCs in the reservoir and Ferry Creek downstream of the dam. These impacts and implications for the drawdown plan are discussed in Section 3. Drawdown is scheduled for the beginning of the IWW, and the duration is a function of drawdown rate, as discussed in Section 4.3.

4.2 Dam Removal Overview and Method

A potential dam removal sequence is provided on DWG 3.0 (Appendix A) and summarized below. This is one approach to the sequence and other options exist that could best be vetted with a qualified construction contractor. Reference to report sections with additional description are provided parenthetically.

1. Install traffic control measures.
2. Utilize tapped existing 36 in pipe to draw down reservoir (Section 4.3).
3. Install erosion control and work area isolation measures (Section 4.4) and perform fish salvage (Section 5).
4. Remove rack and floating dock and dispose of materials off site.
5. Notch river-left upstream berm and realign tributary.
6. Remove concrete spillway structure (100 CY), excavate materials from dam embankment, and reconstruct portions Ferry Creek and tributary channels.
7. Remove existing culvert from river-right downstream tributary.
8. Dispose of excavated materials in upland disposal locations and dispose of concrete off-site at legal dumping facility.
9. Place salvaged large wood materials (Section 6.2).
10. Activate restored stream by removing work area isolation measures.
11. Plug existing 36 in pipe with concrete prior to fill placement in fill site 3.
12. Revegetate site (Section 6.2).

4.3 Reservoir Drawdown

Reservoir drawdown would occur using an existing 36 in steel pipe from the existing rack through the dam to the downstream end of the spillway pending an evaluation of the suitability of the condition of the pipe. A 5 in valve and orifice tap would be placed on the pipe inlet to provide flow rate control through the pipe. The reservoir water surface will be at approximately 399.5 ft, and the tap orifice will be at 365.0 ft for a total drawdown height of nearly 35 ft. The dam crest elevation is 404.0 ft for a total embankment height of 39 ft on the upstream side. The total volume of water in the full reservoir is approximately 3.8M ft^3.

The orifice pipe diameter is selected to create a relatively slow average drawdown rate of 2.1 ft per day and reduce the risk of slope and dam embankment instability and reduce SSCs in downstream channels. The preferred timing for drawdown is in the beginning of the IWW to allow ample time for a slow drawdown, which will discourage slope failures and allow the saturated materials in the reservoir area to desiccate and firm up prior to the introduction of construction equipment. We justify drawdown decisions in the following sections.

4.3.1 Motivation and Overview

Several drawdown scenarios were considered including slow and rapid and a phased drawdown. The slow drawdown condition is where drawdown rate occurs slow enough for the water table/phreatic surface in an earthen dam and/or reservoir-adjacent hillslopes to equilibrate. Rapid drawdown is when the permeability of the earthen materials is too low to keep pace with the drawdown of the reservoir, so that functionally the phreatic surface is at the same level as the initial reservoir water level. A phased drawdown consists of some combination of rapid, slow, and intermediate drawdown rates. For a period of time following reconstruction, the reservoir was seasonally drawn down during its use as a water supply. Such drawdown likely would have occurred slow enough for the phreatic surface and pore pressures in the dam and landslide deposits to equilibrate and provides a bound on potential stable drawdown rates and durations.

The impact of drawdown rate on dam and hillslope stability is a critical issue. During rapid drawdown, the confining stress of the reservoir water is removed while the internal pore-water pressure in the slope continues to reflect the original water level. Changes in the pore water pressure (Pinyol, 2008) and the extra weight of the water (relative to the drained condition) can lead to geotechnical failure (Lane and Griffiths, 2000). The stability of earthen dams and hillslopes should be analyzed under multiple scenarios (rapid or phased drawdown) to determine if the slopes are stable within a desired factor of safety (FoS).

The most significant drawdown-related hazard is downstream flooding caused by dam failure from either destabilization of the dam itself during rapid drawdown or water displacement from slope failure associated with reactivation of the large river left deep-seated landslide deposit (LS2). Reactivation in the form of rapid mobilization of the deposit could displace water in the reservoir significantly enough to cause downstream flooding by either overtopping the dam or causing dam failure.

While the river-left reservoir landslides seem to show evidence of active creep, the risk of the deep-seated landslide mobilization as a result of reservoir drawdown is relatively low based on the lack of mobilization in response to historical seasonal dewatering practices and topographic manipulation, i.e., the excavation of a road / T-RL2 tributary channel at the toe of the deposit over 60 years ago (Rohde, 1966). The primary deposits on river left (LS1 and LS2, Figure 2-10) are a historical deep-seated landslide with no known significant movements in the last 150 years (Burns, 2021). The likelihood of reactivating the deep-seated landslide deposits is relatively low given its long-term stability, which likely has persisted through multiple CSZ earthquakes and wet meteorological extremes. The toe of the LS2 deposits is buffered from the reservoir by the berm, so drawdown should not impact stability.

Shallow landsliding from within the surficial material of the deep-seated landslide deposit is another potential landscape response to drawdown. Shallow landslides have smaller volumes than their deep-seated source deposits, so they would have a less dramatic potential impact on valley geometry and Ferry Creek planform. A rapid shallow slide early during the drawdown could potentially displace enough water overtop the dam, but the likelihood of such an occurrence is low because the FoS is highest (and risk of failure lowest) during the first 30% drawdown in reservoir depth (Lane and Griffiths, 2000). The volume of reservoir water available to be displaced is much lower (and less likely to overtop and cause dam failure during displacement) when the risk of slope failure is higher, which tends to occur once reservoir depths are less than half of the original values.

No measurements of geotechnical properties or recent activity are available for the LS1 or LS2 landslides. The approximate topographic geometry is attainable from the existing ground surface, but there is no information on the deposit thickness or geometry of its basal surface. While values of geotechnical properties can be estimated from the range of published values for landslides, we have no estimates of cohesion, which can range widely in landslide deposits between saturated and highly unsaturated conditions (Pinyol et al., 2008). We expect intermediate soil saturation conditions in the deposit at the onset of drawdown early in the IWW.

There are additional considerations beyond slope stability when selecting drawdown and outlet flow rates. The pipe outflow is introduced to the downstream channel, and the magnitude of the flow and its potential impacts must be considered within the context of the range of flows typically experienced by the channel. Outflow rates of similar magnitude to floods could potentially cause downstream erosion, particularly at the toes of some of the actively creeping landslide deposits. Drawdown rate influences the amount of fine sediment initially evacuated from the reservoir and magnitude and duration of elevated SSCs in the channel downstream. More rapid drawdown can cause fine sediments to slough and be mobilized into the channel. If maximizing sediment evacuation during drawdown is a goal, then higher drawdown rates are preferred. Elevated SSCs can be detrimental to downstream biota with species-dependent impacts a function of concentration and duration of exposure. Concentration and duration are often inversely related quantities in a dam removal context. The drawdown rate can be selected for higher concentrations for a shorter duration, or lower concentrations for a longer duration.

4.3.2 Drawdown Slope Stability Analysis

We use several lines of evidence to determine drawdown rates that will not pose a significant risk of slope instability in the dam or adjacent hillslopes and landslide deposits. First, we calculate the minimum FoS under the rapid drawdown scenario using the charts from Lane and Griffiths (2000; Figure 7 therein). Lane and Griffiths (2000) use a finite element approach to model slope stability under a range of drawdown conditions and present FoS vs. drawdown ratio results for select parameter values for a 2:1 slope condition. Material properties for the dam are from FEI (2018), and dam geometry is from RDG's existing ground surface for the site. The minimum FoS at rapid drawdown using the Lane and Griffiths (2000) chart is approximately 1.63 and occurs when the reservoir depth is 30% of full (i.e., the reservoir water level has dropped approximately 25 ft). This FoS was calculated for a simulation using a 2:1 to slope and interpolating between the minimum values for the $\phi = 20°$ and 30° cases (Table 4-1). The upstream face of Ferry Creek Dam is 1.5:1, so the FoS for Ferry Creek may be lower than 1.63. Slope stability analyses and material property measurements for the dam were completed in the 1960s (Rohde, 1966), and these data were used or informed parameter values in the geotechnical evaluation performed by FEI (2018).

Rohde (1966) performed rapid drawdown calculations using the Taylor (1948) method and calculated a FoS of 1.08.

The drawdown stability analysis suggests that Ferry Creek Dam will be stable under a rapid drawdown scenario with a minimum FoS of 1.63 when the reservoir is 30% full and the flooding risk is lower. Project goals and design do not require a rapid drawdown, so a more conservative drawdown plan is proposed. The 36 in pipe will be fitted with an orifice tap to control pipe outflow rate. We propose an orifice diameter of 0.42 ft (5 in), which will allow for maximum outflow rates of 3.8 cfs at the outset of drawdown (Figure 4-1) and average drawdown rates of 2.1 ft per day. Drawdown would be completed in 17 days under these conditions. Outflow rate is calculated using the orifice flow equation for a sharp-edged orifice (Hibbeler, 2015). For context, rapid drawdown rates are typically faster (e.g., ~6 ft/day, Siacara et al. (2020). Other similar earthen dam removals with concerns for slope failure have used maximum drawdown rates of 3 to 5 ft/day for FoS ranging from 1.15 to 1.3.

Table 4-1. Comparison of dam stability analysis parameters and FoS for Ferry Creek Dam and Lane and Griffiths (2000).

Parameter	Ferry Creek Dam (FEI, 2018)	Ferry Creek Dam (Rohde, 1966)[c]	Lane and Griffiths (2000)	Lane and Griffiths (2000)
Slope angle	1.5:1[a]	1.3:1	2:1	2:1
Friction angle, ϕ (degrees)	28[a]	6.6[c]	30	20
Cohesion intercept, c [kN/m^2]	9.58[a]	42		
Unit weight, γ [kN/m^3]	1922[a]	2034		
Dam height, H [m]	10.7	13.7		
$c'/\gamma H$	0.05	0.15	0.05	0.05
Minimum FoS	1.63[b]	1.08	1.72	1.28

[a] Value converted from value in FEI (2018), from or modified from Rohde (1966).

[b] Value interpolated based on ϕ values from Lane and Griffiths (2000).

[c] Value for a water content of 22.4%

With the proposed drawdown plan, the water surface elevation is lowered slowly (1 ft per 11+ hrs) for the first 25 ft of reservoir drawdown, after which point the vertical drawdown rate increases as a result of changes in reservoir stage-storage geometry to maximum rates of 1 ft per 4 hrs (Figure 4-1). Under these conditions, drawdown is slowest when the reservoir has the most water and when the hazards associated with dam or slope failure and flooding are the greatest. After 25 ft of vertical drawdown, the reservoir water surface area will have been reduced from approximately 4 acres to 1.80 acres, so much of the reservoir-adjacent area will have time for the phreatic surfaces to adjust to the lowered reservoir water surface.

The maximum outflow rate of 3.8 cfs at the outset of drawdown is between the 25% and 10% annual exceedance flows (Table 2-3) and much less than the 1.25-year RI flood and the 5% exceedance flow of 68.0 and 10.3 cfs, respectively. As such, the outflow will likely not cause any negative geomorphic impacts downstream, such as bank erosion, winnowing of fine sediment, or destabilizing of landslide deposits. The low outflow rate will not evacuate as much reservoir sediment as a faster rate and will therefore result in lower SSCs in Ferry Creek and Chetco River. The Chetco River, which typically has a discharge of hundreds of cfs during the drawdown period, will readily dilute the elevated Ferry Creek SSCs to negligible levels.

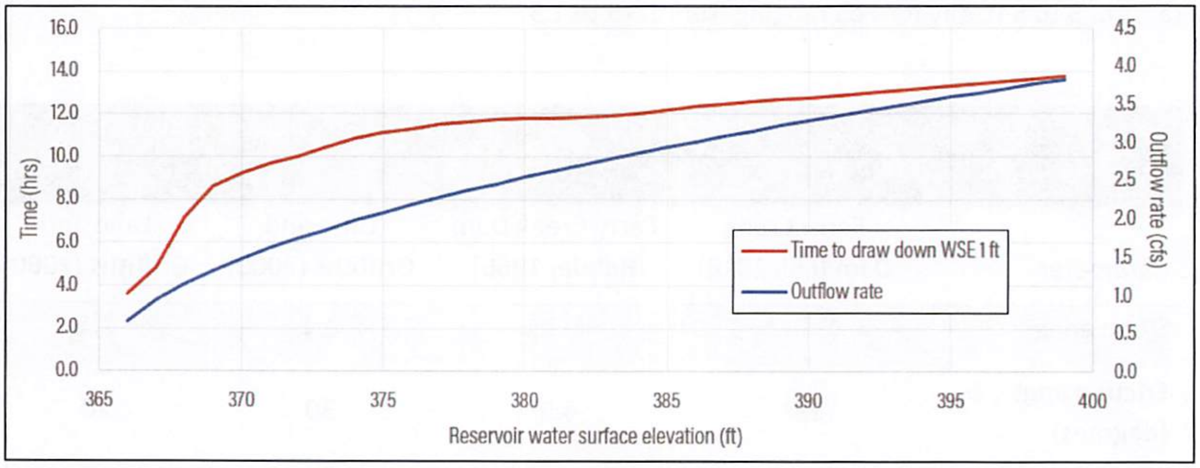

Figure 4-1. Time to draw down the reservoir water surface elevation (WSE) by 1 ft and pipe outflow rate vs reservoir water surface elevation using a 0.4 ft diameter orifice tap.

4.4 Work Area Isolation and Care and Diversion of Water

An important aspect of in-water work is isolation of the work area. Work area isolation creates a safer environment for construction activities and protects aquatic species and wildlife from the work area. The plan for work area isolation and care and diversion of water for the Project is provided in DWG 3.1 (Appendix A). First, an orifice plate valve will be installed on the upstream/reservoir end of the existing 36 in steel pipe to control reservoir drawdown rate. Next, the reservoir will be drawn down to expose the dam embankment as described in Section 4.3.2. At the conclusion of draw down, fish block nets will be installed to exclude fish from the work area, and a fish salvage will be performed. Next, water isolation measures (e.g., sand or bulk bags, or alternative coffer dam) will be placed upstream of the area for pilot channel and tributary grading and excavation of the dam embankment. Flow will be routed via gravity pipe from upstream of the cofferdams into the existing 36 in pipe for Ferry Creek and T-RR1 flows and to downstream of the work area for T-RL1. A silt curtain will be installed in Ferry Creek downstream of the work area to protect any waters from suspended sediments generated during construction. Following completion of the grading and excavation, the work area isolation measures will be removed, and flow will be permanently rerouted into the pilot channel.

In-water work will be performed during IWW (July 15 – September 30). Hydrologic conditions during the construction period are provided in Section 2.4.1.

4.5 Dam Removal and Fill Placement

The dam removal and site grading plan are provided in DWG 4.0 – 5.0 (Appendix A). A V-shaped notch will be excavated into the dam embankment to function as the new pathway for Ferry Creek through the dam area. The Ferry Creek pilot channel and notch requires removal of 16,000 to 18,000 CY, and tributary excavation requires 4500 to 5400 CY of excavation for a potential total excavation volume of 20,500 to 23,400 CY. The notch includes channel alignments for both Ferry Creek and the downstream portions of the T-RL1 and T-RR1 tributaries. From the channel bottoms, 1.5:1 valley sideslopes will be graded back to match existing terrain. The culvert and road fill associated with the T-RR1 tributary will be removed. A notch will be excavated into the berm to reroute the T-RL2 tributary into its historical alignment in the upstream portion of the reservoir footprint.

The sediment excavated from the dam and reservoir will be placed permanently in four designated fill sites in the Project area and to fill one low area for the T-RR1 realignment (Appendix A, DWG 4.0). The total available fill volume is 34,000 CY, which is more than sufficient to accommodate all excavated materials. Sites were selected to provide long-term stability for the deposited material and to reduce additional disturbance to the Project area. All placed fill deposits will be graded at 1.5:1 slopes or gentler (Appendix A, DWG 4.1) and revegetated with upland vegetation to improve surface cohesion and stability. Site 1 (maximum capacity = 1600 CY) is located along the downstream face of the remnant dam on the river-right side of the bimrock that protrudes out of the dam. This site is a long-term stable landscape feature as evidenced by pre-dam topography (Figure 2-11). Site 2 (13,000 CY) is located within the reservoir footprint between the two river-right tributaries (T-RR1 and T-RR2) from the abandoned road down to the bottom of the former reservoir. Site 3 (10,000 CY) can be placed on the upstream face of the remnant dam on the river-right side of Ferry Creek and the T-RR1 tributary alignment. Site 3 fill will bury the existing 36 in pipe, which will have been plugged with concrete. Site 4 (9000 CY) is located in the ditch on the river-left side of the berm after the berm is notched and the T-RL2 tributary is realigned. The placement of fill in the ditch should have the added benefit of helping stabilize the upslope hillside and mapped landslide deposit. More than 99% of the fill deposits are above the modeled post-removal OHW inundation extents (Figure 3-1). The toe of Fill Site 2 and portions of the fill proposed in low areas adjacent to the pilot channel are within OHW, but inundated water surface elevations will likely be lower than modeled once reservoir sediments have been evacuated post-dam removal.

5 Fish Passage Plan

This Fish Passage Plan provides an overview of the dam removal plan and strategy for fish passage during and following construction activities. Ferry Creek Dam is a complete fish passage barrier; thus, fish passage will not be provided through the dam site during construction. Following construction, a pilot channel through the dam will provide fish passage conditions comparable to the native channel downstream of the dam.

5.1 Fish Presence and Dam Removal Schedule

Dam removal is anticipated to be completed during the IWW of July 15 to September 30 (ODFW, 2022). The following schedule is anticipated for removing the dam and stabilizing the dam site.

- July Year 1 – mobilize necessary construction equipment and prepare construction zones, begin staging isolation materials and cofferdam bulk bags.
- July-September Year 1 – excavate pilot channel and tributary channels.
- September Year 1 – Implement site restoration and Phase 1 revegetation plan.
- Year 2 – Implement Phase 2 revegetation plan.

Section 2.8 provides a summary of fisheries information for the Project site. Coastal cutthroat trout are expected to be present at the site year-round, and both juveniles and adults may be present during construction. Other non-game species may also be present. Anadromous fish may be expected to be present at the site, however there is a natural obstruction that hinders most passage downstream.

Fish presence in the tributaries is unknown. The river left tributaries are connected to Ferry Creek at the existing dam spillway and the river right tributary is connected to the existing reservoir via a small culvert. Given the poor passage conditions at the spillway and lack of significant flow in the tributaries, fish are not expected to be present, though other species may be.

5.2 Fish Passage During Construction

Section 4.1 and Drawing 1.1 (Appendix A) provide overviews of the dam removal sequencing. The Dam Removal and Water Management Plan (Section 4) creates a controlled environment that is isolated from moving water, minimizing the potential for disturbance to aquatic resources. The plan calls for a controlled drawdown of the reservoir prior to deconstruction activities (Section 4.3). An adaptive management approach will be taken during the drawdown process as necessary.

All work areas will be isolated from stream flow and fish during construction activities per Sections 4.4 and 5.3.2 and Drawings 3.1-3.2 (Appendix A). Fish salvage will be completed in isolated work areas before in-stream construction activities commence per Section 5.3.3. During construction, all stream flow in Ferry Creek will be consolidated and routed through the isolated work area via an existing pipe. The existing 36 in diameter steel pipe is 230 ft long with an approximate slope of 4%. Temporary bypass pipes may be used to extend the existing pipe upstream and/or downstream outside of the isolated work area. Fish passage will not be provided during the bypass, and this is not a change from existing conditions where the dam blocks fish passage. The three tributaries in which grading is proposed are expected to have little to no flow during the IWW. If flows allow, fish passage may be provided through isolated areas via gravity bypass pipes. Following construction, the isolated work areas will be rewatered slowly and in a controlled manner to ensure that there is no loss of surface water in the downstream reach.

5.3 Fish Capture and Release

This section provides the concepts for defishing isolated work areas. The primary focus of the plan is to minimize the potential for fish harm or "take" by isolating the work areas to the maximum extent possible. In addition, the work schedule has been established based on opportune times to minimize potential risk to aquatic organisms as determined by ODFW and NMFS. As with all work efforts, life safety is of utmost importance and fish salvage will be performed in a manner that does not sacrifice personal safety.

Isolation of the work area, fish removal, and release of fish will be conducted or directed by a fisheries biologist who possesses the competence to ensure safe handling of fish and other aquatic organisms, and who is also experienced with work area isolation techniques. The fish salvage plan is based on a multi-level effort that uses a combination of isolation and strategic handling of fish to minimize risks to aquatic resources. The fish capture and release plan uses handheld dip nets, seine nets, and backpack electrofishing units in isolated pool areas as described below.

5.3.1 Species

Sections 2.8 and 5.1 of this report describe the fish species likely to be found at the project site. The following steps will be taken to ensure fish and aquatic wildlife are properly handled and removed from the isolated work areas and reservoir drawdown areas.

5.3.2 Initial Isolation

The quickest and safest way to minimize potential harm to fish and aquatic resources is effective isolation of the work areas creating separation between equipment and moving water. Bulk bags filled with native stream sediments and floating silt curtains will be installed to isolate work areas as described in the dam removal and water management plan found in Section 4 and DWG 3.1 (Appendix A).

5.3.3 Fish Removal in Isolated Areas

In cofferdam work areas and other isolated areas, the first step will be to reduce the volume of water to the fullest extent possible to help consolidate fish and improve salvage efforts. By reducing the water volumes, it will be easier to improve capture and salvage success using seine nets and electrofishing equipment, if necessary. Drawdown of the reservoir will primarily occur via an existing 36 in gravity pipe. If necessary, water volume may be further reduced using diesel powered pumps. To reduce fish exposure, pump intakes will be set near the water surface and fitted with approved wire fish screens that prevent impingement or entrainment of fish.

Water will be lowered in a controlled manner with fish salvage crews continuously monitoring the pumps, newly exposed areas, and fish numbers for crowding. If isolated pockets or pools are uncovered, they will be defished with dip nets and electrofishing equipment will be used if necessary. Pumping will be reduced once manageable water levels are obtained that can easily be waded and de-fished. After waters are reduced to a manageable level, seine nets (made from 9.5 mm stretched nylon mesh) will be used to remove fish from the isolated in-water work areas. An on-site biologist will determine the pass methods and the number of times each area will be seined. Once the seining becomes ineffective, areas conducive to electrofishing may be electrofished. Electrofishing will be conducted by ODFW or other qualified fisheries biologists and will be conducted in a manner consistent with permit guidelines.

5.3.4 Fish Release

For the period between capture and release, all captured aquatic life will be immediately put into dark colored five-gallon buckets filled with clean stream water. Fish will be transferred in the buckets to low velocity flowing water upstream or downstream of the site depending on conditions. Fish removal personnel will provide a healthy environment for the stressed fish and minimum holding periods. Large fish will be kept separate from smaller prey-sized fish to avoid predation during containment. Non-native gamefish shall be relocated to a suitable location by ODFW personnel. Upon coordination with the salvage activities, ODFW will transport the non-native species from the site to the release location. Injuries or mortalities to ESA-listed or proposed species will be provided to NOAA Fisheries.

5.4 Post Dam Removal Fish Passage Conditions

The proposed Dam Removal and Water Management Plan (Section 4) involves the partial removal of the existing dam embankment and the construction of a pilot channel to restore a continuous stream profile with improved fish passage conditions through the dam site. A notch will be excavated of sufficient width to accommodate the restored stream channel without constricting flow. The proposed pilot channel dimensions match the anticipated natural channel that will develop at the site.

A natural stream simulation approach was used to design the pilot channel, with the proposed dimensions matching the native channel outside the limits of the reservoir. The pilot channel ties into the existing channel downstream of the dam embankment and extends through the existing dam into the reservoir at a slope of 0.0196 ft/ft. The streambed will consist of native sediment and include a low flow thalweg. Partially buried boulders sourced from within the project site will be placed throughout the pilot channel to form large scale roughness elements. During the first year, Ferry Creek will naturally evolve throughout the dam and reservoir extents, and the pilot channel may be understood as a temporary nature-like fishway.

Current levels of fish passage will be maintained in the channel below the existing dam and passage will be improved through the existing earthen dam. Under present conditions, the dam is a complete fish passage barrier due to the steep spillway. Passage conditions within the pilot channel will mimic conditions found in comparable portions of the native channel. Visual inspections will be used to determine if there are fish passage concerns during periods of low flow.

Fish passage conditions following dam removal were evaluated using a one-dimensional HEC-RAS model (Section 2.9). The conditions within the pilot channel are compared to existing conditions in comparable portions of the channel downstream of the dam. The existing downstream channel consists of two high gradient cascades (approx. 30-40% slopes) and two lower gradient segments (approx. 2-3% slopes). The pilot channel is designed to approximate conditions in the latter. Flow depths in the pilot channel at both low and high flow are shallow (0.14 ft and 0.55 ft, respectively) but comparable to existing depths in the downstream channel (0.14 ft and 0.58 ft). Velocities in the pilot channel average 0.56 feet per second (fps) and 1.76 fps at low and high flow, respectively. These velocities are slightly higher than in the downstream channel (0.54 fps and 1.66 fps) but are below 2 fps. Partially buried boulders throughout the pilot channel will provide additional roughness and areas of low velocity for fish resting spots.

The steep portions of the existing downstream channel present a potential barrier to fish passage. These portions of the channel are located at the toe of a grade-controlling landslide that is considered stable under existing conditions (Section 2.5.1). These natural features have not been identified as fish passage barriers in the past. Modification of the stream profile through this reach is not proposed as it would risk destabilization of the landslide toe. Conditions in these segments are not impacted by the proposed dam removal.

Fish passage will be improved in three tributaries that have been impacted by access roads associated with dam construction. On river left, two tributaries (T-RR1, T-RR2) were rerouted along a ditch that acted as a bypass for Ferry Creek during dam construction. The T-RR1 tributary is crossed by an access road with a small culvert. The tributaries will be graded with continuous profiles connecting to proposed pilot channel (T-RR1, T-RL1) or to the existing Ferry Creek channel (T-RL2).

5.5 Climate Change Resilience

The Fifth Oregon Climate Assessment Report predicts an average temperature increase of 5°F by the 2050s and 8.2°F by the 2080s across Oregon with the greatest increases in summer, and precipitation is predicted to increase in winter decrease during summer (Dalton & Fleishman, 2021). These changes may impact Ferry Creek by increasing peak flows in the winter and decreasing baseflows in the summer. Decreasing baseflows coupled with higher air temperatures could increase water temperature, which has a detrimental effect on salmonids and other native aquatic species.

The National Marine Fisheries Service (NMFS) guidance on designing fish passage facilities for climate resilience is to evaluate the project life expectancy (NMFS, 2022b). The pilot channel in Ferry Creek is expected to persist as built for less than 10 years after dam removal as stored sediment is naturally transported and incorporated into the fluvial system. Projects with a life expectancy of less than 10 years are recommended to use recent hydrologic data as the basis of design with consideration of future climate conditions and impacts (NMFS, 2022b). Removing Ferry Creek Dam will increase the resilience of Ferry Creek to accommodate climate change impacts through restoration of sediment and debris transport and natural flow regimes. The conversion of the reservoir to a free-flowing channel will also reduce the solar input on the water surface and partially mitigate warmer air temperatures.

5.6 Fish Passage Monitoring and Adaptive Management

A goal of the Ferry Creek Dam removal is to restore longitudinal stream processes that facilitate fish passage and develop natural stream corridor conditions that sustain ecosystem functions. Long-term monitoring of the site is critical to confirm that this goal is met after dam removal. It is inherently challenging to predict the natural response of the stream to dam removal and the conditions for fish passage due to the stored reservoir sediment and dynamic nature of rivers. The following monitoring and adaptive management plan is proposed to identify and facilitate correction of an unforeseen condition that hinders fish passage and longitudinal stream connectivity (Table 5-1).

Table 5-1. Monitoring decision pathways for selected metrics.

Monitoring Technique	Monitoring Metric	Thresholds	Decision Pathway	Applicability
Longitudinal Profile	Gradient	0.5 – 6%	1. > 0.5 and < 6 (Pass) 2. > 6% (Fail)	Project Area*
Fish Passage	Connectivity	Surface connectivity	1. Surface connectivity (Pass) 2. Intermittent flow substantially less than upstream tributary (Fail)	Low flow, main channel
	Jump height	No unnatural barriers exceeding 6 inches** in height	1. No barriers exceeding 6" (Pass) 2. Unnatural barriers present (Fail)	Project Area*
	Water depth	Depth of main channel thalweg of sufficient depth to allow passage of fish present	1. Continuous flow (low-flow depth) consistent with depths of contributing upstream tributary (Pass) 2. Discontinuous or very shallow flow depths that is substantially less than contributing tributary (Fail)	Low flow, thalweg

*STA 2+50 – 15+00 (Appendix A).

**Natural jump heights in the Ferry Creek channel below the dam exceed 6 inches in numerous locations. The channel is extremely variable in bedform and topography with extreme hydraulic flow diversity. Fish have been found in the reach below the dam, indicating that these may not form passage impediments.

1. **As-Built Survey**: An as-built survey will be performed to document the completed project and provide the baseline condition for future monitoring. Permanent markers will be established for the purpose of conducting consistent monitoring. The exact location of monitoring points will be determined in the field after dam removal. The following information and data will be collected as part of the as-built documentation:
    a. Longitudinal channel profile and channel cross-sections,
    b. GPS survey to create surface model map to document important features, and
    c. Photos at permanent monitoring points.
2. **Post-Dam Removal Stream Conditions**: Monitoring of the post-dam removal stream conditions will be conducted for three years to ensure fish passage is acceptable and consistent with surrounding conditions upstream and downstream of the site. Site monitoring should occur after flows anticipated to transport sediment occur. During the first winter is when the most significant channel changes are expected to occur as a result of natural erosion of the stored reservoir sediment. Due to this dynamic time, more frequent monitoring is required in the first winter. It is recommended that visual observations be performed after large precipitation events.
3. **Channel and Landscape Stability**: During monitoring visits, channels should be monitored for knickpoints or bank erosion that could potentially impact hillslope and landslide stability. Any signs of slope instability in the remnant embankment, fill sites, and landslide deposits should be documented.

If the fish passage or channel stability does not meet the performance standard, a corrective action will be recommended. The City of Brookings will be the lead organization responsible for developing a corrective action, procuring funds, and ensuring implementation to rectify the performance of unsuitable conditions.

6 Restoration Plan

This Restoration Plan provides a description of the expected site conditions post-removal, and the design of post-removal site elements such as channel alignment and fill placement, and revegetation design and methods. This section provides an overview of expected conditions based on geomorphic conditions, hydraulic modeling, sediment characteristics, and insight from past dam removal projects. Additional details for channel profile and dimensions, post-removal conditions, and revegetation are in Appendix A.

6.1 Post Dam Removal Conditions

Once the Ferry Creek Dam is notched and natural river processes are connected in an unimpeded manner, short-term and long-term changes to the channel boundaries and longitudinal profile are expected. The initial alignment of Ferry Creek and its tributaries will be partially set by grading during dam removal. The tributaries are steeper than Ferry Creek and not expected to undergo significant changes in channel alignment, whereas Ferry Creek, which flows on the wide low gradient valley floor of the former reservoir, could experience some modification in alignment and channel dimensions as it evacuates reservoir sediments over time. Hydraulic modeling of OHW inundation of the pilot channel and uneroded reservoir surface (Figure 3-1) represents the maximum likely water surface elevations during OHW given that some reservoir sediments will be evacuated during drawdown and by free-flowing Ferry Creek. More than 99% of the placed fill is above the modeled OHW inundation extents and may be completely isolated from OHW flows once reservoir sediments are evacuated. Reservoir sediment deposit evolution is discussed in Section 3.2. Large wood and floodplain roughness elements will be placed on the surface of the reservoir sediments and in Ferry Creek and tributary channels. These woody materials will provide habitat for terrestrial and aquatic species, help support natural revegetation and soil development, and will promote sediment evacuation within the Ferry Creek footprint.

6.2 Revegetation Plan

A revegetation plan was developed based on existing vegetation communities found upstream and downstream of the reservoir site (Appendix A). In these reaches, Ferry Creek has a dense riparian canopy primarily consisting of red alder (*Alnus rubra*) with Douglas fir (*Pseudotsuga menziesii*) and big leaf maple (*Acer macrophyllum*) also present. A dense shrub understory is primarily composed of salmonberry (*Rubus spectabilis*), vine maple (*Acer circinatum*) and stink currant (*Ribes bracteosum*) and many herb species are present including lady fern (*Athyrium filix-femina*), sword fern (*Polystichum munitum*), and skunk cabbage (*Lysichiton americanus*).

The revegetation plan includes two phases. Phase 1 is to be implemented immediately following grading activities to promote stabilization of disturbed areas and exposed reservoir sediments. Phase 1 involves seeding of riparian and upland areas with native seed mixes. Phase 2 will be implemented in the first year following construction. Containerized plantings will be used to establish riparian and upland tree and shrub communities within the exposed reservoir and pilot channel and tributary grading extents. Establishment of native trees and shrubs will promote stream surface shading, recruitment of large woody debris, and litter delivery to terrestrial and aquatic food webs.

7 Permitting Plan

The Project will require Federal and State environmental regulatory permits prior to implementation. Figure 7-1 summarizes the proposed regulatory roadmap for compliance with federal and state environmental permitting requirements and each permit is discussed in the rest of this section.

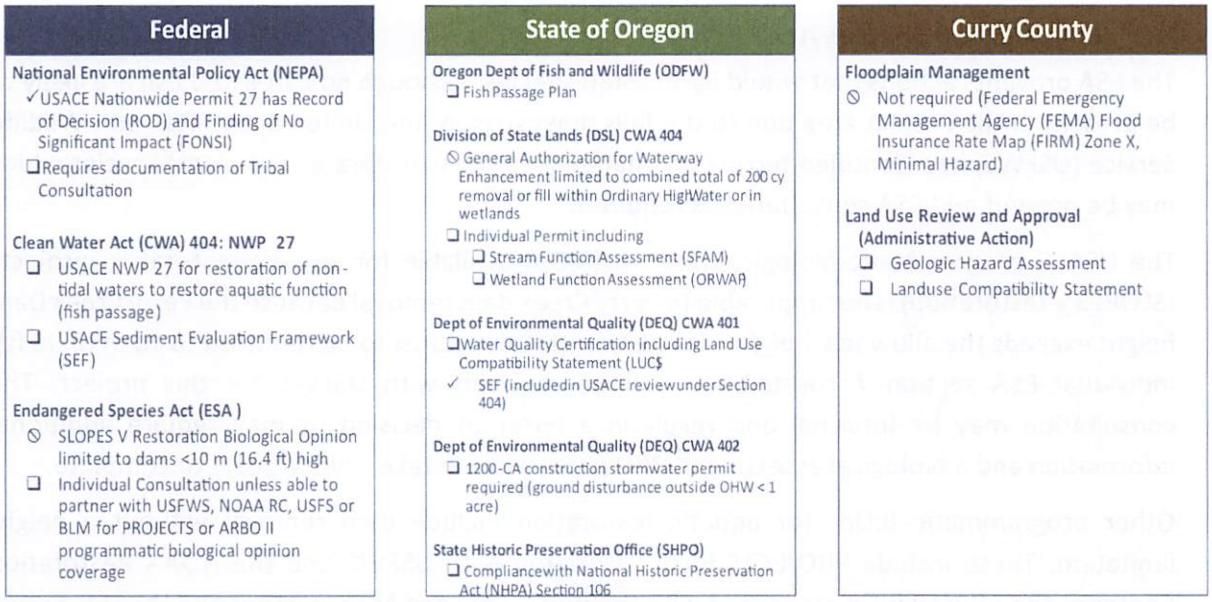

Figure 7-1. Regulatory roadmap for the Ferry Creek Dam Removal project.

7.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires that federal agencies implementing actions with potential to impact the environment evaluate the impacts of any actions (including a no-action alternative). The U.S. Army Corps of Engineers (USACE) will be the federal nexus for compliance with NEPA since it is currently the only federal agency involved with the Project. Other federal agencies could serve as the nexus if they are funding or permitting the Project.

The Clean Water Act (CWA) Section 404 Nationwide Permit (NWP) includes NEPA review, and a Record of Decision was issued in 2021 with a Finding of No Significant Impact (FONSI) and that an environmental impact statement is not required for projects meetings the requirements of the NWP. NEPA requires CWA Section 401 water quality certification, Endangered Species Act (ESA) Section 7 consultation, and National Historic Preservation Act (NHPA) Section 106 review and concurrence. These regulatory conditions are separate from and in addition to the NEPA FONSI.

7.2 National Historic Preservation Act

The State Historic Preservation Office (SHPO) administers Section 106 of the National Historic Preservation Act within Oregon to determine if a project will have impacts on properties of historic significance. Archaeologists will survey the area of potential effects for prehistoric or historic districts, sites, buildings, structures, objects, artifacts, records, material remains, and traditional, religious, spiritual, storied, or legendary places and submit their findings to SHPO for review and concurrence. Local tribes will be notified and consulted during the SHPO review process.

7.3 Endangered Species Act

The ESA prevents actions that would harm listed species. Although no ESA-listed fish are likely to be present in the Project area due to the falls downstream, the United States Fish and Wildlife Service (USFWS) has identified terrestrial (mammal, bird, invertebrate, and plant) species which may be present and ESA consultation is required.

The USACE programmatic biological opinion (BiOp) available for aquatic restoration projects (SLOPES V restoration) is not applicable to Ferry Creek dam removal because the Ferry Creek Dam height exceeds the allowable height of water control structures to be removed to 10 m (32.8 ft). Individual ESA section 7 consultation will be required with USFWS for this project. The consultation may be informal and result in a letter of decision or may require additional information and a biological assessment. This process could take several years to complete.

Other programmatic BiOps for aquatic restoration include dam removal without a height limitation. These include PROJECTS BiOp associated with USFWS and the NOAA Restoration Center or the ARBO II BiOp associated with the Bureau of Land Management and the U.S. Forest Service. Partnership with any of these agencies could allow for expedited ESA consultation by utilizing the programmatic BiOp.

7.4 Clean Water Act

The CWA protects water quality in the waters of the United States through regulating the removal and fill of materials below OHW and in wetlands (Section 404) and limiting in-channel turbidity (Section 401). The USACE and Oregon Department of State Lands (DSL) jointly administer the CWA section 404 permits. The ODEQ administers the CWA section 401 permits.

7.4.1 CWA 404 USACE Nationwide Permit 27

Nationwide permit (NWP) 27 covers aquatic habitat restoration, enhancement and establishment activities. It authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services. Removal of the dam and restoration of the channel and floodplain will increase fish passage and in-stream aquatic resources. The NWP has general conditions related to construction and erosion control which must be incorporated into the final project design. Coverage by NWP 27 will require preparation and submittal of a Joint Permit Application (JPA) to USACE, DSL, and ODEQ. USACE has up to 150 days to issue a permit after application.

In addition to NWP 27 guidance, USACE Regulatory Guidance Letter No. 18-01 states that losses of wetlands that occur from removal of obsolete dams and other structures from rivers and streams does not require compensatory mitigation. The USACE CWA 404 permits in Oregon require evaluation of sediment impounded by the dam prior to removal.

7.4.2 Sediment Evaluation Framework (SEF)

Evaluation of the existing sediment impounded behind the dam is necessary to determine potential for pollutants and exposure impacts to biologic receptors. This process is carried out through the Sediment Evaluation Framework (SEF) (RSET, 2018). The SEF is a tiered evaluation process designed to systematically assess, characterize, and manage sediments in areas that will be dredged, disturbed, or naturally released into the environment.

The SEF begins with a description of the Project, an assessment of geophysical, chemical, and land use conditions, and an evaluation of sediment and the risk it poses to the biological community. The evaluation of sediment toxicity and risk can be completed without chemical testing of sediments (a Level 1 evaluation) or with testing (a Level 2 evaluation). The need for testing and a Level 2 evaluation is based on site conditions and contamination risk and is decided by the Portland Sediment Evaluation Team (PSET), who is responsible for reviewing the SEF and approving the Project. In special circumstances, chemical testing is not required, and a Level 1 evaluation is sufficient for PSET to evaluate the Project and issue a Suitability Determination Memorandum (SDM) to approve the Project. These circumstances include those with a Management Area Rank (MAR) of "very low," which can be given in high energy environments with coarse-grained impounded sediments, low percentages of organic matter, and absence of contaminant sources in the contributing watershed.

For dam removal and natural release of impounded sediment for the Ferry Creek Dam, a Level 1 evaluation with no chemical testing may be sufficient for PSET to review and approve the Project as part of the CWA permitting. We anticipate the risk of reservoir sediment contamination to be low because the site is located in a high energy, steep fluvial landscape with coarse boulder-cobble substrate upstream and downstream of the dam that receives over 90 inches of annual precipitation to drive hydrology and strong currents in Ferry Creek and the Chetco River. Much of the reservoir sediments are likely fine-grained based on observations of typical weathering products of the local bedrock and may have a high organic content generated by the heavily forested contributing basin. Both of these sediment characteristics can be associated with higher sediment toxicity, but the other factors indicate that the overall contamination risk is low.

A Level 1 analysis requires an evaluation of potential sources of contamination in the watershed upstream of the dam that could lead to harmful concentrations of contaminants in impounded sediments. The evaluation includes description of current and past land uses and a review of pollution and environmental cleanup databases from ODEQ, the Environmental Protection Agency, and others. The contributing watershed is 87% forested with little development or agriculture and is underlain by sedimentary rocks usually not associated with high concentrations of chemicals of concern, so contaminant sources are not expected. Furthermore, water quality is suitable for municipal drinking water supply, so upstream land use has probably already been deemed suitable. A review of environmental databases showed no potential contaminant sources in the forested contributing watershed. The Project may meet all the criteria for a Level 1 evaluation without the need for sediment testing. We would anticipate the dam removal with natural release of reservoir sediments to be approved by PSET without requirement for manual sediment excavation or other special construction technique qualifications.

RDG has prepared a Level 1 SEF evaluation for the Ferry Creek Dam removal that is ready for submission to PSET for review (Appendix B).

7.4.3 CWA 404 DSL Individual Removal-Fill Permit

The Oregon DSL regulates removal and fill of materials in waters of the state, including wetlands and channels below OHW, exceeding a cumulative removal and fill volume of 50 CY. The Project exceeds this threshold and will require a removal-fill permit from DSL. DSL has a general authorization for waterway enhancement that is limited to a cumulative removal and fill volume of 200 CY for barrier removal. The Project exceeds this threshold and will require an individual removal-fill permit.

Coverage by the individual removal-fill permit will require preparation and submittal of a JPA to USACE, DSL, and DEQ. DSL will also require preparation and submittal of a delineation report including a stream function assessment using the Stream Function Assessment Methodology (SFAM) and wetland function assessment using the Oregon Wetland Assessment Protocol (ORWAP). DSL has up to 150 days to issue a permit after application.

7.4.4 CWA 401 Water Quality Certification

A Section 401 water quality certification (WQC) will be required from ODEQ. The WQC will contain turbidity monitoring and reporting requirements. DEQ requires a landuse compatibility statement (LUCS) from Curry County in order to issue the WQC (see Section 7.7).

The WQC application requires a pre-filing notice a minimum of 30 days prior to application and DEQ has up to 90 days to issue the certification after application. Coverage by the water quality certification will require preparation and submittal of a JPA to USACE, DSL, and DEQ.

7.4.5 CWA 402 Construction Stormwater 1200-CA Permit

A construction stormwater 1200-CA permit will be required if the area of ground disturbance outside of DSL jurisdiction (wetlands and below OHW) exceeds 1 acre and has the potential to discharge to surface waters or a conveyance system that leads to surface waters. The 1200-CA permit assumes that the City of Brookings or the OWRD will be the applicant; if construction activities are not being conducted under the jurisdiction or authority of a public entity, alternative coverage may be required under the 1200-C General Stormwater Permit.

Coverage by the 1200-CA permit will require preparation and submittal of an Erosion and Sediment Control Plan (ESCP) and several reports during and after project implementation. This permit is separate from and in addition to the 401 WQC.

7.5 ODFW Fish Passage Plan

Removal (abandonment) of the dam will require review and approval from ODFW for fish passage. Fish passage is required in waters in which native migratory fish are currently or were historically present. This report (Section 5) will form the basis for ODFW review and approval of fish passage during and after the dam is removed.

7.6 Water Rights Cancellation or Transfer

Several water rights are currently associated with the dam with rights for storage and diversion of waters from Ferry Creek and Joe Hall Creek. The priority dates for the water rights range from 1913 to 1966 (Table 7-1). All of the water rights are year-round and non-cancelled in the OWRD Water Rights Information System (WRIS) database. The C&O Lumber Company began diverting water from Ferry Creek for use at their mill and lumber yard in 1913 with a timber crib dam without reservoir storage. They increased the dam height and created reservoir storage in 1916 and 1917. Water from Joe Hall Creek in the adjacent drainage basin to the northeast was diverted to the Ferry Creek reservoir in 1920. The City of Brookings built the Bankus dam in 1966 and increased the stored water right to the modern reservoir.

The 2018 Ferry Creek Dam Feasibility study evaluated the water rights associated with the dam and concluded that the City of Brookings does not need the diverted water from Ferry Creek or the stored water in the reservoir to meet their projected water demand in 2038 (Dyer Partnership, 2018). The water storage rights associated with the dam point of diversion will need to be cancelled and the diversion rights transferred or dedicated to in-stream use. The water rights transfer process can take several years.

Table 7-1. Water rights summary at Ferry Creek dam.

Source	Certificate No.	Priority Date	Water Rights Holder	Use	Maximum Diversion Rate (cfs)	Maximum Storage (Acre-Feet)	Notes
Ferry Creek	2078	8/22/1913	C&O Lumber Co.	Industrial and Domestic	3		Surface water diversion into 16-inch pipeline to lumber mill yard. Timber crib dam 5' tall x 10' wide.
Ferry Creek	1407	8/9/1916	C&O Lumber Co.	Domestic		4.6033	1,500,000 gallons. 12-ft tall x 100-ft long dam with three feet freeboard above reservoir surface. 1.5-acre reservoir
Ferry Creek	2071	8/25/1917	C&O Lumber Co.	Domestic		28	Dam height raised to 27-ft tall.
Ferry Creek and Reservoir	46860/46861	2/10/1966	City of Brookings	Municipal		167.4	Bankus Dam rebuilt to 65-ft height x 440-ft long with 16-inch and 30-inch steel pipes. Separate certificates for reservoir and stream; same storage right.
Joe Hall Creek	4953	6/23/1920	C&O Lumber Co.	Industrial and Domestic	2.5		Diverted from Joe Hall Creek to supplement Ferry Creek reservoir in flume (1-ft x 1-ft canal).

7.7 Curry County Landuse Review and Compatibility Statement

A landuse compatibility statement (LUCS) from Curry County is required for the DEQ WQC. Prior to issuing the LUCS, Curry County will need a land use decision application demonstrating how the project meets the requirements of the Curry Counting Zoning Ordinance (CCZO). The project taxlots are zoned Forestry Grazing (FG) and subject to the riparian corridor buffer overlay due to the presence of the creek and the geological hazards overlay due to the presence of landslides.

Article I of CCZO defines Development Activity as, "Any use or proposed use of land that requires disturbance of the vegetation or soils or which requires action of the Planning Division or Building Division to allow the construction or modification of structures or other improvements or to allow the division of the land."

Per the CCZO, Article II. Procedures For Making Land Use Decisions: "Section 2.060(1) Director Authority. The Director shall have the authority to review, and approve or deny the following applications which shall be Administrative Actions:

1. Development of property subject to the following overlay zoning districts including:
    a. Riparian Corridor Buffer Overlay Zone. (Section 3.280)
    b. Geological hazards. (Section 3.252)
    c. Airport related areas. (Section 3.270)
2. Uses listed as "Conditional Uses Subject to Administrative Approval by the Director" in each of the various zoning classifications of Article III.
3. Uses and Development listed as "Permitted" in each of the zoning classifications of Article III.
4. Authorizations required by this Ordinance (such as but not limited to erosion control plans and other environmentally related actions required due to the physical location of the subject property) for uses and development listed as "Permitted Outright" in each of the zoning classifications of Article III.
5. The determination of the existence and/or alteration of a nonconforming use (Section 5.060-5.062).
6. Variance as specified in Article VIII.
7. Waivers of minimum lot size pursuant to Section 5.040.
8. Historical site provisions pursuant to Section 3.262.

Actions delegated to the authority of the Director in the Curry County Land Division Ordinance."

The project is subject to the following Zoning Ordinances:

- Forestry Grazing Zone (FG). (Section 3.050)
- Riparian Corridor Buffer Overlay Zone. (Section 3.280)
- Geological hazards. (Section 3.252)

The proposed development activity (dam removal, channel restoration, native revegetation) meets the permitted uses of the FG zone and the development requirements for the Riparian Corridor Buffer and Geological Hazards Overlays.

Permitted uses in the FG zone include Section 3.050(6): "Uses to conserve soil, air and water quality on forest lands and to provide for wildlife and fisheries resources." Removal of the dam and restoration of the channel corridor will provide wildlife and fisheries resources and is a permitted use in this zone.

Section 3.281 of the CCZO defines the riparian corridor based on average annual streamflow in the channel: "Along all lakes, and streams within a river drainage basin in which the principal river or creek has an average annual stream flow less than 1000 cubic feet per second (cfs), the riparian corridor shall be fifty (50) feet from the top of each bank." Permitted uses in the riparian buffer overlay follow the underlying zone (FG) with prohibitions on vegetation removal and alteration. Section 3.283(2) allows removal of vegetation in the riparian corridor area "As necessary for restoration activities, such as replacement of non-native vegetation with native riparian species. The replacement vegetation shall cover, at a minimum, the area from which vegetation was removed, and shall maintain or exceed the density of the removed vegetation." The project may require removal of some riparian vegetation and all areas disturbed will be replanted with native riparian species.

Section 3.252(1) of the CCZO requires the following for development activities in areas of geological hazards: "The applicant shall present a geologic hazard assessment prepared by a geologist at the applicant's expense that identifies site specific geologic hazards, associated levels of risk and the suitability of the site for the development activity in view of such hazards. The geologic hazard assessment shall include an analysis of the risk of geologic hazards on the subject property, on contiguous and adjacent property and on upslope and downslope properties that may be at risk from, or pose a risk to, the development activity. The geologic hazard assessment shall also assess erosion and any increase in storm water runoff and any diversion or alteration of natural storm water runoff patterns resulting from the development activity. The geologic hazard assessment shall include one of the following:

> a) A certification that the development activity can be accomplished without measures to mitigate or control the risk of geologic hazard to the subject property or to adjacent properties resulting from the proposed development activity.
>
> b) A statement that there is an elevated risk posed to the subject property or to adjacent properties by geologic hazards that requires mitigation measures in order for the development activity to be undertaken safely and within the purposes of Section 3.250."

Per Section 3.252(2) of the CCZO, "If the assessment provides a certification pursuant to Section 3.252(1)(a), the development activity may proceed without further requirements of this Section." The project (dam removal and channel restoration) can be accomplished without measures to mitigate or control the risk of geologic hazards. Otherwise, per Section 3.252(3) of the CCZO, "If the assessment provides a statement pursuant to Section 3.252(1)(b), the applicant must apply for and receive an Administrative Decision prior to any disturbance of the soils or construction." The requirements for the Administrative Decision application are detailed in Section 3.252(4) of the CCZO.

7.8 Anticipated Permit Application Fees

The required permits have application fees separate from and in addition to the opinion of probable construction costs. Table 7-2 summarizes the fees for the anticipated permits. The fees are current as of May 2023 and do not include online payment processing charges. The fee for the ESA section 7 consultation is unknown prior to initiating consultation. The fee for the water rights transfer includes the 50% 'fish-friendly discount' and transfers to uses other than instream would cost $5,110.

Table 7-2. Summary of Anticipated Permit Application Fees

Agency	Permit	Application Fee in USD (as of May 2023)
USACE	Clean Water Act (CWA) Section 404 Nationwide Permit 27	0
USACE	Sediment Evaluation	0
NMFS/USFWS	Endangered Species Act Section 7 consultation	TBD
ODFW	Fish Passage Approval	0
DSL	Delineation Concurrence including Stream Function Assessment and Wetland Assessment	$540
DSL	CWA 404 Individual Permit	$578
DEQ	CWA 401 Water Quality Certification	$985
SHPO	National Historic Preservation Act Section 106 concurrence	0
Curry County	Pre-Application Conference	$500
Curry County	Planning Application including Geologic Assessment and Landuse Compatibility Statement	$450
DEQ	1200-C Stormwater Permit	$2,815
OWRD	Water Diversion Rights Transfer for Instream Use	$2,555
Estimated Total Permit Application Fees		**$8423 + ESA consultation**

8 Schedule

All work to execute removal of Ferry Creek Dam will be completed during the IWW (July 15 – September 30; ODFW, 2022). Drawdown of the reservoir will begin early during the IWW and take approximately 17 days to complete. The orifice tap will need to be installed prior to drawdown. Work area isolation measures and construction BMPs will be installed upon conclusion of drawdown. Dam and berm excavation and site grading (i.e., pilot channel construction and fill placement) will occur during the remainder of the IWW. Removal and work area isolation measures and phase 1 of site reclamation will conclude the project in late summer / early fall. Phase 2 revegetation and planting will continue into the first year following completion of dam removal. Monitoring will occur for three years following completion of dam removal.

9 Cost Estimate

An opinion of probable costs for construction was developed in accordance with the American Association of Cost Engineers (AACE) recommendations. AACE guidance for studies like this where the definition of the design is on the order of 90% maturity level, recommends a Class 1 cost estimate (DOE, 2018). Our class 1 estimates utilize a combination of parametric (statistical relationships from historical data), analogous (past projects), and actual cost estimates from suppliers to create a robust opinion of probable cost for each alternative. The following assumptions are applied to the estimate:

- Project is built by a qualified construction contractor with experience building similar dam removal projects and is experienced with dewatering methods and in-water work.
- Dam removal and initial restoration will be completed in less than 8 months, additional restoration and revegetation may take place the following year.
- All costs in current dollars (2023) with no escalation of costs due to inflation, fuel prices, etc.
- Regulatory compliance permitting, contractor procurement, and construction administration estimated at approximately 10% of probable construction costs based on project complexity and magnitude.
- Contingency is added to the probable construction costs to account for uncertainty and potential fluctuations in construction costs.

Table 9-1. Summary of Opinion of Probable Cost for Implementation.

CATEGORY		ITEM	ESTIMATE
1 General Requirements			
	1.1	Insurance, bonds, contractual obligations	$ 50,000
	1.2	Temporary facilities and restroom	$ 10,000
	1.3	Job trailer and small equipment (pumps, hand tools)	$ 20,000
	1.4	Mobilization (large equipment)	$ 16,000
	1.5	Demobilization (large equipment)	$ 12,000
2 Construction			
	2.1	Traffic Control	$ 5,000
	2.2	Utilities & Power	$ 15,000
	2.3	Erosion & Sediment Control	$ 40,500

Table 9-1. Summary of Opinion of Probable Cost for Implementation.

CATEGORY	ITEM	ESTIMATE
2.4	Care & Diversion of Water	$ 187,500
2.5	Staging & Access Roads	$ 27,500
2.6	Dam Removal / Earthen Embankment	$ 496,500
2.7	Fish Passage Channel thru Dam & Reservoir	$ 99,000
2.8	Site Stabilization and Revegetation	$ 76,000
3 Engineering		
3.1	Final Engineering + Design Plans + Contract Documents	$ 48,000
3.2	Permitting Assistance including NEPA	$ 48,000
3.3	Contractor Bidding	$ 5,500
3.4	Construction Administration & Stakeout	$ 105,500
3.5	Project as-builts & closeout	$ 14,000
4 Contingency		
4.1	25% Contingency	$ 264,000
	Opinion of Probable Costs for Implementation	**$ 1,540,000**
	Low Opinion	$ 1,386,000
	High Opinion	$ 1,848,000

Grants are typically available at the state and federal level (on a competitive basis) to support projects that improve fish passage and dam removal. In addition, many non-profits and conservation trusts exist that target resources and funding towards dam removal projects. Below are a few examples of potential funding for dam removal.

- NOAA Restoration Center / Open Rivers Initiative provides funding and technical assistance to remove dams.
- USFWS National Fish Passage Program is a nationwide program that provides funding to remove fish passage barriers.
- National Fish and Wildlife Foundation (NFWF) is a non-profit organization, partially funded by the federal government, that provides grants for dam removals.
- American Rivers is a conservation group that provides technical assistance, facilitation, and potential funding partners for dam removal.
- Resource Legacy Fund (RLF) / Open Rivers Fund is a fund setup with the specific intent to remove dams.
- WaterWatch of Oregon is a non-profit that provides technical assistance and helps secure grant funds for dam removal.

10 Summary

RDG prepared this Design and Management Plan for OWRD for the Ferry Creek Dam Removal Project. Ferry Creek Dam, which is owned by the City of Brookings, is a 45-ft-tall, 300-ft-wide earthen embankment near Brookings that was designated as high hazard and in unsatisfactory condition by OWRD. This document and the accompanying 90% design drawings (Appendix A) provide the information and design to execute the partial removal of Ferry Creek dam to allow a free-flowing condition for Ferry Creek and remove the hazard of the existing dam. This removal plan will create volitional fish passage throughout the dam and reservoir area post-implementation. Included are specific plans that describe the motivation and methods for reservoir sediment management, dam removal and water management, fish salvage and passage, restoration, and permitting. A proposed schedule and construction cost estimate are provided that give an overall implementation plan that is based on similar dam removal projects. This document is intended to support the City of Brookings in their interest in the removal of Ferry Creek Dam.

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APPENDIX A

Design Drawings

APPENDIX B

Sediment Evaluation Framework Level 1 Evaluation

Report Criteria:
Report type: Summary

GL Period	Check Issue Date	Check Number	Vendor Number	Payee	Check GL Account	Amount	
08/23	08/30/2023	88370	6013	Compass Rose Cafe	32-00-2005	300.00-	V
08/23	08/15/2023	90267	3834	Clean Sweep Janitorial Service	25-00-2005	175.00-	V
08/23	08/09/2023	90342	6213	RSR Group Inc	10-00-2005	5,684.54-	V
08/23	08/03/2023	90344	5876	Advanced Reporting LLC	10-00-2005	220.00	
08/23	08/03/2023	90345	5908	Amazon Capital Services	49-00-2005	175.36	
08/23	08/03/2023	90346	313	Brookings Vol Firefighters	10-00-2005	2,250.00	
08/23	08/03/2023	90347	715	Budge McHugh Supply	20-00-2005	5,363.83	
08/23	08/03/2023	90348	5567	CAL/OR Insurance Agency	30-00-2005	683.33	
08/23	08/03/2023	90349	6031	Cascade Home Center	15-00-2005	429.53	
08/23	08/03/2023	90350	5952	Chetco Auto Marine & Industrial Supply	15-00-2005	200.58	
08/23	08/03/2023	90351	6214	Chetco Trader Pawn Shop	10-00-2005	6,864.12	
08/23	08/03/2023	90352	3834	Clean Sweep Janitorial Service	10-00-2005	2,222.00	
08/23	08/03/2023	90353	5827	Coastal Investments LLC	10-00-2005	960.00	
08/23	08/03/2023	90354	1745	Coastal Paper & Supply, Inc	10-00-2005	1,759.77	
08/23	08/03/2023	90355	1620	Curry County Community Development	10-00-2005	247.50	
08/23	08/03/2023	90356	4746	Curry County Treasurer	10-00-2005	240.00	
08/23	08/03/2023	90357	317	DCBS - Fiscal Services	10-00-2005	110.88	
08/23	08/03/2023	90358	1	Reverend Cindy Elliott	20-00-2005	133.22	
08/23	08/03/2023	90359	2640	Dyer Partnership, The	52-00-2005	28,658.28	
08/23	08/03/2023	90360	5804	Early Management Team Inc	50-00-2005	2,000.00	
08/23	08/03/2023	90361	749	Emerald Pool & Patio	10-00-2005	220.49	
08/23	08/03/2023	90362	5432	First Community Credit Union	25-00-2005	4,662.00	
08/23	08/03/2023	90363	6097	GP Energy	10-00-2005	3,820.59	
08/23	08/03/2023	90364	6030	Hartwick Automotive LLC	10-00-2005	1,189.33	
08/23	08/03/2023	90365	4171	In-Motion Graphics	10-00-2005	275.00	
08/23	08/03/2023	90366	328	Les Schwab Tire Center	10-00-2005	998.64	
08/23	08/03/2023	90367	4261	Lexipol LLC	10-00-2005	8,296.65	
08/23	08/03/2023	90368	4269	Gary Milliman	10-00-2005	325.00	
08/23	08/03/2023	90369	6215	Mobile Madness Medford	10-00-2005	15.00	
08/23	08/03/2023	90370	4443	Napa Auto Parts-Golder's	15-00-2005	79.24	
08/23	08/03/2023	90371	5008	Online Information Services	10-00-2005	132.71	
08/23	08/03/2023	90372	5155	Oregon Department of Revenue	10-00-2005	750.00	
08/23	08/03/2023	90373	6167	Paragon Property Management	10-00-2005	7.56	
08/23	08/03/2023	90374	4	Adrienne LaCroix	10-00-2005	244.00	
08/23	08/03/2023	90375	322	Postmaster	25-00-2005	2,150.00	
08/23	08/03/2023	90376	6216	Pure Water Aquatics	10-00-2005	3,443.92	
08/23	08/03/2023	90377	207	Quill Corporation	10-00-2005	589.56	
08/23	08/03/2023	90378	612	Strahm's Sealcoat & Striping	61-00-2005	6,808.00	
08/23	08/03/2023	90379	142	Tidewater Contractors Inc	20-00-2005	518.67	
08/23	08/03/2023	90380	3752	Trace Analytics, LLC	10-00-2005	89.00	
08/23	08/03/2023	90381	2863	Verizon Wireless	10-00-2005	713.67	
08/23	08/03/2023	90382	861	Village Express Mail Center	10-00-2005	37.61	
08/23	08/03/2023	90383	2122	Cardmember Service	10-00-2005	9,099.06	
08/23	08/03/2023	90384	5992	Ziply Fiber	30-00-2005	187.21	
08/23	08/03/2023	90385	4131	Zumar Industries Inc	15-00-2005	248.89	
08/23	08/10/2023	90386	4508	Assoc of International CPAs	10-00-2005	340.00	
08/23	08/10/2023	90387	5908	Amazon Capital Services	49-00-2005	899.99	
08/23	08/10/2023	90388	4734	Aramark Uniform Services	10-00-2005	120.00	
08/23	08/10/2023	90389	6121	AutoZone Inc	10-00-2005	60.37	
08/23	08/10/2023	90390	4939	Bi - Mart Corporation	10-00-2005	258.14	
08/23	08/10/2023	90391	2407	Blue Star Gas	10-00-2005	2,970.26	
08/23	08/10/2023	90392	6038	Ray Branion	10-00-2005	259.00	
08/23	08/10/2023	90393	5070	Canon Solutions America	10-00-2005	57.90	

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GL Period	Check Issue Date	Check Number	Vendor Number	Payee	Check GL Account	Amount
08/23	08/10/2023	90394	5822	Chaves Consulting Inc	49-00-2005	370.20
08/23	08/10/2023	90395	4928	CIS Trust	30-00-2005	251,623.67
08/23	08/10/2023	90396	6217	CNA Surety Direct Bill	10-00-2005	350.00
08/23	08/10/2023	90397	185	Del Cur Supply	10-00-2005	119.60
08/23	08/10/2023	90398	1	Michael Failor	20-00-2005	212.42
08/23	08/10/2023	90399	1	Brian Walker	20-00-2005	300.00
08/23	08/10/2023	90400	1	Scott Addy	20-00-2005	300.00
08/23	08/10/2023	90401	1	Peter Brown	20-00-2005	226.28
08/23	08/10/2023	90402	1	Zachary Crehan	20-00-2005	196.78
08/23	08/10/2023	90403	1	Christopher & Courtney Kelly	20-00-2005	200.00
08/23	08/10/2023	90404	1	Stacy Mallie	20-00-2005	130.64
08/23	08/10/2023	90405	1	Carol Raper	20-00-2005	199.53
08/23	08/10/2023	90406	1	Jacob Butler	20-00-2005	8.23
08/23	08/10/2023	90407	371	DEQ - CRIS	25-00-2005	161.94
08/23	08/10/2023	90408	4595	Doctor "D" Autocare	10-00-2005	1,889.47
08/23	08/10/2023	90409	3342	Fastenal	20-00-2005	31.13
08/23	08/10/2023	90410	5004	Galls LLC	10-00-2005	474.00
08/23	08/10/2023	90411	139	Harbor Logging Supply	10-00-2005	1,139.69
08/23	08/10/2023	90412	4171	In-Motion Graphics	61-00-2005	175.00
08/23	08/10/2023	90413	4980	iSecure	10-00-2005	33.00
08/23	08/10/2023	90414	5858	Jacobs Engineering Group Inc	25-00-2005	132,129.50
08/23	08/10/2023	90415	5858	Jacobs Engineering Group Inc	53-00-2005	117,707.60
08/23	08/10/2023	90416	6175	Sophia Lucero	10-00-2005	359.19
08/23	08/10/2023	90417	4487	Net Assets Corporation	10-00-2005	180.00
08/23	08/10/2023	90418	3159	NorthCoast Health Screening	10-00-2005	90.00
08/23	08/10/2023	90419	252	Paramount Pest Control	10-00-2005	140.00
08/23	08/10/2023	90420	207	Quill Corporation	10-00-2005	369.06
08/23	08/10/2023	90421	6094	SAIF Corporation	10-00-2005	314.52
08/23	08/10/2023	90422	582	South Coast Office Supply	10-00-2005	300.64
08/23	08/10/2023	90423	6219	Cameron Stewart	10-00-2005	295.00
08/23	08/10/2023	90424	797	Town & Country Animal Clinic	61-00-2005	42.40
08/23	08/10/2023	90425	4542	Umpqua Bank	45-00-2005	5,322.00
08/23	08/10/2023	90426	169	Waste Connections Inc	10-00-2005	1,286.92
08/23	08/10/2023	90427	6218	Andrew Yock	10-00-2005	295.00
08/23	08/10/2023	90428	5992	Ziply Fiber	30-00-2005	191.30
08/23	08/17/2023	90429	3015	Charter Communications	10-00-2005	749.96
08/23	08/17/2023	90430	3834	Clean Sweep Janitorial Service	25-00-2005	175.00
08/23	08/17/2023	90431	5450	Complete Wireless Technologies	10-00-2005	225.00
08/23	08/17/2023	90432	182	Coos-Curry Electric	10-00-2005	54.64
08/23	08/17/2023	90433	5951	Executech Utah LLC	49-00-2005	30.40
08/23	08/17/2023	90434	6097	GP Energy	10-00-2005	4,075.29
08/23	08/17/2023	90435	6165	Stephanie Herzog	15-00-2005	17.00
08/23	08/17/2023	90436	5858	Jacobs Engineering Group Inc	20-00-2005	20,232.30
08/23	08/17/2023	90437	6187	Richard Kolb Jr	15-00-2005	17.00
08/23	08/17/2023	90438	6065	Local Government Law Group PC	10-00-2005	3,460.50
08/23	08/17/2023	90439	6220	Keyya Malmberg	10-00-2005	34.95
08/23	08/17/2023	90440	4981	McLennan Excavation, Inc	52-00-2005	54,905.39
08/23	08/17/2023	90441	5789	Moss Adams LLP	75-00-2005	5,000.00
08/23	08/17/2023	90442	687	Owen Equipment Company	25-00-2005	2,572.94
08/23	08/17/2023	90443	4	Elizabeth Webb	10-00-2005	244.00
08/23	08/17/2023	90444	5195	Sonsray Machinery LLC	15-00-2005	675.15
08/23	08/17/2023	90445	380	Stadelman Electric Inc	10-00-2005	97.10
08/23	08/17/2023	90446	5829	Transport Wisdom LTD	15-00-2005	260.00
08/23	08/17/2023	90447	5992	Ziply Fiber	10-00-2005	221.44
08/23	08/17/2023	90448	4131	Zumar Industries Inc	15-00-2005	1,254.98
08/23	08/24/2023	90472	5908	Amazon Capital Services	49-00-2005	118.85

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08/23	08/24/2023	90473	6223	Thomas Betlejewski	10-00-2005	58.00
08/23	08/24/2023	90474	5048	Brookings Harbor Medical Center	10-00-2005	150.00
08/23	08/24/2023	90475	5070	Canon Solutions America	10-00-2005	313.05
08/23	08/24/2023	90476	6212	Sarah Michelle Chavez	10-00-2005	225.00
08/23	08/24/2023	90477	173	Curry Equipment	10-00-2005	1,599.32
08/23	08/24/2023	90478	2640	Dyer Partnership, The	52-00-2005	36,973.64
08/23	08/24/2023	90479	749	Emerald Pool & Patio	10-00-2005	2,895.21
08/23	08/24/2023	90480	3342	Fastenal	25-00-2005	612.67
08/23	08/24/2023	90481	5657	Gold Form & Label Company	25-00-2005	1,826.44
08/23	08/24/2023	90482	6221	Kittelson & Associates Inc	75-00-2005	14,062.50
08/23	08/24/2023	90483	3978	KLB Enterprises	15-00-2005	808.00
08/23	08/24/2023	90484	4981	McLennan Excavation, Inc	20-00-2005	4,559.00
08/23	08/24/2023	90485	4	Tim Hartzell	10-00-2005	244.00
08/23	08/24/2023	90486	4	Susan Sullivan	10-00-2005	258.00
08/23	08/24/2023	90487	4	Stephanie Liles	10-00-2005	244.00
08/23	08/24/2023	90488	4546	Pump Tech, LLC	50-00-2005	10,481.28
08/23	08/24/2023	90489	207	Quill Corporation	10-00-2005	205.94
08/23	08/24/2023	90490	6134	Patrick Smith	10-00-2005	1,240.80
08/23	08/24/2023	90491	6222	Travis Stover	10-00-2005	125.00
08/23	08/24/2023	90492	142	Tidewater Contractors Inc	51-00-2005	170,129.05
08/23	08/24/2023	90493	5071	Wes' Towing	10-00-2005	767.00
08/23	08/24/2023	90494	5992	Ziply Fiber	25-00-2005	1,043.58
08/23	08/31/2023	90495	5908	Amazon Capital Services	10-00-2005	913.51
08/23	08/31/2023	90496	5871	BALCO Uniform Co Inc	10-00-2005	1,191.53
08/23	08/31/2023	90497	5048	Brookings Harbor Medical Center	25-00-2005	150.00
08/23	08/31/2023	90498	5598	Brookings Harbor Veterinary Hospital	61-00-2005	538.31
08/23	08/31/2023	90499	6147	Bullard Law	10-00-2005	4,330.45
08/23	08/31/2023	90500	6073	Carpenter Point S	10-00-2005	328.88
08/23	08/31/2023	90501	6031	Cascade Home Center	20-00-2005	1,572.13
08/23	08/31/2023	90502	5842	Century West Engineering Corp	33-00-2005	6,436.00
08/23	08/31/2023	90503	3015	Charter Communications	30-00-2005	699.86
08/23	08/31/2023	90504	4882	Coastal Heating & Air	50-00-2005	418.60
08/23	08/31/2023	90505	6013	Compass Rose Cafe	32-00-2005	300.00
08/23	08/31/2023	90506	182	Coos-Curry Electric	10-00-2005	11,460.94
08/23	08/31/2023	90507	5939	Country Media Inc	32-00-2005	594.61
08/23	08/31/2023	90508	5874	Cumulus Global	49-00-2005	9,216.00
08/23	08/31/2023	90509	1620	Curry County Community Development	10-00-2005	151.25
08/23	08/31/2023	90510	5333	Double D Electric	30-00-2005	1,411.38
08/23	08/31/2023	90511	6115	Douglas A Bergstrom, Ph.D.	10-00-2005	375.00
08/23	08/31/2023	90512	298	Freeman Rock, Inc	50-00-2005	45.14
08/23	08/31/2023	90513	5004	Galls LLC	10-00-2005	24.59
08/23	08/31/2023	90514	6226	Jose Gutierrez	10-00-2005	200.52
08/23	08/31/2023	90515	6227	Darryl Harmon	10-00-2005	207.46
08/23	08/31/2023	90516	4171	In-Motion Graphics	20-00-2005	96.00
08/23	08/31/2023	90517	5733	Thomas W Kerr	10-00-2005	358.92
08/23	08/31/2023	90518	6228	Chris Limon	10-00-2005	451.17
08/23	08/31/2023	90519	123	Motorola Solutions Inc	10-00-2005	250.00
08/23	08/31/2023	90520	6224	NASRO	10-00-2005	500.00
08/23	08/31/2023	90521	5703	PacWest Machinery	15-00-2005	861.49
08/23	08/31/2023	90522	4	Curry County Fair	10-00-2005	398.00
08/23	08/31/2023	90523	3369	Schwabe Williamson & Wyatt PC	20-00-2005	995.00
08/23	08/31/2023	90524	6229	Wayne E Sheffel Jr	10-00-2005	401.04
08/23	08/31/2023	90525	5979	LeeAnn Spring Sheffel	10-00-2005	317.49
08/23	08/31/2023	90526	956	Suiter's Paint & Body	10-00-2005	57.50
08/23	08/31/2023	90527	2863	Verizon Wireless	10-00-2005	713.75
08/23	08/31/2023	90528	861	Village Express Mail Center	10-00-2005	53.35

M = Manual Check, V = Void Check

GL Period	Check Issue Date	Check Number	Vendor Number	Payee	Check GL Account	Amount
08/23	08/31/2023	90529	6225	Amanda Whittemore	32-00-2005	299.75
08/23	08/31/2023	90530	4220	Woof's Dog Bakery	61-00-2005	63.99
08/23	08/31/2023	90531	5992	Ziply Fiber	10-00-2005	210.03
08/23	08/31/2023	90532	5767	Axon Enterprise Inc	10-00-2005	5,652.00
Grand Totals:						1,008,880.14

Dated: ______________________________

Mayor: ______________________________

City Council: ______________________________

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City Recorder: ______________________________

Report Criteria:
Report type: Summary

M = Manual Check, V = Void Check