Adopted by Bonneville Power Administration as DOE/EA-2118 on 11/3/2020.

East Fork Irrigation District Infrastructure Modernization Project

Watershed Plan-Environmental Assessment

Hood River County, Oregon

July 2020

United States Department of Agriculture, Natural Resources Conservation Service – Lead Federal Agency in cooperation with East Fork Irrigation District

Prepared by Farmers Conservation Alliance

Final Watershed Plan-Environmental Assessment for the East Fork Irrigation District Infrastructure Modernization Project

Lead Agency: United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Oregon

Cooperating Agency: United States Department of Energy (USDOE), Bonneville Power Administration (Bonneville), Portland, Oregon; DOE/EA - 2118

Sponsoring Local Organization: East Fork Irrigation District (EFID)

Authority: This Watershed Plan-Environmental Assessment (Plan-EA) has been prepared under the Authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law [PL] 83-566) and the Regional Conservation Partnership Program (RCPP), authorized by Subtitle I of Title XII of the Food Security Act of 1985, as amended by Section 2401 of the Agricultural Act of 2014. This Plan-EA has also been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, PL 91-190, as amended (42 United States Code [U.S.C.] 43221 et seq.). Bonneville is a cooperating agency on this Plan-EA.

Abstract: This document is intended to fulfill requirements of NEPA and to be considered for authorization of PL 83-566 and RCPP funding of the EFID Infrastructure Modernization Project (project). The project seeks to improve water conservation, water delivery reliability, and public safety for irrigation infrastructure in Oregon's Hood River Basin. The project would include converting 56 miles of EFID's canals and laterals to a buried and pressurized pipeline. Total estimated project costs are $67,029,000, of which $37,480,000 would be paid by the sponsors and other non-federal funding sources. The estimated amount to be paid through NRCS PL 83-566 and RCPP funds through PL 83-566 Authority is $29,549,000. The RCPP funds ($1,430,000) were provided to the project in 2018 and pertain to a single, separate project within the larger PL 83-566 Project Group 1. The RCPP project is not receiving funds through this Watershed Plan, rather it has received funds through RCPP and needs an authorized watershed plan in order to implement that portion of the RCPP.

Bonneville is cooperating on this EA due to potentially providing cost share funding of a discrete component of the project, specifically the Eastside Piping Project, as requested by the Confederated Tribes of the Warm Springs (CTWS). Bonneville would provide CTWS with up to $1 million to fund certain design work and materials for the Eastside Piping Project.

Comments: Comments submitted in response to this Notice of Availability must be received within 30 days of the date of publication. Submit comments and inquiries to: Gary Diridoni, USDA/NRCS, 1201 NE Lloyd Blvd, Suite 900, Portland, OR 97232, (503) 414-3092 or gary.diridoni@usda.gov.

Non Discrimination Statement: In accordance with federal civil rights law and USDA civil rights regulations and policies, the USDA, its agencies, offices, employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

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Watershed Plan Agreement
between the
East Fork Irrigation District
(Referred to herein as the sponsor)
and the
U.S. Department of Agriculture,
Natural Resources Conservation Service,
(Referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the sponsor for assistance in preparing a plan for works of improvement for the East Fork Irrigation District (EFID) Infrastructure Modernization Project, State of Oregon, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the sponsors and NRCS a watershed project plan and EA for works of improvement for the EFID Infrastructure Modernization Project, State of Oregon, hereinafter referred to as the watershed project plan or plan, which plan is annexed to and made a part of this agreement.

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the sponsor hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

1. Term. The term of this agreement is for the installation period and evaluated life of the project (110 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

2. Costs. The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. Real Property. The sponsor will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the sponsors and NRCS are as shown in the cost-share table in Section 5 hereof.

The sponsor agrees that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency that will continue to maintain and operate the development in accordance with the operation and maintenance (O&M) agreement.

4. Uniform Relocation Assistance and Real Property Acquisition Policies Act. The sponsors hereby agree to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 Code of Federal Regulations [CFR] Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsor is legally unable to comply with the real property acquisition requirements, it agrees that, before any federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. Cost-share for Watershed Project Plans. The following table will be used to show cost-share percentages and amounts for watershed project plan implementation.

Cost-share Table for Watershed Operation or Rehabilitation Projects					
Works of Improvement	**NRCS**		**Sponsor**		**Total**
	Percent	**Cost**	**Percent**	**Cost**	**Cost**
Cost-Sharable Items[1]					
Agricultural Water Management	42%	$25,000,000	58%	$34,618,000	$59,618,000
Sponsor's Engineering Costs	75%	$1,928,000	25%	$643,000	$2,571,000
Subtotal: Cost-Sharable Costs	43%	$26,928,000	57%	$35,261,000	$62,189,000
Non-Cost-Sharable Items[2]					
NRCS Technical Assistance/Engineering	100%	$2,097,000	0%	$0	$2,097,000
Project Administration[3]	60%	$524,000	40%	$353,000	$877,000
Permits	0%	$0	100%	$1,866,000	$1,866,000
Subtotal: Non-Cost-Share Costs	54%	$2,621,000	46%	$2,219,000	$4,840,000
Total[4]:	44%	$29,549,000	56%	$37,480,000	$67,029,000
Installation costs explanatory notes:					
1. The cost-share rate is the percentage of the average cost of installing the practice in the selected plan for the evaluation unit. During project implementation, the actual cost-share rate must not exceed the rate of assistance for similar practices and measures under existing national programs.					
2. If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.					
3. The sponsor and NRCS will each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.					
4. The sponsor will acquire with other than Watershed Protection and Flood Prevention Act funds, such real property as will be needed in connection with the works of improvement. The value of real property is eligible as in-kind contributions toward the sponsors' share of the works of improvement costs. In no case will the amount of an in-kind contribution exceed the sponsors' share of the cost for the works of improvement. The maximum cost eligible for in-kind credit is the same as that for cost sharing.					

6. Land Treatment Agreements. The sponsor will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsor will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsor will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsor will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

7. Floodplain Management. Before construction of any project for flood prevention, the sponsor must agree to participate in and comply with applicable federal floodplain management and flood insurance programs. For plans approved as of the date of this revised manual the sponsor is required to have development controls in place below low and significant hazard dams prior to NRCS or the sponsor entering into a construction contract.

8. Water and Mineral Rights. The sponsor will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

9. Permits. The sponsor will obtain and bear the cost for all necessary federal, state, and local permits required by law, ordinance, or regulation for installation of the works of improvement.

10. Natural Resources Conservation Service Assistance. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

11. Additional Agreements. A separate agreement will be entered into between NRCS and the sponsor before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. Amendments. This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsor has failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the sponsor in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsor or recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsor having specific responsibilities for the measure involved.

13. Prohibitions. No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. Operation and Maintenance. The sponsor will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M agreement. An O&M agreement will be entered into before federal funds are obligated and will continue for the project life (100 years). Although the sponsor's responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsor acknowledges that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. Emergency Action Plan. Prior to construction, the sponsor must prepare an Emergency Action Plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in NRCS Title 180, *National Operation and Maintenance Manual*, Part 500, Subpart F, Section 500.52, and meet applicable state agency dam safety requirements. NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsor annually.

16. Nondiscrimination Provisions. In accordance with federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

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USDA is an equal opportunity provider, employer, and lender.

By signing this agreement, the recipient assures the USDA that the program or activities provided for under this agreement will be conducted in compliance with all applicable federal civil rights laws, rules, regulations, and policies.

17. Certification Regarding Drug-Free Workplace Requirements (7 CFR Part 3021). By signing this Watershed Agreement, the sponsor is providing the certification set out below. If it is later determined that the sponsor knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

Controlled substance means a controlled substance in schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15).

Conviction means a finding of guilt (including a plea of *nolo contendere*) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the federal or state criminal drug statutes.

Criminal drug statute means a federal or non-federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance.

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including (i) all direct charge employees, (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant, and (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement, consultants or independent contractors not on the grantees' payroll, or employees of subrecipients or subcontractors in covered workplaces).

Certification:

A. The sponsor certifies that they will or will continue to provide a drug-free workplace by—

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.

(2) Establishing an ongoing drug-free awareness program to inform employees about—

   (a) The danger of drug abuse in the workplace.

   (b) The grantee's policy of maintaining a drug-free workplace.

   (c) Any available drug counseling, rehabilitation, and employee assistance programs.

   (d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than 5 calendar days after such conviction.

(5) Notifying NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4)(b), with respect to any employee who is so convicted—

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The sponsor may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. Certification Regarding Lobbying (7 CFR Part 3018).

A. The sponsor certifies to the best of their knowledge and belief, that—

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the

undersigned must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The sponsor must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

19. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).

A. The sponsor certifies to the best of their knowledge and belief, that they and their principals—

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;

(2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state, or local) transaction or contract under a public transaction; violation of federal or state antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and

(4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (federal, state, or local) terminated for cause or default.

B. Where the sponsor is unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. Clean Air and Water Certification.

Applicable if this agreement exceeds $100,000, or a facility to be used has been subject of a conviction under the Clean Air Act (42 U.S.C. Section 7413(c)) or the Federal Water Pollution Control Act (33 U.S.C. Section 1319(c)) and is listed by the U.S. Environmental Protection Agency (USEPA), or is not otherwise exempt.

A. The project sponsoring organizations signatory to this agreement certify as follows:

(1) Any facility to be utilized in the performance of this proposed agreement is (____), is not (_x_) listed on the USEPA List of Violating Facilities.

(2) To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, USEPA, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the USEPA List of Violating Facilities.

(3) To include substantially this certification, including this subparagraph, in every nonexempt subagreement.

B. The project sponsoring organizations signatory to this agreement agree as follows:

(1) To comply with all the requirements of Section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and Section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in Section 114 and Section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.

(2) That no portion of the work required by this agreement will be performed in facilities listed on the USEPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the USEPA eliminates the name of such facility or facilities from such listing.

(3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.

(4) To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

(1) The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).

(2) The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).

(3) The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in Section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under Section 112 of the Air Act (42 U.S.C. Section 7412).

(4) The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the USEPA or by a state under an approved program, as authorized by Section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by Section 307 of the Water Act (33 U.S.C. Section 1317).

(5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal

Activities, USEPA, determines that independent facilities are collocated in one geographical area.

21. Assurances and Compliance.

As a condition of the grant or cooperative agreement, the sponsor assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, executive orders, and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: Office of Management and Budget (OMB) Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

22. Examination of Records.

The sponsors must give NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of 3 years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

23. Signatures

EAST FORK IRRIGATION DISTRICT

The signing of this plan was authorized by a resolution by the EFID governing body and adopted at an official meeting held on

July 16, 2020 4PM, at [Hood River], Oregon.

By: John Buckley

Date: July 20, 2020

John Buckley, Manager
East Fork Irrigation District
3500 Graves Rd
Hood River, OR 97031

USDA-NATURAL RESOURCES CONSERVATION SERVICE
Approved by:

Date: 07/16/2020

Ron Alvarado, State Conservationist
Natural Resources Conservation Service
1201 NE Lloyd Blvd
Suite 900
Portland, OR 97232

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East Fork Irrigation District Infrastructure Modernization Project
Middle Columbia-Hood Basin Subwatersheds: Lower East Fork Hood River, Neal Creek, Odell Creek-Hood River, and Indian Creek-Hood River
Hood River County, Oregon
Oregon 2nd Congressional District</th></tr>
<tr><td>Authorization</td><td>PL 83-566 Stat. 666 as amended (16 U.S.C. Section 1001 et seq.) 1954 and the RCPP, authorized by Subtitle I of Title XII of the Food Security Act of 1985, as amended by Section 2401 of the Agricultural Act of 2014.</td></tr>
<tr><td>Lead Sponsor</td><td>East Fork Irrigation District (EFID)</td></tr>
<tr><td>Proposed Action</td><td>The EFID Infrastructure Modernization Project is a large agricultural water conveyance efficiency project. The proposed action would pipe and pressurize 56 miles of EFID's canals and laterals.</td></tr>
<tr><td>Purpose and Need</td><td>The purpose of this project is to improve water conservation in District infrastructure, improve water delivery reliability, and increase public safety of District-owned canals and laterals.

The proposed action would meet PL 83-566 Authorized Project Purpose (v), Agricultural Water Management, through irrigation water conservation, water quality improvement, and more reliable agricultural water supply.

Federal assistance through PL 83-566 and RCPP would support the District in addressing the following watershed problems and resource concerns: water loss in District conveyance systems; water delivery and operations inefficiencies; instream flow for fish and aquatic habitat; risks to public safety from open irrigation canals; sediment in irrigation water; and projected decline in future watershed yield during the irrigation season.

The proposed action would support agricultural production in an area where environmental concerns, public safety, and the projected impact of climate trends on water supply necessitate federal action. The proposed action addresses the need to reduce conveyance water loss in District infrastructure and provide better-managed water diversion for farm use; improve streamflow for fish, aquatic, and riparian habitat; and increase public safety. These measures would serve to stretch the supply of water for agriculture by increasing the reliability and efficiency of water delivered for irrigation while permanently reducing the amount of water diverted, and legally protecting saved water instream.

Funding the proposed action would help fulfill Bonneville's obligation to mitigate under the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (16 U.S.C. 839 §§ et seq.) (Northwest Power Act) for effects of the development and operation of the federal hydroelectric dams in the Columbia River basin on fish and wildlife, fulfill commitments to CTWS, and minimize harm to natural and human resources, including species listed under the Endangered Species Act (ESA).</td></tr>
<tr><td>Description of the Preferred Alternative</td><td>Under the Preferred Alternative, 56 miles of District-owned canals and laterals in the EFID system would be converted to high-density polyethylene (HDPE) gravity-fed pressurized buried pipe.</td></tr>
</table>

<table>
<tr><td>Project Measures</td><td colspan="4">Under the Preferred Alternative, the project sponsor would replace canals and laterals with HDPE pipe; install 61 pressure reducing values; and upgrade 384 turnouts for pressurized water delivery. Additionally, a sedimentation basin would be installed close to the diversion. Construction of the Preferred Alternative would occur in 3 project groups over the course of 10 years.</td></tr>
<tr><td colspan="5">Resource Information</td></tr>
<tr><td>Subwatersheds</td><td>12-digit Hydrologic Unit Code</td><td colspan="2">Latitude and Longitude</td><td>Subwatershed Size</td></tr>
<tr><td>Lower East Fork Hood River</td><td>170701050706</td><td colspan="2">45.5188469, -121.582468</td><td>27,146 acres</td></tr>
<tr><td>Neal Creek</td><td>170701050701</td><td colspan="2">45.58036939, -121.502756</td><td>19,713 acres</td></tr>
<tr><td>Odell Creek-Hood River</td><td>170701050702</td><td colspan="2">45.62660139, -121.596705</td><td>20,905 acres</td></tr>
<tr><td>Indian Creek-Hood River</td><td>170701050703</td><td colspan="2">45.67596815, -121.531906</td><td>10,018 acres</td></tr>
<tr><td>Subwatershed Total Size</td><td colspan="4">77,782 acres</td></tr>
<tr><td>East Fork Irrigation District Size</td><td colspan="4">16,160 acres[1]</td></tr>
<tr><td>Climate and Topography</td><td colspan="4">The project is located along the eastern slopes of the Cascade Mountain range in the Hood River Valley. Annual average precipitation is 31 inches. The average high temperature for July is 81 degrees Fahrenheit and average low temperature for January is 28 degrees Fahrenheit. The irrigated land within EFID varies from flat to moderately sloping, with an average elevation of 930 feet above mean sea level.</td></tr>
<tr><td rowspan="4">Land Use East Fork Irrigation District (total 16,160 acres)</td><td colspan="3">Use</td><td>Acres</td></tr>
<tr><td colspan="3">Agriculture</td><td>9,607</td></tr>
<tr><td colspan="3">Developed</td><td>4,849</td></tr>
<tr><td colspan="3">Undeveloped</td><td>1,704</td></tr>
<tr><td rowspan="4">Land Ownership East Fork Irrigation District (total 16,160 acres)</td><td colspan="3">Owner</td><td>Percentage</td></tr>
<tr><td colspan="3">Private</td><td>91.3% (14,759 acres)</td></tr>
<tr><td colspan="3">State-Local</td><td>8.7% (1,401 acres)</td></tr>
<tr><td colspan="3">Federal</td><td>None</td></tr>
<tr><td>Population and Demographics</td><td colspan="4">The Preferred Alternative would occur within Hood River County, Oregon. In 2017, the population of Hood River County was 23,377, or 45 people per square mile. The population growth rate of the county was 4.6 percent between 2010 and 2017. The population of the State of Oregon grew by 8.1 percent over the same period.</td></tr>
</table>

[1] In this Plan-EA the District's area is reported as 16,160 acres, which was calculated using geographic information system (GIS) data provided by EFID. Other documents report the area of the District as 15,150 acres.

<table>
<tr><td rowspan="4">Population and Demographics</td><td></td><td>Hood River County</td><td>Oregon</td></tr>
<tr><td>Population 2017</td><td>23,377</td><td>4,142,776</td></tr>
<tr><td>Unemployment Rate 2017</td><td>3.6 %</td><td>4.1 %</td></tr>
<tr><td>Median Household Income 2017</td><td>$63,951</td><td>$60,123</td></tr>
<tr><td>Relevant Resource Concerns</td><td colspan="3">Resource concerns identified through scoping were water conservation and quality, surface and ground water, aquatic and fish resources, visual resources, land use, cultural resources, socioeconomics, wetlands, terrestrial wildlife, and vegetation.</td></tr>
<tr><td colspan="4">Alternatives</td></tr>
<tr><td>Alternatives Considered</td><td colspan="3">Fifteen alternatives were initially considered; 13 were eliminated from full analysis because they did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or because they became unreasonable due to cost, logistics, existing technology, social, or environmental reasons. The No Action Alternative and Piping Alternative were analyzed in full.</td></tr>
<tr><td>No Action Alternative</td><td colspan="3">Under the No Action Alternative, EFID would continue to operate and maintain its existing canal and pipe system in their current condition. The need for the project would still exist; and the District would only be able to modernize its infrastructure on a project-by-project basis as public funding became available. Public funding is not reasonably certain to be available under a project-by-project approach at a scale large enough to fully modernize the District’s infrastructure.</td></tr>
<tr><td>Proposed Action</td><td colspan="3">Under the Piping Alternative, EFID would replace 56 miles of canals and laterals with gravity pressurized HDPE buried pipe. The Piping Alternative has been identified as the National Economic Efficiency (NEE) plan and is also the Preferred Alternative.</td></tr>
<tr><td>Mitigation, Minimization, and Avoidance Measures</td><td colspan="3">Land that could provide areas having seasonal wetland characteristics along 17.5 miles of open canals would be converted to upland vegetation. Project canals are not considered jurisdictional wetlands by state or federal agencies. The wetland characteristics that could occur in the canals have low function, and the loss would be offset by gains in water quantity, water quality, and habitat function in the project area’s natural riverine systems. The National Wetland Inventory (NWI) identifies approximately 42.2 acres of wetland features within and adjacent to canals and laterals that would be affected by the project (USFWS 2016). These have not been field verified. Wetland determinations and/or delineations would be conducted adjacent to canals in areas where work would occur prior to construction of each project group, and if present, wetlands would be avoided to the extent practicable.

Consultation between the District, NRCS, and the Oregon State Historic Preservation Office (SHPO) for compliance with Section 106 of the National Historic Preservation Act (NHPA) would occur prior to project implementation. If eligible resources are documented in the project area by a cultural resource specialist, consultation would identify appropriate mitigation measures.

For all project groups, ground disturbances would be limited to only those areas necessary to minimize effects on vegetation, wildlife, wetlands, land use, and visual resources. Where roads or access routes do not currently allow construction access, temporary access routes would be selected in a manner to minimize erosion and effects on vegetation and avoid the removal of trees. Stormwater best management practices would be employed during and</td></tr>
</table>

	after construction, and construction schedules would be determined to minimize disturbance to wildlife and the public. After construction, disturbed areas would be graded and replanted with a mix of native grasses and forbs to reduce the risk of erosion and spread of noxious weeds.

Project costs	**PL 83-566 funds**		**Other funds**		**Total**	
Construction	$25,000,000	42%	$34,618,000	58%	$59,618,0000	(100%)
Engineering	$1,928,000	75%	$643,000	25%	$2,571,000	(100%)
SUBTOTAL COSTS	$26,928,000	43%	$35,261,000	57%	$62,189,000	(100%)
Technical assistance	$2,097,000	100%	$0	0%	$2,097,000	(100%)
Relocation	Not applicable					
Real property rights	Not applicable					
Project administration	$524,000	60%	$353,000	40%	$877,000	(100%)
Permitting	$0	0%	$1,866,000	100%	$1,866,000	(100%)
Annual O&M	Not applicable					
TOTAL COSTS	$29,549,000	44%	$37,480,000	56%	$67,029,000	(100%)

Project Benefits	
Project Benefits	The Preferred Alternative would improve water delivery reliability for EFID's patrons, conserve up to 16.6 cubic feet per second (cfs) of water for instream and agricultural use (5,287 acre-feet annually), reduce EFID's O&M costs, improve public safety, reduce on-farm pumping costs, and help address concerns about sediment content in irrigation water.
Number of Direct Beneficiaries	EFID serves 990 patrons, all of which would directly benefit from the project.
Other Beneficial Effects-Physical Terms	The Preferred Alternative would have beneficial effects on agricultural water availability, water quantity, water quality, and fish and wildlife habitat.

Damage Reduction Benefits	**Project Group***		
	1	**2**	**3**
Other – Agricultural Yield Enhancement (Increased Net Returns)	$91,000	$760,000	$522,000
Other - Reduced O&M	$119,000	$200,000	$0
Other – Patron Pumping Cost Savings	$134,000	$91,000	$54,000
Other - Social Value of Carbon (Avoided Carbon Emissions)	$3,000	$1,000	$1,000

Water Conservation-Instream Flow Value	$115,000	$166,000	$56,000
Total Quantified Benefits	$462,000	$1,218,000	$633,000
Benefit to Cost Ratio	1.17	1.18	1.87
*Project group refers to groupings of canals and laterals that would undergo construction during the same period. Canals and laterals under each project group are as follows: 1. Eastside Service Area 2. Main and Dukes Valley Service Areas 3. Central Service Area			
Installation Period (years)	3	5	2
Project Life	100 years for each project group		

Funding Schedule

Year—Project Group		PL 83-566	Other Funds	Total
2020-2023	1	$10,252,000	$3,510,000	$13,762,000
2023-2028	2	$18,842,000	$20,227,000	$39,069,000
2028-2030	3	$455,000	$13,743,000	$14,198,000

Environmental Effects

The Preferred Alternative would be planned, designed, and installed to have long-term net beneficial effects on agricultural production, water quantity, water quality, public safety, ESA-listed fish species and their habitats, and other aquatic species. Long-term, adverse effects would include alterations to the visual landscape following the elimination of 17.5 miles of open irrigation canals; the conversion of approximately 36 acres of artificial wetlands and associated artificial riparian areas to upland habitat; and reduced streamflow in five tributary streams where streamflow is currently artificially augmented by irrigation end spills. The artificial wetlands and riparian areas consist of the irrigation canals and the vegetation growth supported by moist soils or seepage along the canal banks. Loss of existing artificial wetland and riparian habitat would be offset by enhancement of naturally functioning wetland and riparian habitat in the East Fork Hood River. Effects on instream and riparian habitat from reduced streamflow in tributaries that would no longer receive end spills would be offset by improvement in water quality and the return of affected tributaries to a more natural hydrologic condition.

Implementation of the Preferred Alternative to improve water conservation, water delivery reliability, and public safety may result in minor, short-term, adverse effects, such as effects on vegetation along the canals. Most of these short-term adverse effects would result from construction activities in the project area. The Sponsor would work closely with partners, contractors, and affected landowners to incorporate measures to avoid and minimize short-term, adverse effects.

Major Conclusions	The Preferred Alternative would improve the reliability of water delivery for farmers; eliminate water loss from end spills, seepage, and evaporation in District infrastructure; enhance fish and aquatic habitat through greater instream flows; reduce EFID's O&M costs; and improve public safety while supporting agriculture and improving the environmental quality of the East Fork Hood River, Hood River, and several Hood River tributaries.
Areas of Controversy	No areas of controversy have been identified.
Issues to be Resolved	None
Evidence of Unusual Congressional or Local Interest	Comments during the scoping period were received from the Confederated Tribes of Warm Springs, local non-governmental organizations, and individuals. Comments on the Draft Plan-EA were received from Oregon Department of Fish and Wildlife and individuals.
Compliance	Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes _X_ No____

1 Introduction

Aging infrastructure, growing populations, shifting rural economies, and changing climate conditions have increased pressure on water resources across the western United States (U.S.). In Oregon's Hood River basin, irrigated agriculture is the primary out-of-stream water use and relies on 100-year-old, open, unlined canals to deliver water to farms and orchards. In recent years, the improvement of water resources has been a focus of the five irrigation districts within the Hood River basin, with the goal of addressing environmental needs for instream flows while still delivering enough water to district patrons (Figure 1-1).

The Hood River basin is one of Oregon's leading fruit growing regions, producing one third of the U.S. winter pear crop (Stampfli et al. 2012). The East Fork Irrigation District (herein referred to as EFID or the District) is the largest irrigation district in the basin and includes 16,160 acres, of which 9,607 acres are currently irrigated by 990 patrons. The District diverts its water supply from the East Fork Hood River for delivery to patrons through an 82.8-mile-long system of canals and laterals.[2] Approximately 18 percent of the water diverted is currently returned to surface waters as spill at the end of the canals and laterals. As a result, the District diverts more water than is required for irrigation to help ensure that water reaches all patrons throughout the District.

The District has made improvements to its infrastructure in recent decades and has legally protected 1.58 cubic feet per second (cfs) of conserved water in the East Fork Hood River, and another 0.52 cfs is pending for permanent instream use. Although some improvements have been made, EFID's aging and outdated infrastructure contributes to water supply insecurity for agriculture and continues to affect aquatic habitat and water quality in the East Fork Hood River and several other tributaries. The District's open canals present an ongoing public safety risk. The high natural sediment load in the EFID water source presents a maintenance challenge for the District and its patrons, and limits the on-farm use of high-efficiency sprinklers and drip emitters. Inefficient infrastructure also affects the financial stability of EFID, as the District must find new approaches to fund growing maintenance needs.

If EFID's water distribution system were modernized and more efficient, the District would divert less water and leave more water instream in the East Fork Hood River. Returning a portion of the water saved through modernization would allow EFID to address fish and aquatic habitat concerns associated with low streamflow, and is required under the District's Conserved Water Policy when over 25 percent of conservation project financing comes from public sources (Section 6.7.2). Improving irrigation infrastructure offers an opportunity to conserve water; save energy; increase the reliability of water delivery to farms; enhance streamflow, water quality, and aquatic habitat; reduce risks to public safety from open irrigation canals; and reduce operation and maintenance (O&M) costs for the District.

[2] "Laterals" refer to canals or pipelines that branch off from a main or larger canal or pipeline.

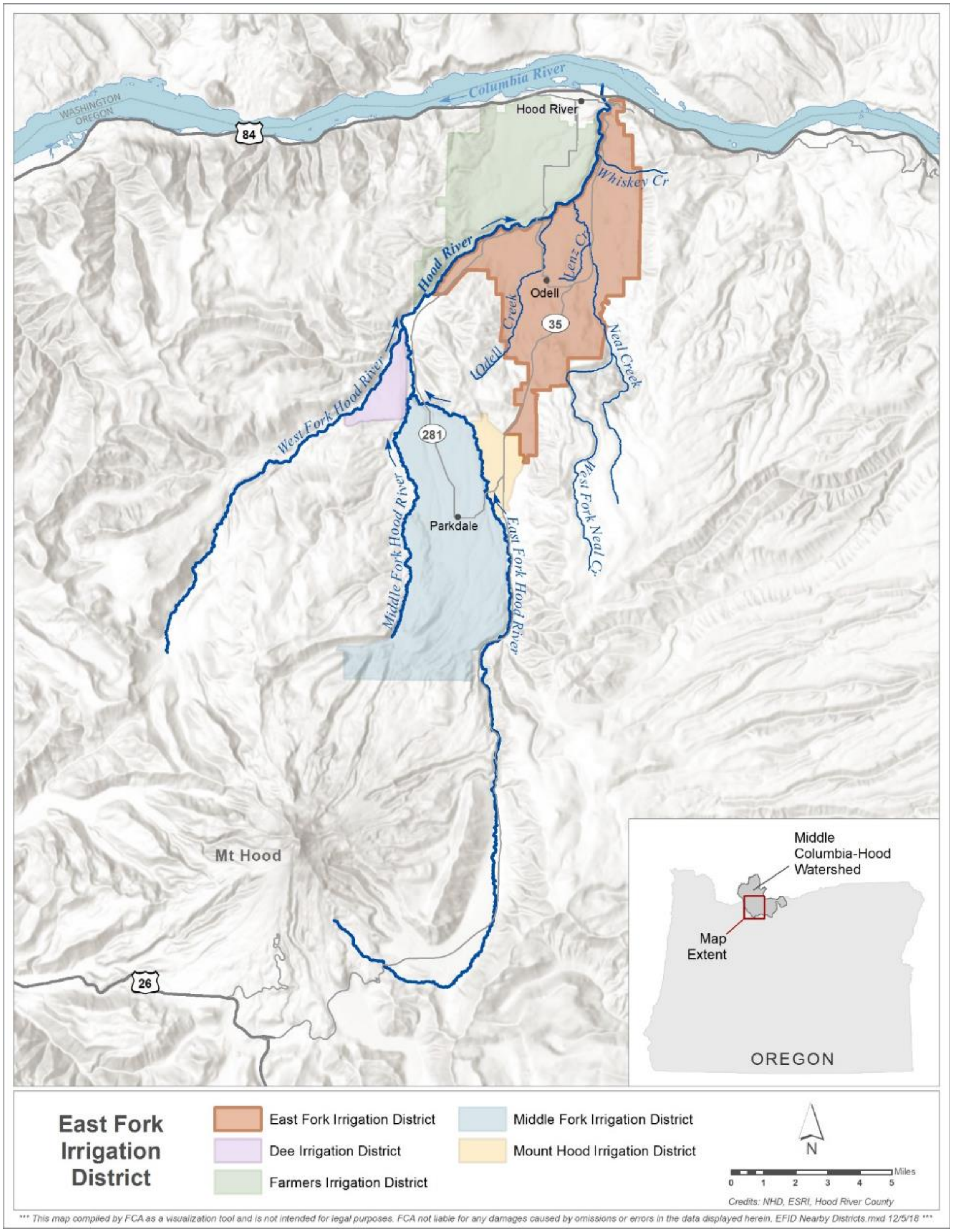


Figure 1-1. Irrigation districts within the Hood River basin.

1.1 Watershed Planning Area

The District's service area and the EFID Infrastructure Modernization Project (herein referred to as project or proposed action) area are located in four subwatersheds: Neal Creek, Odell Creek-Hood River, Indian Creek-Hood River, and Lower East Fork Hood River (Figure 1-2.). They are located within the larger Middle Columbia-Hood watershed (Hydrologic Unit Code 17070105) and cover a total of 77,780 acres. The four subwatersheds comprise the EFID Watershed Planning Area (Table 1-1).

Table 1-1. East Fork Irrigation District Watershed Planning Area.

Name	Hydrologic Unit Code	Area (acres)
Neal Creek	170701050701	19,713
Odell Creek-Hood River	170701050702	20,905
Indian Creek-Hood River	170701050703	10,017
Lower East Fork Hood River	170701050706	27,145
	Total	**77,780**

1.2 Project Area

The project area is where construction activities would occur to modernize up to 56 miles of the District's canals and laterals (Figure 1-3.). Construction activities would occur within the District's existing easements, except in limited areas where additional space may be needed on a temporary or permanent basis to accomplish the work. For example, approximately 0.5 mile of the pipeline that would replace the Eastside Canal (EC) would not follow the existing canal alignment, but instead would follow a shorter route through both private land and county-owned forest land under a new easement. In such cases, the District would work with individual landowners to obtain permission for any land use outside of easements.

For the purposes of this Watershed Plan-Environmental Assessment (Plan-EA), the project area is defined as extending 50 feet on each side of the affected canals and pipelines, and 50 feet around the proposed 30,000 square foot sedimentation basin near the District's diversion.

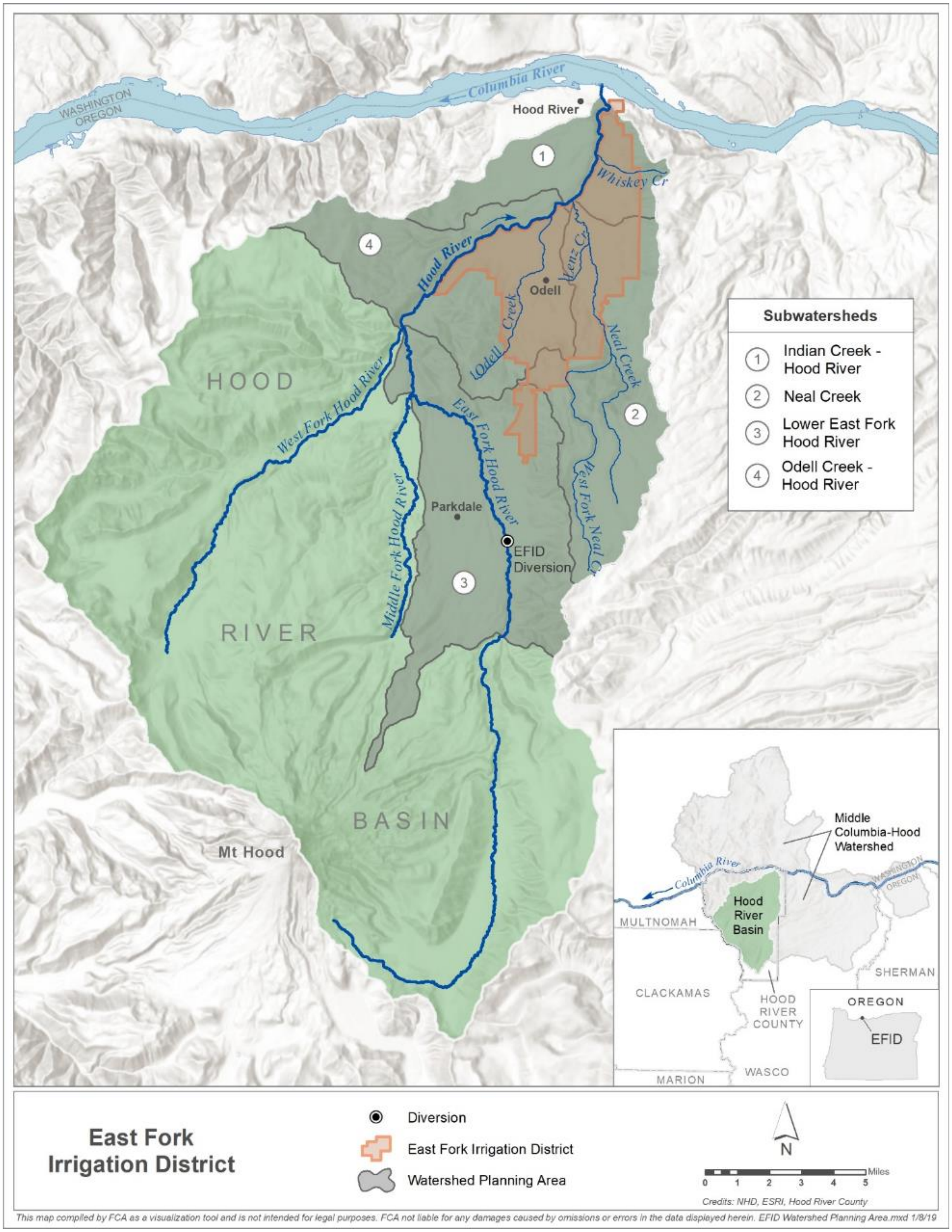


Figure 1-2. The four subwatersheds comprising the East Fork Irrigation District watershed planning area.

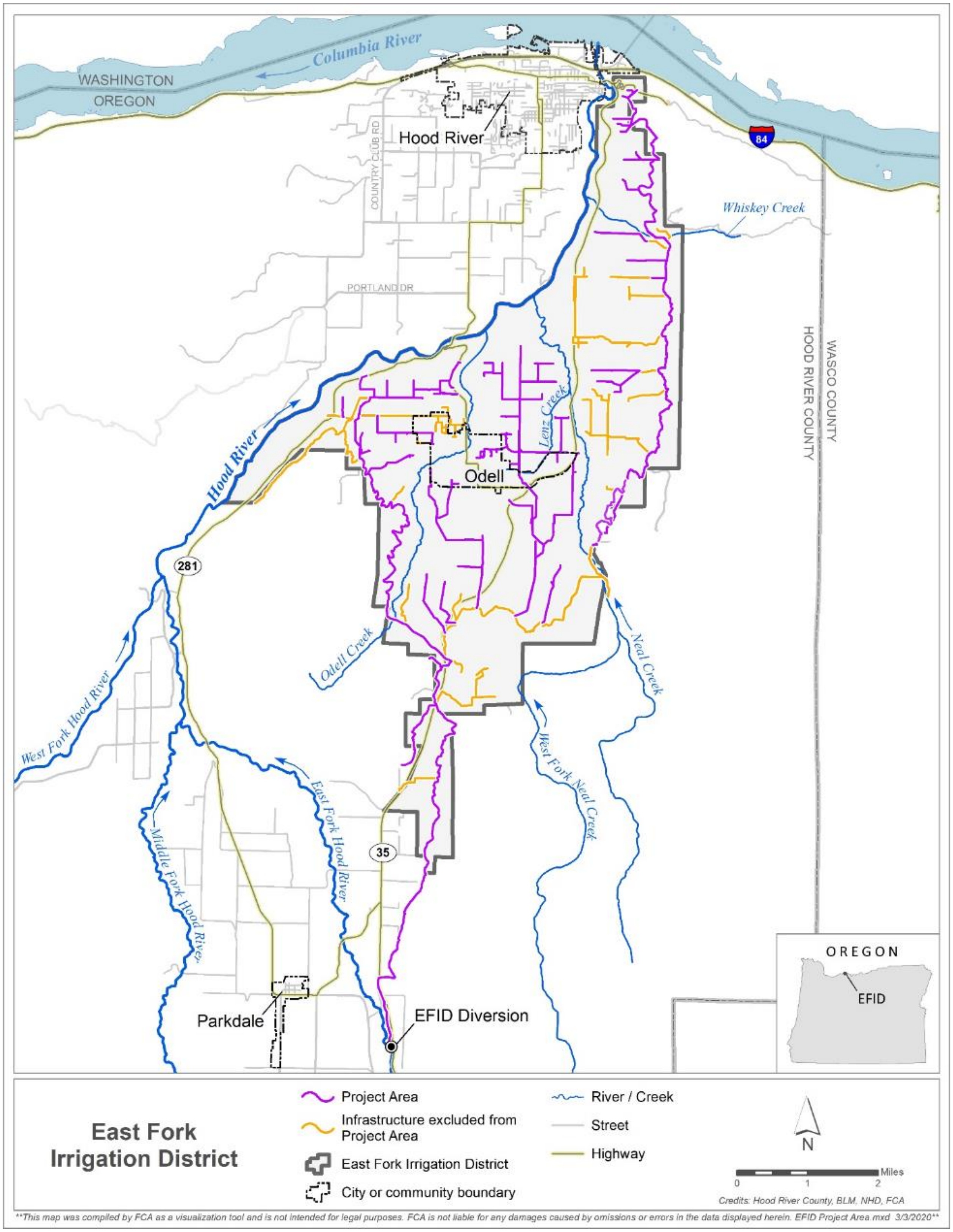


Figure 1-3. Location of the East Fork Irrigation District Infrastructure Modernization Project area.

1.3 Current Infrastructure

The District's 82.8-mile irrigation conveyance system includes 64.9 miles of pipeline and 17.9 miles of open, unlined canals. System conveyance occurs through gravity. Many of the existing pipelines are not rated for pressurization, including segments of concrete pipeline. The District operates a single diversion at its headworks on the East Fork Hood River (River Mile [RM] 6.6). A rock push-up dam and wood headgate were replaced in 2013 with an Obermeyer weir, four steel headgates, and a vertical slot fish ladder (Figure 1-4.). The District's water rights allow for the diversion of up to 117.36 cfs from the East Fork Hood River. EFID also diverts water for the Mount Hood Irrigation District (MHID). MHID withdraws up to 12.65 cfs under its own water rights from two points along the EFID Main Canal into a fully piped distribution system. EFID has no reservoir storage and relies on live flow from the East Fork Hood River for irrigation water supply.

Source: Hood River Watershed Group, photographed in 2014

Figure 1-4. The District's diversion weir, fish ladder, and intake facilities on the East Fork Hood River at River Mile 6.6.

The East Fork Hood River's high glacial sand and silt content requires that sediment be separated from irrigation water near the point of diversion. From the diversion, water is conveyed in an open channel to a large concrete sand trap structure with five settling bays (Figure 1-5) designed to separate, retain, and dispose of over 1,000 cubic yards of sand in an 8-hour period (Buell and Associates 2000). The sand trap settles coarse sand and some fine sand, while smaller particles pass through the system into the District's canals (Wharry 2016). It is estimated that the trap is able to settle out 12 percent of the overall incoming sediment load (Christensen 2013). In a typical year, 10 to 13 thousand cubic yards of sand are sluiced from the trap to the river (EFID 2011). A wide area in the channel upstream of the trap provides additional sand-settling capacity. The District also maintains three additional in-canal settling basins at other locations throughout its system to limit sediment accumulation in its conveyance infrastructure. The total volume of all existing settling facilities is approximately 2.8 acre-feet (Wharry 2016).

Source: East Fork Irrigation District, photographed in 2010

Figure 1-5. The District's sand trap facility located 0.4 mile from the diversion at the start of the Main Canal.

Fixed plate, semi-horizontal Coanda fish screens are installed at the downstream ends of the sand trap settling bays (Figure 1-6.). These screens separate the water diverted for irrigation from the water and fish that are returned instream, preventing fish from entering the District's canals and pipelines. Testing conducted in 1996 after screen and sand trap construction found no fish injuries or mortality of fish passing the screens; however, Coanda screens do not meet the National Oceanic and Atmospheric Administration (NOAA) Fisheries' fish screening criteria and are regarded as experimental technology (NMFS 2011). Further discussion of fish screening is provided in Section 4.8.

From the sand trap and fish screen facility, the water diverted for irrigation enters EFID's open Main Canal and is conveyed 6.8 miles north to a distribution center where the system splits into two laterals: the 4.5-mile Central Lateral Pipeline (CLP) and the 5-mile open Dukes Valley Canal (DVC). The DVC conveys water to the southwestern extent of the District via five lateral pipelines. Before entering the CLP, irrigation water flows through a large trash rack and over a traveling debris screen. The CLP supplies water to 10 District-owned, sub-lateral pipelines and to the open EC. The EC is 6.1 miles long and supplies water to seven District-owned piped laterals and transitions into the Whiskey Creek Pipeline. The system includes 536 turnouts that are gate-regulated and weir-measured by EFID field staff.

The conveyance system is fed entirely by gravity. The elevation in the District drops approximately 800 feet between the diversion and the northern limit of the District.

Approximately 78 percent, or 64.9 miles, of the District's conveyance system has been piped. However, at least half of the District's piping is outdated or is not rated to withstand the water pressures expected in an enclosed and pressurized delivery system.

Source: Hood River Watershed Group

Figure 1-6. Coanda type fish screens installed at the end of the District's sand trap settling bays.

The District's delivery infrastructure loses approximately 5,287 acre-feet of water annually through end spills at roughly 25 locations throughout the District. End spills are excess water released into ditches or streams at the termination of an unpressurized canal or lateral. Because the system is not fully pressurized, the District must divert this water to ensure a continual water supply for all patrons. A further discussion of system water losses is provided in Section 2.1.1.

1.4 Decision Framework

This Plan-EA has been prepared to assess and disclose the potential effects of the proposed action. This Plan-EA is required to request federal funding through the Watershed Protection and Flood Prevention Act, Public Law (PL) 83-566, authorized by Congress in 1954 (herein referred to as PL 83-566). NRCS is the lead federal agency for this Plan-EA and is responsible for review and issuance of a decision in accordance with the National Environmental Policy Act (NEPA). NEPA requires that Environmental Impact Statements (EISs) are completed for projects using federal funds and that significantly affect the quality of the human and natural environment (individually or cumulatively). When a proposed project is not likely to result in significant impacts requiring an EIS, but the activity has not been categorically excluded from NEPA, an agency can prepare an EA to assist them in determining whether there is a need for an EIS (See 40 Code of Federal Regulations [CFR] 1501.4, 1508.9; 7 CFR 650.8.). For purposes of NEPA compliance, the intent of this Plan-EA is to determine if the project, as proposed, significantly affects the quality of the human environment.

This Plan-EA utilizes a tiering approach. Tiering is a staged approach to NEPA as described in the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 to 1508). Broad programs and issues are described in initial analyses, while site-specific proposals and impacts are described in subsequent site-specific studies. The tiered process permits the lead agency to focus on issues that are ripe for decision and exclude from consideration issues already decided or not yet ripe. Tiering eliminates repetitive discussions of the same issues through incorporating by reference of the general discussions.

NRCS has determined the need for a Plan-EA to analyze the effects of the proposed action under PL 83-566 watershed authority. Due to the multi-year project group approach, this Plan-EA does not identify the specific details associated with the engineering design and construction activities that would be required to implement the proposed action. Instead, this document intends to present an analysis in sufficient detail to allow implementation of a proposed action within the designated project. If the analysis demonstrates that the project does not significantly affect the quality of the human environment, minimal additional NEPA analysis would be required.

The proposed action is planned to be completed in project groups.[3] Consistent with the tiering process as described above, prior to implementation of each project group, an on-site Environmental Evaluation (EE) review would occur using Form NRCS-CPA-52, "Environmental Evaluation Worksheet." The EE process would determine if that particular project group meets applicable project specifications, and whether the site-specific environmental effects are consistent with those as described and developed in this Plan-EA. This process provides information for the Responsible Federal Official to determine if the proposed action has been adequately analyzed and if the conditions and environmental effects described in a Plan-EA are still valid. Where the impacts of the narrower project-specific action are identified and analyzed in a Plan-EA, no further analysis would occur and the Plan-EA would be used for purposes of the pending action.

If it is determined based on the findings of the EE that the Plan-EA is not sufficiently comprehensive, not adequate to support further decisions, or if resource concerns or effects have not been adequately evaluated, a separate project group-specific supplemental Plan-EA would be prepared.

This Plan-EA has been prepared to meet NEPA requirements[4] as well as program and environmental review requirements specific to NRCS federal investments in water resources

[3] "Project group" refers to groupings of canals and laterals that would undergo construction during the same period. The project groups identified in the System Improvement Plan (SIP) (FCA 2018a) may differ from the project groups identified in this Plan-EA.

[4] The Plan-EA has been prepared in accordance with applicable CEQ regulations for implementing NEPA (40 CFR 1500–1508), U.S. Department of Agriculture's (USDA) NEPA regulations (7 CFR Part 650), NRCS Title 190 General Manual Part 410, and the NRCS National Environmental Compliance Handbook, Title 190 Part 610 (NRCS 2016).

projects.[5] Some considerations and analyses in this Plan-EA are strictly NRCS program requirements; they are not required by NEPA. These differences are identified throughout this Plan-EA.

1.5 Bonneville's Decision Framework

Bonneville Power Administration (Bonneville) is a federal power-marketing agency within the U.S. Department of Energy. Bonneville is governed by several organic statutes, including the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (16 United States Code [U.S.C.] 839 §§ *et seq.*) (Northwest Power Act). Among other things, the Northwest Power Act directs Bonneville to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the federal hydroelectric dams in the Columbia River basin from which Bonneville markets commercial power, and to do so in a manner consistent with the purposes of the Act and the Northwest Power and Conservation Council's Fish and Wildlife Program.

Although NRCS is the lead agency with responsibility for the completion of this Plan-EA, Bonneville is a cooperating agency for the development of this Plan-EA because Bonneville is considering providing fish mitigation funding to the Confederated Tribes of Warm Springs (CTWS) to assist in implementation of the Eastside Piping Project, a subset of EFID's Infrastructure Modernization Project. Bonneville would provide CTWS with up to $1 million in cost share for design work and materials as part of the Eastside Piping Project. The information in this Plan-EA, received public comments, and Bonneville's own expertise related to the project will help Bonneville in making a decision of whether to provide the requested funding.

[5] The Plan-EA has been prepared in accordance to the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies (PR&G; USDA 2017), the 2013 Principles and Requirements for Federal Investments in Water Resources (USDA 2013), guidelines in the 2015 NRCS National Watershed Program Manual (NWPM; NRCS 2015), and the 2014 NRCS National Watershed Program Handbook (NRCS 2014).

2 Purpose and Need for Action

The purpose of this project is to improve water conservation in District infrastructure, improve water delivery reliability, and increase public safety along District infrastructure.

The project is needed due to the following conditions, which are further discussed in Section 2.1:

- An estimated 18.3 percent of the water diverted by EFID from the East Fork Hood River is lost through end spills at the ends of the District's open canals and unpressurized pipelines.
- It is difficult for the District to deliver the correct amount of water to patrons at the correct time due to open, unpressurized canals and laterals.
- The District diverts up to 85 percent of the natural flow of the East Fork Hood River, resulting in diminished habitat for fish and other aquatic life, as well as diminished water quality.
- Due to a high natural sediment load in the East Fork Hood River, the quality of irrigation water is poor for weeks to months each year. Sediment in irrigation water clogs filters, raises on-farm maintenance costs, and causes wear on high-efficiency sprinklers and drip irrigation systems.
- The District is concerned about the safety risk of open canals. Two drowning deaths occurred in the 1980s in the District's canals, which pass through rural residences, orchards, public lands, and irrigated fields.

Additionally, Bonneville's purpose and need for cost share funding to the project are as follows:

- Help fulfill Bonneville's obligation through the Northwest Power Act to mitigate effects of the development and operation of federal hydroelectric dams in the Columbia River basin on fish and wildlife. The proposed action would constitute an enhancement project for Bonneville. Under the Northwest Power Act, "enhancement" is "a means of achieving offsite protection and mitigation" for fish and wildlife affected by development and operation of the hydroelectric facilities of the Columbia River and its tributaries. See 16 U.S.C. § 839b(h)(8)(A).
- Fulfill commitments to CTWS related to the proposed project that are contained in the 2008 Columbia River Basin Fish Accords Memorandum of Agreement among the CTWS, Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, the Columbia River Inter-Tribal Fish Commission, Bonneville, the U.S. Army Corps of Engineers (USACE), and U.S. Bureau of Reclamation, as extended in 2018 (Fish Accord Extension).
- Minimize harm to natural and human resources, including species listed under the Endangered Species Act (ESA).

Bonneville needs to respond to the CTWS's request to fund a portion of the Eastside Piping Project as part of Bonneville's commitment under the Fish Accord Extension.

In addition to the purpose and need stated above, to meet NRCS requirements for a federal investment in a water resources project, the project must meet the Federal Objective set forth in the Water Resources Development Act of 2007, promote the Federal Guiding Principles (as identified in the 2017 Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies [PR&G]), and be an authorized project purpose under Sections 3 and 4 of PL 83-566.

Per the Federal Objective, water resource investments—including the proposed action—put forth in this plan should:

> …reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems. (USDA 2013)

Additionally, the project should seek to achieve the following Guiding Principles as identified by the federal government: Healthy and Resilient Ecosystems, Sustainable Economic Development, Floodplains, Public Safety, Environmental Justice, and Watershed Approach.

The proposed project would be eligible for funding under PL 83-566 requirements as an "Authorized Project Purpose (v), Agricultural Water Management",[6] through irrigation water conservation, water quality improvement, and more reliable agricultural water supply.

2.1 Watershed Problems and Resource Concerns

2.1.1 Water Loss in District Conveyance Systems

Currently, the District's infrastructure loses an estimated 16.6 cfs (5,287 acre-feet annually) to end spills throughout the District, equal to 18.3 percent of the average amount of water that EFID diverts annually. End spill is excess water that is discharged to natural drainages near the termination of an open canal, lateral, or unpressurized pipeline. Because the system is not fully pressurized, EFID is required to maintain end spills to ensure a continual water supply for all patrons. Lesser but additional water losses may occur from seepage along the District's open and unlined canals. Measurements of seepage losses within the District have been inconclusive due measurement problems associated with the large number of turnouts along the canals. Evaporation losses in EFID's system are minor and were estimated to be 0.13 cfs (Wharry 2016). Detailed information on water losses and water demand can be found in the District's System Improvement Plan (SIP) (FCA 2018a). Currently, there is a lack of adequate streamflow in the basin during the summer months to meet the competing demands for water (Reclamation 2015).

2.1.2 Operations Inefficiencies and Water Delivery Reliability

The District's open canals and unpressurized pipelines make it difficult to deliver the correct amount of water to patrons at the correct time. EFID must maintain end spills so that a steady water supply

[6] A description of Authorized Purposes can be found in 390-NWPM, Part 500, Subpart A, Section 500.3B.

can be delivered to all patrons regardless of the actual patron water demand. EFID staff currently monitor end spills that occur at approximately 25 locations throughout the District, adjusting the rate of diversion daily to limit water loss while ensuring sufficient deliveries at the ends of canals and pipelines. This task is challenging as patrons turn delivery gates (individual turnouts) on and off. The District requires that patrons provide a 24-hour notice before patrons increase or decrease their deliveries by 50 gallons per minute or more. Proper notice does not always occur. When proper notice does not occur and patrons decrease their deliveries, excessive end spills may occur. When proper notice does not occur and patrons increase their deliveries, other patrons may receive insufficient deliveries or no deliveries (EFID 2011).

Operating and maintaining the District's century-old open canals requires staff to inspect and repair the canal banks; remove fallen tree limbs and other debris; remove sediment from canals and ditches; clean leaves, algae, and other debris from 12 District-owned screens; treat algae in canals; and adjust flows to patrons.

The District's water supply is fed by snow and glacial melt on Mount Hood and spring sources. Snowpack in the Hood River basin has decreased since the 1920s, and Mount Hood's glaciers have receded since the mid-1900s or earlier (Lillquist and Walker 2006). Continued glacial recession and declining snowpack are expected as a result of warmer temperatures predicted with the changing climate, with lower natural runoff in the spring and summer months when water uses are greatest (Reclamation 2015). Drought has occurred in 3 of the past 14 years and has required EFID, by voluntary request to patrons, to curtail water deliveries by 25 percent throughout the peak irrigation season to avoid depleting streamflow in the East Fork Hood River at its diversion.

2.1.3 Instream Flow for Fish and Aquatic Habitat

The Hood River and its tributaries support threatened and sensitive species, including steelhead trout, bull trout, Chinook and coho salmon, Pacific lamprey, and many other fish, bird, and wildlife species. In the Hood River basin, low streamflow is identified as a primary limiting factor for coho, steelhead, and Chinook populations, which are listed as threatened species under the ESA (NMFS 2013). The East Fork Hood River downstream of the EFID diversion is identified as the highest level of concern for water quantity and water quality in the basin (Shively 2006).

EFID typically diverts 75 percent—and up to 85 percent—of the available flow of the East Fork Hood River during the late summer. Low streamflow associated with water diversions limits the amount and quality of habitat for many fish and aquatic species, concentrates the proximity of predators and prey, increases competition for food and spawning sites, and contributes to warm water temperatures that are harmful to salmon and trout. Because streamflow is strongly correlated with critical physical and biological characteristics of a river, it also influences the functions of associated riparian areas (National Research Council 2002).

2.1.4 Risks to Public Safety

Open canals pose a safety risk for the public and EFID employees. Two drownings in EFID canals occurred in the 1980s involving an adult and a child in separate incidents (J. Buckley, EFID Manager, personal communication, September 24, 2018). The child drowned in the District's Main Canal (J. Buckley, personal communication, February 18, 2020).

During the summer, water depths in EFID canals and laterals range between 2 to 4 feet, with velocities up to 5 feet per second. These conditions make it difficult for a healthy, strong adult to stand in or climb out of a canal without assistance. A child or non/weak-swimmer would have a higher risk of drowning in a canal with these attributes. If a person or animal falls into a canal, they could have serious difficulty gaining a hold on the banks to climb out due to the volume and speed of the moving water. Barriers or fences are not currently installed at the top banks of the canals. The public safety risks from open canals can be expected to increase along with increased development within the District and continued population growth in Hood River County.

2.1.5 Sediment in Irrigation Water

The East Fork Hood River's periodically heavy glacial sand and silt content requires that sediment be separated from irrigation water near the point of diversion. EFID operates a sand trap above its Main Canal near the diversion. Additional in-canal settling areas are used in three locations along the conveyance system, and in another location upstream of the sand trap, to limit sand accumulation in delivery infrastructure and limit the sand and silt content in irrigation water. Despite these facilities, the quality of irrigation water due to sediment is poor for weeks to months each year and is recognized as a limiting factor of EFID's water supply (EFID 2011; Wharry 2016). As a result, filters are used at turnouts or on farms. At times, the high sand and silt content in the EFID water supply requires that filters be cleaned daily or even several times daily.

Sediment in irrigation water reduces the efficiency of irrigation systems on farms. Sand and silt erode sprinkler heads, clog drip emitters, and limit the potential for widespread use of highly efficient on-farm irrigation systems within the District. The sediment load in rivers such as the East Fork Hood River could increase with glacial retreat, reduced snow cover, and in extreme weather events that may cause more landslide activity in the upper East Fork Hood River (Huggel et al. 2012).

2.2 Watershed and Resource Opportunities

The following list of opportunities to address watershed problems and resource concerns would be realized through project implementation. Quantification of these opportunities is provided in the respective sections of this Plan-EA. The project would realize the following opportunities:

- Eliminate end spills, allowing less water to be diverted from the East Fork Hood River while fulfilling patron water rights.
- Improve streamflow, water quality, and habitat conditions in the East Fork Hood River and the Hood River downstream from EFID's diversion.
- Reduce O&M involved in delivering irrigation water to EFID patrons.
- Minimize the potential for injury and loss of life associated with the open EFID canals.
- Help increase future water supply security given competing demands for water and the projected decline in snowpack and summer streamflow associated with the changing climate.
- Reduce energy costs through pressurization, decreasing patron reliance on pumping.

- Support existing agriculture through improved water supply reliability, water management, and water quality.

2.3 Using Oregon's Allocation of Conserved Water Program

The District has determined that the proposed action could save up to 16.6 cfs or 5,287 acre-feet of water annually that is currently lost through end spills. The District would use the State of Oregon's Allocation of Conserved Water Program (Oregon Revised Statute [ORS] 537.470) to legally protect 75 percent of the total water saved by the project as instream flow in the East Fork Hood River downstream from its diversion. The other 25 percent of the total water saved by the project would help EFID maintain a reliable supply of irrigation water for agricultural needs.[7]

The Conserved Water Program creates new water rights for water conserved as the result of an efficiency project (see Oregon Water Resources Department [OWRD] 2017 and Appendix E for more information about the Conserved Water Program). Through the Conserved Water Program, a new water right certificate would be issued to the District with the original irrigation season and priority date of 1895; this water right would reflect the reduced quantity of water needed after the project. An additional certificate with the same priority date would then be issued to the State of Oregon for the new instream water right. The water allocated instream would be legally protected against out-of-stream use; the District would no longer be able to divert the water. OWRD would continue to measure streamflow at existing diversions and stream gaging stations to ensure that the water conserved by the project remains instream.

[7] The majority of irrigated land within the District is planted in crops grown by agricultural producers. A summary of water users by crop and acreage is provided in Table 4-5.

3 Scope of the EA

The scoping process followed the general procedures consistent with NRCS guidance and PL 83-566 requirements. Both NRCS procedures and NEPA regulations (40 CFR 1500 to 1508) require that NRCS use scoping early in the planning process to identify issues, concerns, and potential effects that require detailed analysis.

Using input obtained during scoping, NRCS refined the project to focus on relevant resource concerns and issues, and eliminated those that were not relevant from further detailed study. Relevant resource concerns were carried forward for further study and discussion.

3.1 Agency, Tribal, and Public Outreach

Federal, state, and local agencies and representatives, as well as non-governmental organizations, received an invitation to this Plan-EA scoping period. Advertisements announcing the scoping period and associated scoping meeting were placed in a local newspaper in addition to multiple online locations including NRCS's website and the project website (see Section 7 for more details). Additionally, the District notified patrons of the scoping meeting and invited comments on the Draft Plan-EA.

Tribal consultation was conducted in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments*, to maintain NRCS' government-to-government relationship with Native villages and tribes. NRCS sent letters to the following tribes requesting input and notifying them of the scoping process: the CTWS, the Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes and Band of the Yakama Nation. CTWS responded and requested that they be consulted during the planning phase of the project. Bonneville would conduct site-specific NHPA Section 106 consultation as appropriate during the project planning phase.

3.2 Scoping Meeting

A scoping meeting was held on October 18, 2018, at the Pine Grove Grange (2835 Van Horn Drive, Hood River, Oregon). Presenters at the meeting included Tom Makowski, NRCS; Kate Hart, Farmers Conservation Alliance (FCA); and Alexis Vaivoda, FCA. The presentations covered the financial assistance available through PL 83-566, the project purpose and need, the Plan-EA process, and ways in which the public could get involved. After the presentations, attendees asked questions and provided comments for the public record. A total of 36 people attended the meeting, excluding staff from EFID, NRCS, and FCA.

3.3 Section Scoping Comments

Scoping comments were accepted from October 3 to November 16, 2018. Comments were submitted via the following methods: at the public meeting and by email, online comment, mail, and phone.

Comments generally supported the project. Table 3-1 presents comment topics received and where they are addressed in this Plan-EA.

Table 3-1. Public Scoping Comment Summary.

Comment Topic	Section Where Topic is Discussed
Concern for the effect on District water rates	Section 8.6.6
Request for water meters on farm	Section 6.11.2
Request for on-farm water conservation	Section 5.2.1
Request for reservoir storage	Reservoir storage is not part of the proposed action. See Section 4.7.
Effect of project on silt levels in delivered irrigation water	Section 5.3.2
Whether enough sediment would be removed to use micro sprinklers and other on-farm efficiency projects	Section 5.2.1
Concern regarding sediment settling in pipes	Section 5.3.2
Concern for wildlife finding water sources once canals are piped	Section 6.10
Concern for stormwater, especially on the eastside	Section 6.7
Concern for vegetation along the project, especially mature trees	Section 6.5
Request to coordinate construction on the eastside with Crystal Springs Water District piping project	Section 6.11.3.2
Concern for seismic resilience of the project	Section 6.3.2
Request for information about the type of patron turnouts to be installed	Section 5.3.2
Concern whether relatively recently installed pipe needs to be replaced, especially Dethman Ridge Line and Paasch Pipeline, and if pressure reducing valves (PRVs) could be used instead	A review of the Paasch Pipeline in July 2019 determined that PRVs along the existing piping would not be adequate for pressurized deliveries. The Dethman Ridge Line would be reviewed during engineering design for Project Group 3.
Concern about using HDPE pipe	Section 5.3.2
Request to pipe Main Canal all the way to the diversion for future hydropower needs	Section 5.3.2
Request to include Hood River Residents Committee and Oregon Watershed Enhancement Board as interested parties	Section 7.1

3.4 Identification of Resource Concerns

Table 3-2 provides a summary of resource concerns identified through scoping and their relevancy to the proposed action. Resources determined not relevant were eliminated from detailed study; resources determined to be relevant have been carried forward for analysis.

Table 3-2. Summary of Resource Concerns for the East Fork Irrigation District Infrastructure Modernization Project.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Air			
Air Quality		X	Oregon Department of Environmental Quality (ODEQ) air quality data indicates that the entire project area is in attainment for all criteria pollutants. Emissions from equipment associated with construction activities would occur; however, such emissions are considered negligible when compared to background levels and the application of best management practices (BMPs).
Geology and Soils			
Geology		X	No relevant impact to geology.
Soils		X	No relevant impact to soils. With implementation of BMPs, any impacts during construction would be temporary.
Prime Farmlands		X	The project does not involve any change in land use or conversion of farmlands for development or construction of infrastructure.
Human Environment			
Environmental Justice	X		This project could improve instream habitat for Pacific salmon, Pacific lamprey, and tribal trust and treaty fisheries resources of the CTWS.
Cultural Resources	X		Consultation with the State Historic Preservation Office (SHPO) is required for compliance with Section 106 of the NHPA.
Land Use	X		Construction and operation of the project could affect land use.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
National Parks, Monuments, and Parklands		X	None occur in the project area or would be affected by the project.
Noise		X	No relevant impact to noise. With implementation of BMPs, noise impacts during construction would be negligible and temporary.
Public Safety	X		Drowning risk in open canals could be beneficially affected.
Recreation Trails		X	No public recreation trails occur in the project area.
Visual Resources	X		Visual resources in the project area could be affected where open canals would be altered.
Socioeconomics			
Local and Regional Economy	X		The proposed action involves an expenditure of public funds that could affect the local and regional economy. An evaluation of the effects of providing NRCS funding is included.
National Economic Efficiency (NEE)	X		A NEE analysis has been completed (see Appendix D) as required by the 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.
Vegetation			
Invasive Species/Noxious Weeds		X	No relevant impact. With implementation of BMPs, the spread of noxious weeds during construction would be avoided.
Mature Trees	X		Direct and indirect effects on mature trees could occur.
Special Status/Threatened or Endangered Species		X	None have been observed in the project area, and no designated critical habitat occurs in that area.
Water			
Coastal Zones		X	None present.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Coral Reefs		X	None present.
Floodplain Management	X		Construction and operation of the sedimentation basin would occur in the 100-year floodplain.
Groundwater Quantity, Aquifer Recharge	X		Construction and operation of the project could affect recharge.
Hydrology	X		A change in end spills and seepage, as well as water conserved instream, could affect hydrology.
Private Water Features and Ponds		X	The proposed action would not remove or modify private water features or ponds.
Surface Water Quality	X		The proposed action could affect surface water quality by increasing river flows and by eliminating end spills.
Water Leasing		X	The proposed action would not affect patron leasing options.
Water Rights	X		The proposed action could indirectly affect water rights through use of the Allocation of Conserved Water Program.
Wild and Scenic Rivers		X	None present in the vicinity of District operations.
Wetlands and Riparian Areas			
Wetlands and Riparian Areas	X		Non-jurisdictional wetlands and riparian areas could be affected by the project.
Fish and Wildlife			
Migratory Birds and Eagles	X		Migratory birds and eagles could occur within the project area.
Endangered Species	X		Steelhead, bull trout, coho, and Chinook are known to occur in waterbodies that would be affected by the project.
Essential Fish Habitat (EFH)		X	Since the project would not adversely affect EFH, consultation under the Magnuson Stevens Act is not expected to be required.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Fish and Fish Habitat	X		The proposed action could affect fish habitat in the waterbodies associated with District operations.
General Wildlife and Wildlife Habitat	X		Construction and operation of project components could affect wildlife in the vicinity of District operations.
Ecosystem Services			
Provisioning Services	X		Provisioning services supported by water quantity, quality, and availability could be impacted by the proposed action.
Regulating Services	X		Regulating services supported by water quantity, quality, and availability could be impacted by the proposed action.
Cultural Services	X		Cultural services supported by water quantity, quality, and availability could be impacted by the proposed action.

4 Affected Environment

The following sections describe the existing ecological, physical, biological, economic, and social environment of the project area and areas that could be affected by operation of the EFID system. The project area is defined in Section 1.2.

Per requirements of the PR&Gs, where applicable, the ecosystem services associated with each resource are described. Ecosystem services refer to the benefits that people and their communities derive from their natural environment in which they live. Contributions to water consumption, buffering against crop failure through pollination, and providing places in which people value living are all examples of benefits that flow from nature to people. Because these ecosystem services contribute to people's "health, wealth, and well-being," but often cannot be quantified in the same way as services sold in marketplaces, federal investment into projects that could impact ecosystems and natural resources require an ecosystem services assessment to illuminate how management decisions will enhance, sustain, or degrade the benefits that nature provides (USDA 2017; Olander et al. 2018). An assessment of links between ecological function and social well-being helps ensure that beneficial and detrimental ecological impacts of a project are recognized and that detrimental impacts are minimized to the extent possible (EEA 2019).

Per federal guidance, ecosystem services in this Plan-EA are assessed based on three of the four service categories (USDA 2017):

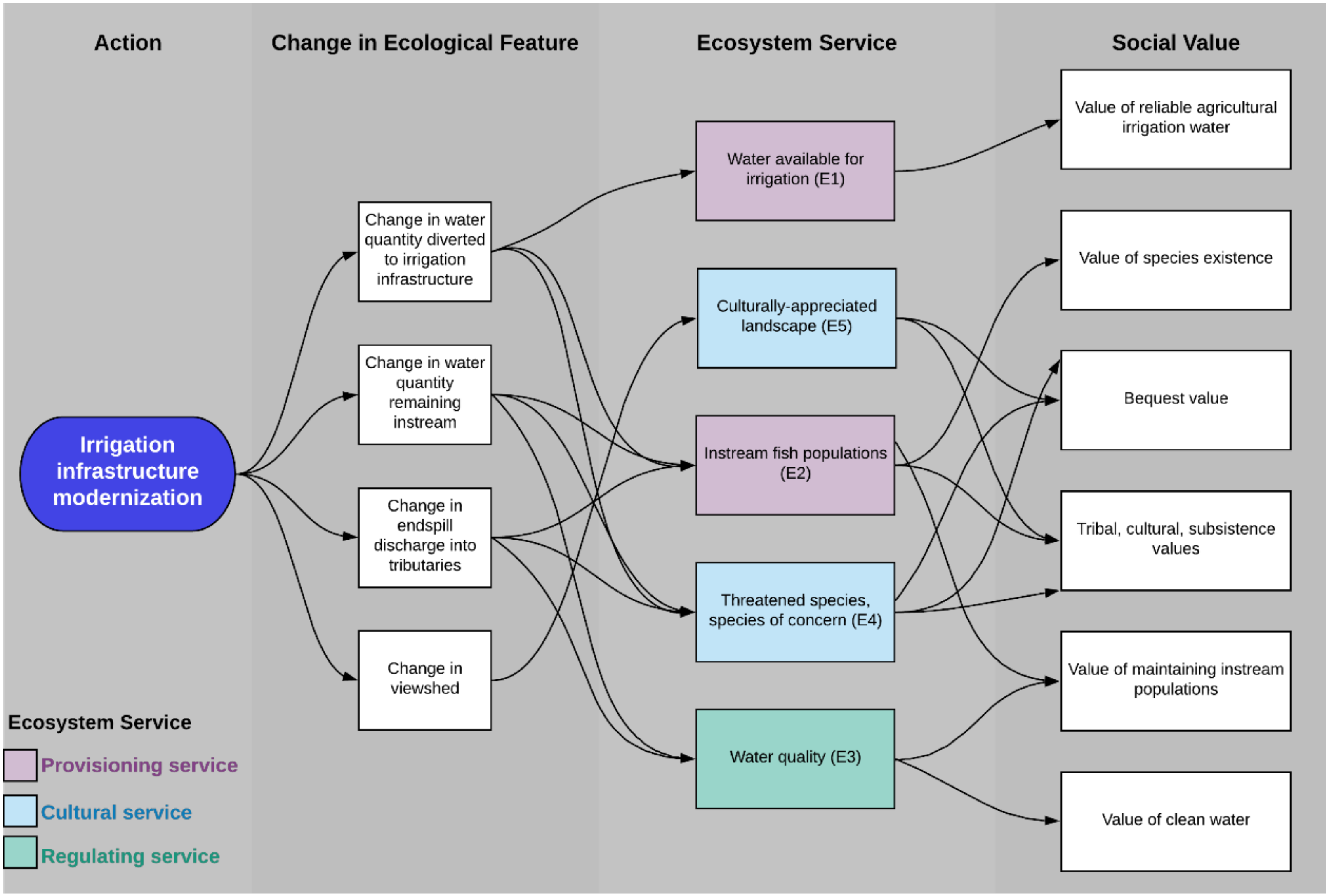
(1) Provisioning services: tangible goods provided for direct human use and consumption, such as food, fiber, water, timber or biomass;

(2) Regulating services: services that maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe—examples include flood and disease control, water filtration, climate stabilization, or crop pollination;

(3) Cultural services: services that make the world a place in which people want to live—examples include spiritual, aesthetic viewsheds, or tribal values; and

(4) Supporting services: services that refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production.

Supporting services are not evaluated in this Plan-EA because they give rise to and support the other three service categories (EEA 2019; USDA 2017). Figure 4-1. provides a concept diagram that highlights the ecosystem services that interact with District operations and provides a baseline for discussion in Section 6. The diagram links an action that would modernize District infrastructure with potentially impacted ecosystem features and the provisioning, regulating, and cultural services that these ecosystems provide to people.



Note: E1 to E5 refer to ecosystem services 1 to 5. These services are referenced and explained in more detail throughout Sections 4 and 6.

Figure 4-1. Ecosystem services concept diagram for the East Fork Irrigation District Infrastructure Modernization Project.

4.1 Cultural Resources

Section 106 of the NHPA requires federal agencies to consider the effects of federally funded projects on historic properties, commonly referred to as cultural resources, prior to the expenditure of federal funds. The NHPA defines an historic property as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property or resource" (ACHP 2019).

4.1.1 Cultural Context

EFID is eligible for inclusion in the NRHP as an Historic District under Criterion A (36 CFR 60.4(a)) for its association with the development of irrigated agriculture in the Hood River region. Additionally, EFID is eligible for inclusion in the NRHP under Criterion C (36 CFR 60.4(c)) as a "significant and distinguishable entity whose individual components may lack individual distinction" (NPS 1995).[8] The period of significance for EFID ranges from 1914 to 1917, when the majority of the EFID system was planned and built. This includes the system that EFID acquired from the East Fork Irrigation Canal Company in 1914.

4.1.2 Types of Impacts from Infrastructure Modernization

Each agency—or lead agency if a multi-agency project—would determine effects on historic properties for each of the site-specific projects and would consult with affected tribes and other parties to satisfy the NHPA requirements. During the design and development of these site-specific projects, measures to avoid, minimize, and mitigate effects on properties on or eligible for listing on the NRHP would be considered. Each agency would comply with Section 106 of the NHPA and any other applicable state or federal cultural resources laws.

The modernization actions envisioned in this Plan-EA include those noted in Section 5.3.2. These actions could impact both buried and aboveground cultural resources.

4.1.3 Cultural Surveys

A pedestrian survey and shovel tests for archaeological resources were completed for the EC by Archaeological Investigations Northwest, Inc. in 2019. The survey identified one refuse scatter of fragmented glass, four historic-period isolates, and one pre-contact isolate; all are recommended to be not eligible for listing in the NRHP (AINW 2019). SHPO reviewed the survey and concurred that the "project will likely have no effect on any significant archaeological objects or sites" (Appendix E). An aboveground survey of the EC for any historical resources is in development, as well as aboveground and belowground surveys of the DVC.

As mitigation for previous adverse effects within EFID, Bonneville will conduct an Intensive Level Survey to document the Main Line (Main Canal) of EFID and its associated features. The survey will identify and document construction dates, material types, and eligibility. The survey will also include an evaluation of significance and integrity, and make a determination of eligibility for the

[8] Concurred by the Oregon State Historic Preservation Office (SHPO) on May 1, 2013 (Case No. 12-1871).

Main Canal. Because the Main Canal forms the core of the District's conveyance system, a determination for the Main Canal will affect the eligibility of the remaining canals and laterals in the District. The Main Canal has been extensively altered over the years, which may make it ineligible. If the Main Canal is deemed ineligible by Bonneville cultural resource specialists, and the State Historic Preservation Office (SHPO) concurs, then the remainder of the District's system could also likely be ineligible as a whole.

4.2 Land Use

4.2.1 Land Ownership

Within the project area, EFID's easements traverse lands that are primarily privately owned. The majority of the project area (88 percent) is adjacent to privately owned land (Figure 4-2.). Approximately 3.3 miles of the project area cross public land managed by Hood River County. Small sections of land managed by the Hood River Valley Parks and Recreation, State of Oregon, and federal government are also crossed by the project. Approximately 3.9 miles of the project area is within the Columbia River Gorge National Scenic Area.

4.2.2 Land Uses

Land use within the project area consists of the conveyance of irrigation water and O&M of the irrigation water conveyance system. The proposed action crosses and is adjacent to a combination of agricultural lands, non-cultivated lands, and developed use. Appendix E provides a detailed breakdown of the proposed action lengths crossing different land use classes.

The majority of EFID patrons irrigate parcels smaller than 5 acres that are primarily zoned by Hood River County as Exclusive Farm Use (EFU).[9] Appendix E provides a summary of the water users by acres served within the District. The primary crops grown in the District are pears, cherries, and apples (see Section 4.4.3).

[9] The EFU designation is meant to preserve and maintain Oregon's agricultural lands and the benefits they provide. The county is required to inventory and protect farmlands under Statewide Goal 3, Agricultural Land, ORS 215 and Oregon Administrative Rule (OAR) 660-033.

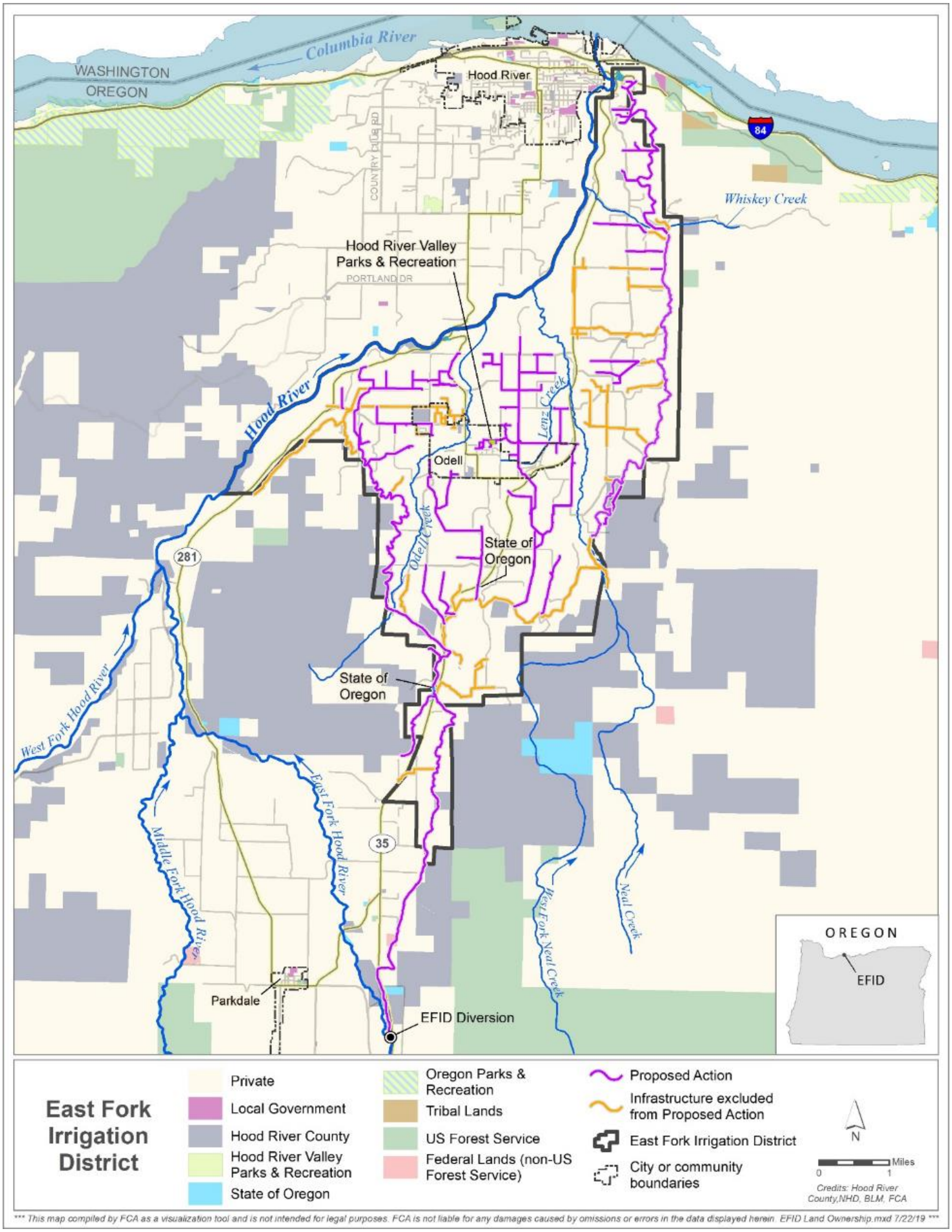


Figure 4-2. Land ownership within and in the vicinity of the East Fork Irrigation District.

4.3 Public Safety

The District has 17.9 miles of open canals. Although most of these canals are on private land, they are accessible to local residents, farmworkers, and in some areas to the public. Approximately 3.5 miles of the open canal segments border county-owned forest land that is open to the public for hunting and other outdoor recreation. Open canals pose a risk to public safety when they carry water. Water depths in the District's canals range between 2 to 4 feet during the irrigation season, with velocities up to 5 feet per second.

These conditions make it difficult for a healthy, strong adult to stand in or climb out of a canal without assistance. A child or non-/weak swimmer would have a higher risk of drowning in a canal with these attributes. If a person or animal falls into a canal, they could have serious difficulty gaining a hold on the banks to climb out to safety. Two drownings occurred in EFID canals in the 1980s involving the death of a child and an adult in two separate incidents (J. Buckley, EFID Manager, personal communication, September 24, 2018). Barriers or fences on the banks of the canals are not currently installed.

4.4 Socioeconomic Resources

4.4.1 Population

Hood River County experienced consistent population growth from 2010 to 2017 (Table 4-1). During this time, the county grew by 4.6 percent, while the state had a growth rate of 8.1 percent (U.S. Census Bureau 2017). Oregon Office of Economic Analysis estimates that by 2050, Hood River County could reach a population of 36,066 (OEA 2013).

4.4.2 Area Employment and Income

Table 4-2 presents the labor force characteristics for Hood River County and the State of Oregon in 2017. Unemployment in Hood River County is less than the state average by half a percent. Educational services, health care, and social assistance consist of 20 percent of the employment rate in Hood River County, while agriculture, forestry, fishing and hunting and mining make up 16 percent (U.S. Census Bureau 2017).

Household income and persons living in poverty are summarized in Table 4-3. Information is presented for two income indicators: median household income and per capita income. The median household income in Hood River County in 2017 was $63,951, which is higher than the median income in the State of Oregon and the United States. The percentage of persons living in poverty in Hood River County was less than the State of Oregon and the United States.

Table 4-1. Population Characteristics by City, County, and State.

Area	Year 2010 Population[1]	Year 2017 Population[2]	Population Growth 2010 to 2017 (%)	Year 2050 Population Forecast[3]	Population Growth 2017 to 2050 (%)
Hood River County	22,346	23,377	4.6%	36,066	54%
Cities and Towns					
Hood River	7,113	7,686	8.1%	--	--
Odell	2,255	2,478[4]	9.9%	--	--
Parkdale	311	528[4]	70%	--	--
State					
Oregon	3,831,072	4,142,776	8.1%	5,588,500	35%

[1] Source: U.S. Census Bureau 2010
[2] Source: U.S. Census Bureau 2017
[3] Source: OEA 2013 (forecasts for Oregon Cities and Towns were not available)
[4] Population for Odell and Parkdale were not available for 2017 (2016 data is shown)

Table 4-2. Labor Force Characteristics in Hood River County and the State of Oregon, 2017.

Indicator	Hood River County	Oregon (State)
Labor Force	14,359	2,103,478
Employed	13,841	2,016,722
Unemployed	518	86,757
Unemployment Rate	3.6%	4.1%

Source: U.S. Bureau of Labor Statistics 2017

Table 4-3. Income and Poverty Rates in Hood River County, Oregon State, and United States, 2017.

Indicator	Hood River County	Oregon (State)	United States
Median Household Income	$63,951	$60,123	$60,336
Per Capita Income	$29,595	$30,410	$31,177
Persons in Poverty	10.6%	13.2%	13.4%

Source: U.S. Census Bureau 2017

4.4.3 Agricultural Statistics

Hood River County is the world's leading producer of Anjou pears (Oregon Encyclopedia 2019). In 2012, total agricultural product sales in Hood River County was $77,117,000 (Table 4-4; USDA 2012). Tree fruits including pears, apples, and cherries represented 94 percent of the total market value of products, and the average farm size was 47 acres. Within EFID, the most recent survey of crop types from 2008 to 2009 indicates that orchards (pears, cherries, apples) comprise approximately 75 percent of the irrigated acres (Table 4-5; EFID 2011).

Table 4-4. Agricultural Statistics for Hood River County.

Agricultural Statistic	2007	2012	Percent Change
Number of Farms	553	554	0%
Land in Farms (acres)	26,952	25,817	-4%
Average Size of Farm (acres)	49	47	-4%
Market Value of Products Sold	$100,440,000	$77,117,000	-23%
Average Sales per Farm	$181,663	$139,200	-23%

Source: USDA 2012

Table 4-5. Crops Grown in East Fork Irrigation District.

Crop	Area (acres)[1]	Area (percent)
Pears	5,290	56%
Cherries	900	10%
Apples	880	9%
Blueberries	62	1%
Grapes	21	<0.25%
Grass, Pasture, Hay	1,450	15%
Other Orchards	100	1%
Urban and Schools Landscaping	750	8%
Total	**9,453**	**100%**

[1] Acreage from 2009 (EFID 2011)

4.5 Vegetation

4.5.1 General Vegetation

The District lies along the eastern foothills of the Cascade Mountains in the Columbia River Gorge, where native vegetation is characterized by Oregon white oak, ponderosa pine, and Douglas fir. Over the past century, agricultural land use has changed much of the native vegetation within EFID; as a result, the dominant upland vegetation today consists of fruit trees and pasture grasses. A mix of shrublands, grasslands, and Douglas fir, ponderosa pine, and white oak woodlands is common in undeveloped uplands along the District's borders.

Within the canals and pipeline corridors in the project area, the type and density of vegetation varies widely from forest and brush to cultivated crops and grasses (Figure 4-3.). Common vegetation includes native trees and shrubs including Ponderosa pine, Douglas fir, vine maple, Oregon grape, snowberry, and other plants as well as non-native plants such as reed canary grass, knapweed, and blackberry (Table 4-6). An unpaved maintenance access road limits vegetation alongside one bank of most EFID canals. In scattered locations, native hydrophytic (water tolerant) plants may be present along the margins of the canal banks represented by such species as black cottonwood, willow, and rushes. These areas do not function as a wetland habitat type due in part to maintenance activities including annual removal of trees, tree branches, and brush along canals and ditches. During the non-irrigation season, the District canals are maintained by grading, clearing, excavation, and bank repairs, and no vegetation is allowed to develop within the canals. Any fallen trees are removed by the District from its easement area to ensure maintenance access.

Vegetation types commonly found along the buried pipelines and associated easement areas within the project area consist of grass and cultivated crops (mostly pear trees). Orchards occupy or border a substantial portion of the project area. Typically, buried pipelines passing through orchards are overlain by mowed grass or a dirt track. No plant species that are federally listed or state listed as endangered or threatened, their designated critical habitats, or species of concern are known to occur within the project area.

Figure 4-3. Examples of vegetation along the Eastside Canal (left photo) and Main Canal (right photo) in the East Fork Irrigation District.

Table 4-6. General Vegetation within East Fork Irrigation District.

Vegetation Species	Scientific Name
Big leaf maple	*Acer macrophyllum*
Black Cottonwood	*Populus balsamifera*
Douglas fir	*Pseudotsuga menziesii*
Douglas spirea	*Spiraea douglasii*
Lodgepole pine	*Pinus contorta*
Oregon grape	*Mahonia aquifolium*
Oregon white oak	*Quercus garryana*
Ponderosa pine	*Pinus ponderosa*
Red alder	*Alnus rubra*
Reed canary grass (non-native)	*Phalaris arundinacea*
Snowberry	*Symphoricarpos albus*
Vine maple	*Acer circinatum*
Willow	*Salix spp.*

Source: C. Mead, Mount Hood National Forest Eastside Botanist U.S. Forest Service, personal communication, July 26, 2018

4.6 Visual Resources

4.6.1 Regional Context

The District is located in the Hood River Valley, which is dominated by the 11,249-foot snow-covered peak of Mount Hood and expanses of orchard trees. The Hood River Valley is bordered by dry grassy slopes of the Hood River Mountains to the east and the evergreen forests of the Cascade Mountain Range to the west. The Hood River Valley is well known for its scenic orchards where the fruit tree bloom lasts several weeks in April and May, drawing visitors from miles around. The northern border of EFID is within the Columbia River Gorge National Scenic Area. Designated by Congress in 1986, the Columbia River Gorge National Scenic Area is known for numerous waterfalls and for forest, mountain, and river views shaped by its geologic history. Its scenery includes rain forests, farmlands, and semi-arid grasslands.

4.6.2 Project Area and Adjacent Landscape

The District's open canals generally lie flat against the landscape or a few feet lower than the landscape level. Within the project area, vegetation growing adjacent to canals and laterals can obscure the view of water flowing in the canals. Throughout the agricultural lands, the visual characteristics of the existing canals and lateral alignments varies. In most areas, the canal features are obscured by vegetation, or are hidden by sloping terrain or located at the back of larger agricultural tracts or residential properties. Most of the District's open canals are visible to the public only at a few road crossings or sporadically alongside minor roadways (Figure 4-4.). In one area, an open canal segment is a visible water feature adjacent to the outdoor seating area of a restaurant.

Although the canals are not naturally formed waterways, some residents consider the presence of open channels with flowing water to be an amenity that provides a unique water feature on or near their property or an enjoyable view when those residents walk along the District's maintenance roads and trails. The vast majority of the proposed project would occur on private lands where the District operates under easements that were grated for maintaining irrigation infrastructure and conveying irrigation water only. Public use of the property alongside the District's canals and laterals is not a purpose of the District's easements and occurs at the discretion of each property owner.

Viewers' experiences of open canals differ throughout the year. The District's irrigation season extends from mid-April through September, although water is diverted for frost control and spray purposes in March and October. During these months, the District's canals convey irrigation water. From November through February, the canals do not convey irrigation water. In some locations, water may remain in the District's canals during the non-irrigation season due to water pooling in low-lying areas and inputs from precipitation, snowmelt, springs, or other sources.

The District's pipelines are buried, and the associated pipeline corridors are generally indistinguishable from adjacent landscape features.

The existing open canal system provides the following ecosystem service for the private property owners that live along the project area:

Cultural Service, Culturally Appreciated Landscape (Figure 4-1 [E5]): People's values for landscapes may arise from personal use (i.e., enjoying the area for recreation, scenic quality, or the environmental value it provides), personal beliefs and moral ethics (i.e., believe protecting a natural area is the right thing to do), altruism (i.e., believing a resource should be protected so that others can use it or benefit from it), and/or a desire to bequest the resource (i.e., believing a resource should be protected for future generations). Although the canals were constructed and are annually maintained to convey irrigation water, some private landowners living adjacent to the project area view the open canals as a natural feature of the landscape. They derive value by walking along the canals, from the scenic quality of the canals, and from the habitat it can provide to wildlife (see Section 4.10 for further discussion).

Source: Google Earth Pro v. 7.3.2.5776; imagery date 9/3/2018

Figure 4-4. The Eastside Canal along Wells Drive and orchards in the East Fork Irrigation District.

4.7 Water Resources

The primary demands on water resources in the Hood River basin include irrigation; potable water; hydropower; protection of aquatic life, particularly for ESA-listed fish; recreation; and scenic value. There are five irrigation districts in the basin, of which EFID is the largest. Potable water supply is provided from stream or spring sources and domestic wells, including municipal water supplies of the cities of The Dalles and Hood River, and operations of smaller utilities and water districts serving rural communities. Laurance Lake Reservoir in the Middle Fork Hood River subbasin is the largest of three major reservoirs in the basin with a volume of 3,565 acre-feet storage for irrigation (Reclamation 2015). The others are Kingsley and Lower Green Point reservoirs. The three reservoirs have a combined capacity of 4,553 acre-feet, or less than 1 percent, of the basin's average annual discharge. None of these reservoirs are associated with EFID operations.

Hydrologic conditions in the Hood River have changed with the construction and operation of reservoirs and diversions on the river and its tributaries. Water management, primarily for irrigation, reduces natural streamflow downstream from reservoirs during the storage season (i.e., late fall, winter, and early spring) and downstream from diversions during the irrigation season (late spring to early fall). The total estimated consumptive diversion during the peak summer irrigation season is 296 cfs, or 40 percent, of the average natural flow of the Hood River (Stampfli 2008).

EFID's water supply comes from the diversion of live flow of the East Fork Hood River. The District has no reservoir storage facilities and relies on natural streamflow produced by snow and glacial meltwater on Mount Hood and spring sources. Drought has limited the irrigation water supply in 3 of the last 14 years, when the District has asked patrons to voluntarily curtail water use to help the District keep water in the East Fork Hood River downstream of the diversion for threatened salmon and steelhead.[10] Curtailment of water delivery by 25 percent has begun as early as mid-July and extended throughout the peak summer demand period.

The waterbodies that are affected by EFID operations are shown in Table 4-7 and Figure 4-5. The District's diversion affects a total of 21.2 river miles: 6.6 river miles in the East Fork Hood River (RM 6.6 to RM 0) and 14.6 river miles in the Hood River from the confluence of the East Fork Hood River and Middle Fork Hood River to the Columbia River (RM 14.6 to RM 0). During the irrigation season, the District maintains end spills at approximately 25 locations. These end spills are piped to natural drainages and streams within the basin. While most end spills have a small flow rate, the District maintains end spills of 1 cfs or more at 7 locations. These larger end spills affect a total of approximately 13.4 river miles in 5 tributaries to the lower Hood River (Table 4-8).

Water flowing through the East Fork Hood provides the following ecosystem services:

- *Provisioning Service, Irrigation Water (Figure 4-1 [E1])*: As described in Sections 1.3 and 4.7.1, water from the East Fork Hood River is diverted into the District's irrigation conveyance system and delivered to patrons for agricultural purposes. Water of the East Fork Hood River is primarily generated from annual snow and glacial melt on Mount Hood. As Mount Hood glaciers continue to recede and associated snowpack lessens, water as a provisioning service for the District will become scarcer and water curtailment may increase.

- *Regulating Service, Water Quality (Figure 4-1 [E3]):* The amount of water instream impacts water quality including temperature, turbidity, sediment, and pollutants. In general, low streamflow challenges a waterbody's ability to resist warming because less water heats faster than more water. Because of this property, greater instream flow helps to keep water cool—an important factor for temperature sensitive, aquatic species living in these stream habitats (Section 4.8). Given pollutant input, less water also leads to higher concentration of pollutants than does more water. Therefore, greater streamflow also helps to dilute pollutants. However, while increasing streamflow generally improves water quality, an increase in streamflow from low quality end spills can be counterproductive if the quality of water spilled is low. Open irrigation canals can collect contaminants, including sediment and pollutants, and can become warmer than nearby waterbodies due to low volume in the canals. This provides a source for heat and contaminant transfer into waterbodies, resulting in lower stream water quality. Section 4.7.3 describes surface water quality in the waterbodies associated with District operations.

[10] Through past conservation projects and requested voluntary curtailment by patrons, EFID was able to maintain at least 15 cfs in the river at its diversion during the 2015 and 2018 droughts, and 5 cfs during the 2005 drought.

Table 4-7. Waterbodies Associated with District Operations.

Name	Reach	Tributary to	Relationship to District Operations
East Fork Hood River	East Fork Hood River from the EFID diversion at RM 6.6 to its confluence with the Middle Fork Hood River	Hood River	Diversion of up to 117.36 cfs affects streamflow and water quality in this reach.
Hood River	Hood River from Middle Fork Hood River (RM 14.6) to mouth	Columbia River	Diversion of up to 117.36 cfs affects streamflow and water quality in this reach.
West Fork Neal Creek	West Fork Neal Creek from RM 1.8 to confluence with Neal Creek	Neal Creek	End spill affects streamflow and water quality in this reach.
Neal Creek	Neal Creek from West Fork Neal Creek confluence (RM 5.8) to mouth	Hood River	End spill affects streamflow and water quality in this reach.
Odell Creek	Odell Creek from RM 2.3 to mouth[1]	Hood River	End spill affects streamflow and water quality in this reach.
Whiskey Creek	Whiskey Creek from RM 1.3 to mouth	Hood River	End spill affects streamflow and water quality in this reach.
Lenz Creek	Lenz Creek from RM 1.2 to mouth[1]	Neal Creek	End spill affects streamflow and water quality in this reach.

[1] Affected stream miles are approximate.

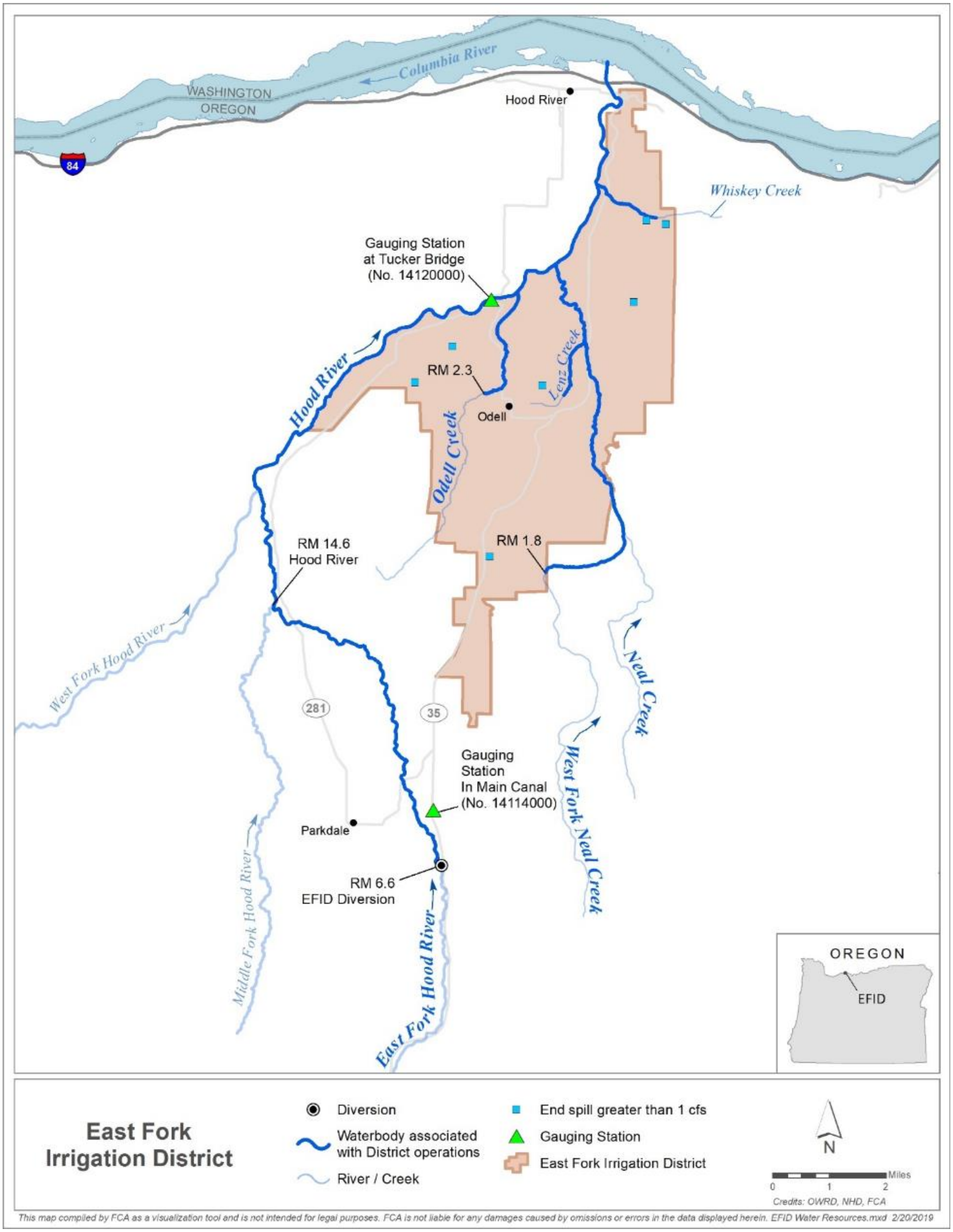


Figure 4-5. Waterbodies associated with District operations and locations of streamflow gaging stations.

Table 4-8. Major End Spills in Waterbodies Associated with EFID Operations.

Overflow Box Name	Receiving Waterbody	Affected River Miles	Average End Spill Rate (cfs) (year measured)	Average September Streamflow (cfs) (period of record)
Central Distribution	West Fork Neal Creek	RM 1.8 to RM 0	4.72 (2016)	Data not available
Eastside	Neal Creek	RM 5.8 to RM 0	1.50 (2016)	22 (2010- 2014)
Dethman	Lenz Creek	RM 1.3 to RM 0 (approximate)	3.02 (2016) 2.40 (2017)	Data not available
Whiskey Creek	Whiskey Creek	RM 1.3 to RM 0	2.99 (2016)	Data not available
Stricker	Whiskey Creek	RM 1 to RM 0	0.35 (2017)	Data not available
Marsh-Chamberlin	Odell Creek	RM 2.3 to RM 0 (approx.)	1.93 (2016)	11 (2011-2018)
Chamberlin Drive	Hood River	RM 7.2 to RM 0	1.10 (2016) 1.17 (2017)	308 (1989-2018)

Sources: FCA 2018a; Megan McKim, CTWS, unpublished streamflow data for Neal and Odell creek; U.S. Geological Survey (USGS) Surface-Water Monthly Statistics for Oregon, USGS 14120000 Hood River at Tucker Bridge near Hood River, Oregon

4.7.1 Water Rights

4.7.1.1 District Water Rights

EFID diverts water from the East Fork Hood River for delivery to approximately 9,600 acres for agricultural, fire, and industrial purposes. The District also provides water for the MHID, which obtains up to 12.65 cfs from two locations along EFID's Main Canal under its own water rights. The authorized irrigation season is from April 15 to September 30. Peak irrigation demand occurs in July and August.

EFID is the largest and second-most senior water right holder on the East Fork Hood River.[11] The District holds 8 water rights on the East Fork Hood River that allow it to divert a total of 117.36 cfs of live flow for irrigation. Its largest single water right is for 104.5 cfs under Certificate 92000 with a priority date of November 25, 1895.

As noted previously, drought conditions have prompted a request for voluntary curtailment in EFID in 3 of the past 14 years (2005, 2015, and 2018). Had both EFID and MHID used their full legal water rights in late summer during the 2005 and 2015 droughts, the entire flow of the East Fork Hood River at the diversion would have been depleted.

[11] The City of The Dalles has a water right with a priority date of August 1, 1870, on Dog River, an East Fork Hood River tributary located upstream of the EFID diversion. The city has diverted up to 8.5 cfs during the summer for municipal and other purposes (Christensen and Salminen 2013).

4.7.1.2 Instream Water Rights

In 1987, the Oregon legislature passed the Instream Water Rights Act and created a legal framework to establish instream water rights for the maintenance and enhancement of aquatic and fish life, wildlife, recreation, and other public values. OWRD is the only entity that may hold instream rights in Oregon. However, instream rights can be gifted to the state by anyone with a valid water right looking to lease their water rights instream or gift their water rights to the state for permanent instream use (Golden and Aylward 2006; Oregon Administrative Rule [OAR] 690-077). The law also allows the respective state departments of fish and wildlife, environmental quality, and parks and recreation to apply for instream water rights.

Instream water rights have a priority date and are regulated in the same way as other water rights. They do not take away or impair any legally established water rights having an earlier priority date than the instream right (OAR 690-077) and do not guarantee that a certain quantity of water will be present in the stream. Instream water rights are established at seven locations in the Hood River basin; however, they are consistently met at only two locations due to the presence of other, out-of-stream water rights with earlier priority dates.

Instream rights created through permanent water right transfers have the same priority date as the original right that was transferred instream. OWRD's water transfers program allows for a variety of instream transfers, including permanent transfers, temporary transfers, leases, and transfers of conserved water. Transfers of conserved water are facilitated through Oregon's Allocation of Conserved Water Program (OAR 690-018). Such transfers associated with EFID water conservation projects in recent years have modified the District's water rights by allocating part of the conserved water to instream use in accordance with a District-approved conserved water policy. Over the past 11 years, the District has saved 3.3 cfs of water as a result of piping over 11 miles of open canals. As of January 2019, it has permanently protected 1.58 cfs of the water saved in the East Fork Hood River using the Oregon Allocation of Conserved Water Program.[12] An additional transfer of water is in progress that, when finalized, would allocate another 0.525 cfs of conserved water to instream use. Piping and other conservation projects have been completed by all five major irrigation districts in the Hood River basin in recent decades. These projects have generally led to increased summer streamflow in affected streams due to conserved water being managed instream by the irrigation districts; however, only a small portion of the water savings has been permanently protected instream.[13]

Four waterbodies affected by District operations have junior instream water rights established by the state or pending instream water right applications for public use, specifically for the beneficial use of fish life and wildlife (OWRD 2018a; Christensen and Salminen 2013) (Table 4-9). Further details are included in Appendix E. State instream water rights in the East Fork Hood River are typically not met from late July to October each year (Figures 4-6 and 4-7).

[12] Instream Water Right Certificate 86005 and 91999

[13] As of January 2019, 4.58 cfs of conserved water has been converted to an instream water right in the Hood River basin, with an additional 3.012 cfs pending (Teri Hranac, ORWD ACWP Administrator, personal communication, January 11, 2019).

Table 4-9. State Instream Water Rights in Waterbodies Associated with EFID Operations.

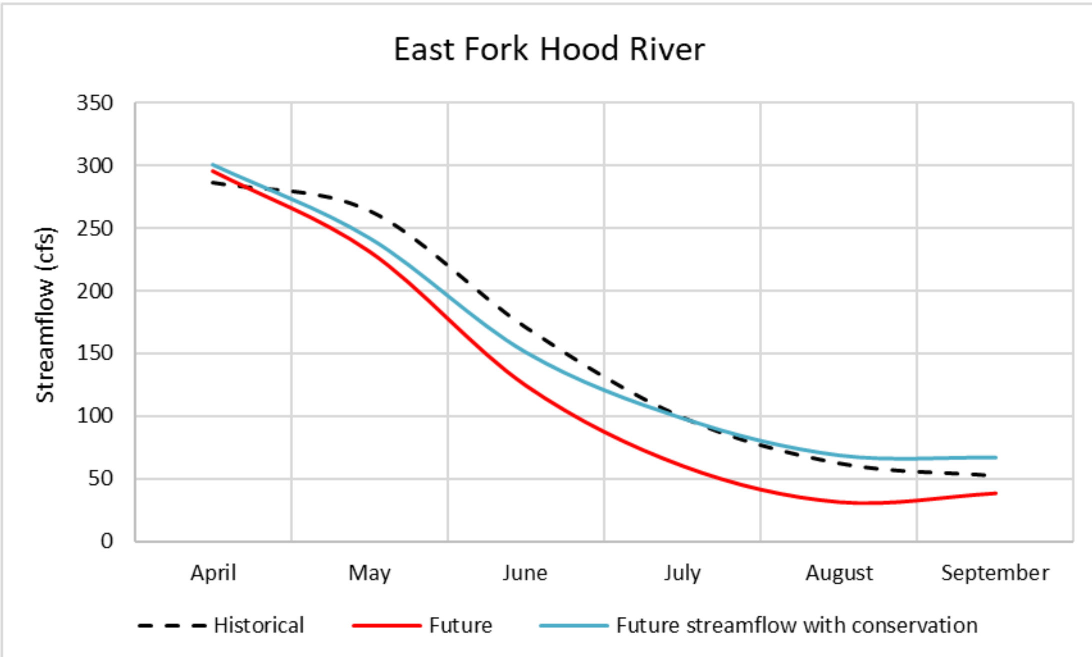
Waterbody	Certificate or Application	River Mile Location or Reach	Monthly Rate (cfs)	Priority Date
East Fork Hood River	Certificate #68457	RM 0 (at Middle Fork Hood River confluence)	100 to 150	November 3, 1983
East Fork Hood River	Application #IS-88322 (submitted by ODFW)	RM 0 (at Middle Fork Hood River confluence)	150 to 210	December 1, 2016
Hood River	Certificate #59679	RM 4.0 to RM 0	100 to 270	November 3, 1983
Hood River	Certificate #76155	RM 4.0 to RM 0	220 to 250 (May through October)	October 8, 1998
Neal Creek	Certificate #59681	RM 0 (at the mouth)	5 to 20	November 3, 1983

ODFW = Oregon Department of Fish and Wildlife

4.7.2 Surface Water Hydrology

The hydrology of the Hood River basin is characterized by highly variable streamflow and rapid runoff. The primary sources of surface water and springs are snowpack and glacial melt on Mount Hood. Snowmelt typically begins in April, while glacial melt contributing to streamflow generally occurs between July and October. Many basin tributaries have very low summer flows, while tributaries with glacial sources maintain higher flows. The average annual discharge in the Hood River is 930 cfs at Tucker Bridge (USGS 2019). The record flood at this gage is reported as 33,000 cfs (December 1964), while the minimum 7-day average streamflow was 155 cfs (September 1994) (ODA 2016).

Currently, streamflow in the basin is insufficient to meet competing demands for water during the summer months (Reclamation 2015). This imbalance is expected to be exacerbated by climate trends. Mount Hood's glaciers have been receding since the mid-1900s or earlier, including the Newton-Clark glacier in the headwaters of the East Fork Hood River. The aerial extent of snowpack on April 1 each year from 1920 through 2009 has decreased by approximately 5 percent every 30 years (Reclamation 2015). Glacial recession and declining snowpack are expected to continue as a result of the warmer air temperatures predicted with changing climate (Phillippe 2008; Reclamation 2015). Basin runoff is predicted to increase in fall and winter and decrease in spring and summer when water uses are greatest. In the East Fork Hood River, the modeled future decline in average streamflow for May through September approached 30 percent for the period 2030 to 2059 compared to the period 1980 to 2009 (Reclamation 2015). Warmer temperatures will cause earlier snowmelt and increase the speed of glacial melting. Glacial melt currently provides between 50 and 70 percent of the basin's streamflow during the critical summer water use period (Reclamation 2015). Once the Mount Hood glaciers fully recede, the basin will lose one of its largest water storage supplies (Reclamation 2015). Average streamflow in the lower East Fork Hood River under historic and future conditions is shown on Figure 4-6.. Future streamflow is based on the median climate change scenario developed by the U.S. Bureau of Reclamation (Reclamation 2015) and is shown with and without the proposed action and other likely conservation actions, including on-farm irrigation improvements.



Source: Salminen et al. 2016

Figure 4-6. Average historical summer streamflow and projected future streamflow in the lower East Fork Hood River below the EFID diversion based on climate simulations.

The following sections summarize surface water hydrology in the waterbodies associated with EFID operations.

4.7.2.1 East Fork Hood River

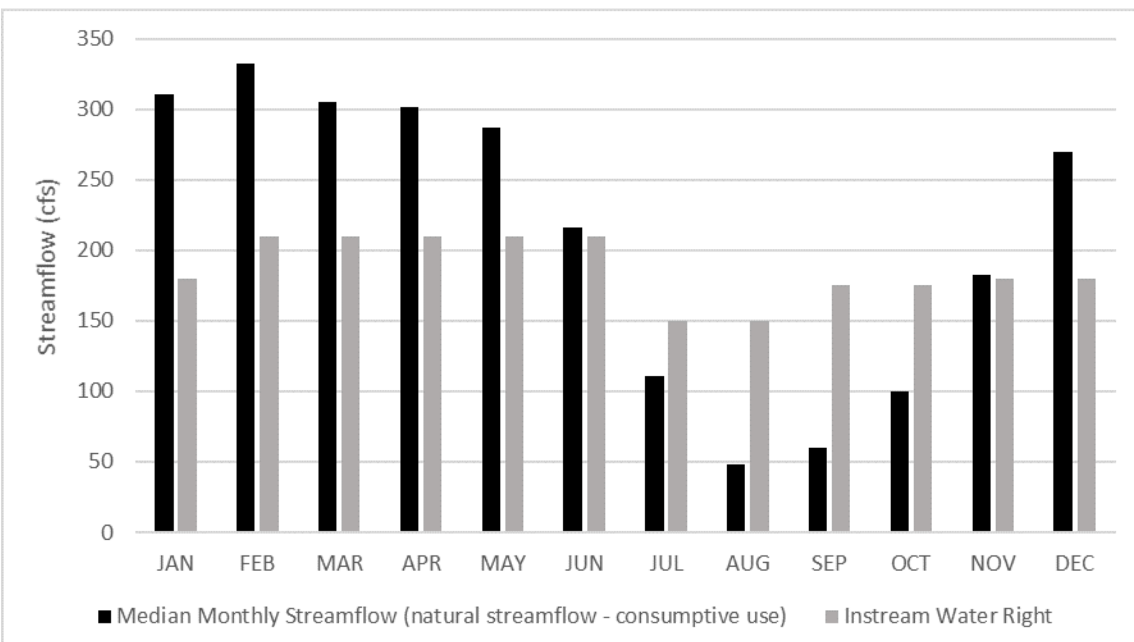
EFID's diversion reduces streamflow in the East Fork Hood River from the diversion to its Middle Fork Hood River confluence (RM 6.6 to RM 0). The river has no long-term stream gage; therefore, historical streamflow data is limited. Simulated natural monthly streamflow (i.e., without water diversions) at RM 0 averaged from 145 cfs in September to 383 cfs in March for water years 1980 through 2009 (Reclamation 2014a).

The District diverts up to 117.36 cfs and an annual average volume of 28,829 acre-feet of water for irrigation within EFID (FCA 2018a). During the late summer, EFID typically diverts approximately 75 percent, and up to 85 percent, of the available flow of the East Fork Hood River at the point of diversion. Streamflow is lowest in the bypass reach between the diversion structure and the point 0.5 mile downstream where a small portion of the diverted water returns to the river from the District's sand trap and fish screen facility.[14] Historically, the entire flow of the river could be

[14] The amount of diverted water returned to the river from the fish screens varies from approximately 5 cfs to 22 cfs, depending on the amount of water diverted.

diverted during drought periods, leaving the bypass reach dry and fish migration blocked. In 2013, a Memorandum of Understanding[15] between EFID and CTWS established an interim minimum instream flow of 15 cfs for the bypass reach, while a multi-year study of adult fish passage conditions in the bypass reach was conducted to identify a permanent minimum flow level. Although a final report is not available, this study identified that a minimum of 27 cfs is required to maintain fish passage for adult Chinook salmon in the bypass reach (J. Buckley, EFID Manager, personal communication, January 10, 2019). Since 2013, EFID has been able to maintain at least 15 cfs in the bypass reach through a combination of water saved from completed conservation projects and voluntary water use reduction by patrons during drought events.

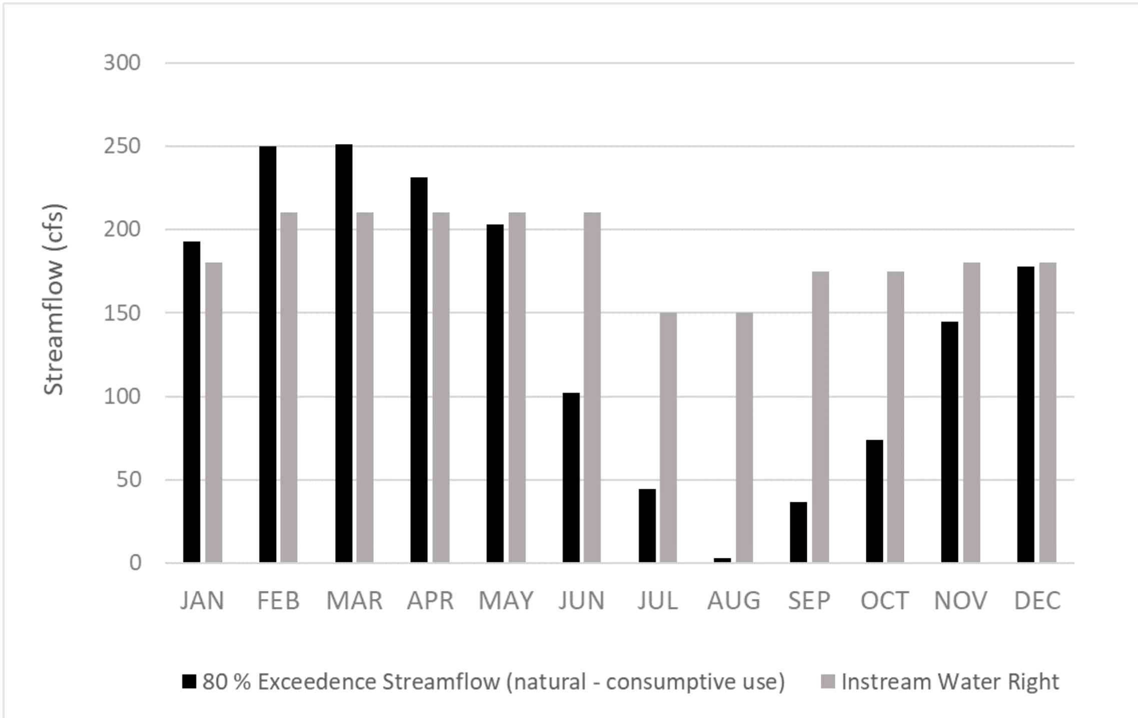
OWRD estimates of the monthly average streamflow at RM 0 under median (50 percent exceedance) and dry (80 percent exceedance) conditions are shown on Figure 4-6 and Figure 4-7 together with existing and pending state instream water rights. Streamflow measurements collected by the Oregon Department of Fish and Wildlife (ODFW) at RM 1 from 1996 to 2017 (Simpson 2018) indicate that the actual streamflow was greater than that estimated by OWRD; this is because OWRD estimates include the full use of all authorized consumptive water rights, a situation that does not always occur. For example, EFID has managed part of their water rights at times to remain instream past their diversion to benefit listed fish species.



Source: data from OWRD 2018a

Figure 4-7. Estimated median streamflow in the East Fork Hood River and state instream water rights at the Middle Fork Hood River confluence (RM 0).

[15] The Memorandum of Understanding was associated with a partnership project for the design and construction of new headworks facilities.



Source: data from OWRD 2018a

Figure 4-8. Estimated 80 percent exceedance monthly streamflow in the East Fork Hood River and state instream water rights at the Middle Fork Hood River confluence (RM 0).

4.7.2.2 Hood River

EFID's diversion of up to 117.36 cfs from the East Fork Hood River during the irrigation season also affects streamflow in the Hood River from the confluence of the East Fork Hood River and the Middle Fork Hood River to its mouth at the Columbia River (RM 14.6 to RM 0). The average monthly streamflow at the U.S. Geological Survey (USGS) gage No. 14120000 in Hood River at Tucker Bridge (RM 6) ranges from 303 cfs in September to 1,430 cfs in January for the years 1987 to 2016. The lowest average monthly flow in the Hood River during this period was 180 cfs in September 2005 during a severe drought year. Snowmelt generally begins during April.

4.7.2.3 EFID End Spill Overflows

An estimated 16.6 cfs of the water diverted by EFID is lost to end spills (overflows) that are maintained throughout the District to ensure that a continual water supply reaches all patrons (FCA 2018a). End spill is excess water that is discharged to natural drainages near the termination of an open canal, lateral, or unpressurized pipeline. End spill is required because the EFID conveyance system is predominantly an open canal system (Wharry 2016). Hydraulic modeling found that the District could save this water if its conveyance system was fully piped and pressurized (FCA 2018a). Piping projects completed in recent years have eliminated dozens of end spills in the District. Currently, approximately 25 end spills remain throughout EFID (J. Buckley, EFID Manager, personal communication, January 11, 2019). These end spills artificially augment streamflow in the receiving stream reaches during the irrigation season.

Discharge rates measured over the 2016 and 2017 irrigation season at the District's seven largest end spill locations and the associated receiving waterbodies are shown in Table 4-8. The end spill discharge rates at each overflow box were highly variable and were not correlated with the diversion rate (FCA 2018b). Minor, unmeasured end spill occurs at approximately 18 other locations.

4.7.2.4 EFID Canals and Stormwater

The District's open canals can affect local surface water hydrology by collecting and redirecting stormwater and snowmelt runoff during winter and spring months. This is known to occur in areas where the canals run along the foot of hillslopes and intercept numerous draws[16] or natural drainage channels with intermittent flow. In such locations, open canals can modify the natural surface water hydrology and reduce flooding on orchard, road, and rural residential properties that have been developed down gradient of the canals following canal construction.

The District maintains approximately 10 drains in the canals at the bottom of the draws consisting of large pipes or culverts. The drains are sealed off when the canals are running during irrigation season. At the end of the irrigation season, EFID opens the drains to protect the canals from winter damage and allow runoff to flow into natural drainage channels at the bottom of the draws. During an extreme flood event, the capacity of the canals and the drain culverts can be overwhelmed and flooding of property can occur. Affected roads have at times included areas along Oregon Route 35, Eastside Road, and Central Vale Road (J. Buckley, EFID Manager, personal communication, December 5, 2018).

4.7.3 Surface Water Quality

Under Section 303(d) of the Clean Water Act (CWA) (33 U.S.C. 1251 et seq.), the Oregon Department of Environmental Quality (ODEQ) is required to maintain a list of all surface waters in the state that are considered impaired because they do not meet water quality standards. These standards are set to protect designated beneficial uses. In the Hood River basin, beneficial uses include fish and aquatic life, irrigation, public and private domestic water supply, wildlife and hunting, hydropower, water contact recreation, fishing, boating, livestock watering, industrial use, and aesthetic quality (OAR 340-41-0160). The 2012 303(d) list is currently effective for CWA purposes. Six of the seven waterbodies affected by EFID's operations are included on Oregon's 303(d) list for not meeting water quality standards for one or more parameters (Table 4-10). Four of these waterbodies are identified as water quality limited for temperature by ODEQ, although the temperature listings were removed from the 303(d) list following the approval of ODEQ's 2001 Western Hood Total Maximum Daily Load study by the U.S. Environmental Protection Agency (USEPA).

[16] A draw is a terrain feature similar to a valley on a smaller scale; although it is perpendicular to the ridgeline. A draw is usually etched in a hillside by water flow and is usually dry, but may contain an ephemeral stream.

Table 4-10. Impaired Waterbodies Associated with District Operations.

Waterbody Name	Listed Reach (river miles)	Parameters Included on Oregon's 303(d) List	Water Quality Limited for Temperature
East Fork Hood River	RM 0 to RM 27.4	Beryllium, Biological Criteria, Copper, Iron, Thallium	Yes
Hood River	RM 0 to RM 14.6	Beryllium, Copper, Iron, Thallium	Yes
Lenz Creek	RM 0 to 1.8	Biological Criteria, Chlorpyrifos, Guthion, Iron, pH	No
Neal Creek	RM 0 to 5.6 RM 0 to 6.4 RM 0 to 11.1	Chlorpyrifos, Guthion, Iron Dissolved Oxygen Silver	Yes
West Fork Neal Creek	RM 0 to RM 9	Dissolved Oxygen	No
Whiskey Creek	RM 0 to RM 1.3	N/A	Yes

Source: ODEQ 2012; ODEQ 2017
N/A = not applicable

Water management in the Hood River basin for irrigation reduces streamflow in spring, summer, and early fall. Low streamflow can affect water quality by raising water temperatures, reducing dissolved oxygen, and increasing the concentration of pollutants. EFID's irrigation diversion reduces streamflow in the East Fork Hood River and the Hood River. Return flows known as end spills maintained by the District artificially increase streamflow during the irrigation season in several lower Hood River tributaries (Table 4-8). At the same time, these spills transfer glacial silt and heat to receiving streams, along with any contaminants such as pesticides and herbicides that may be present in canal water.

4.7.3.1 Temperature

Water temperature is one of the most important characteristics of an aquatic ecosystem, affecting dissolved oxygen levels, chemical processes, and the metabolism, growth, and reproduction of species. Many aquatic species can survive only within a limited temperature range. Temperatures above the water quality criteria that do not reach lethal levels are considered sub-lethal and can be stressful for cold water fish species such as salmon and trout and may lead to mortality. Fish mortality related to sub-lethal temperature effects is commonly attributed to the interaction of decreased metabolic energy for feeding, growth, or reproduction; increased exposure to pathogens (viruses, bacteria, and fungus), decreased food supply (impaired macroinvertebrate populations), and increased competition from warm water tolerant species (ODEQ 2001). Low streamflow can contribute to elevated water temperature. Other factors such as a lack of riparian vegetation and stream widening can also contribute to elevated stream temperatures.

Four streams affected by the District's diversion and end spills do not meet stream temperature criteria, including the East Fork Hood River, Hood River, Neal Creek, and Whiskey Creek (Table 4-10). The applicable temperature criteria for protection of salmonid fish rearing is 64.4 degrees Fahrenheit (ºF) in the East Fork Hood River, Whiskey Creek, and Neal Creek and 60.8 °F in the Hood River (ODEQ 2017). The 64.4 ºF criterion is typically exceeded in the East Fork Hood River during the summer, with 7-day average daily maximum temperatures reaching 68º F upstream of the Middle Fork Hood River confluence (ODEQ 2017). Irrigation diversion greatly reduces streamflow in the lower river during the summer, contributing to the warm temperatures. Modeling simulations conducted by ODEQ indicated that without EFID's diversion, the East Fork Hood River would be cooler by approximately 3.5 ºF above the confluence with the Middle Fork Hood River, and the Hood River at its mouth would be cooler by 2 ºF (ODEQ 2001).

End spills maintained by the District can increase temperatures in receiving streams. For example, continuous temperature monitoring during the 2009 to 2011 irrigation seasons found that the 7-day moving average daily maximum temperature in West Fork Neal Creek downstream of the EFID end spill discharge was approximately 5 °F warmer than the creek upstream of the discharge (Stampfli et al. 2012). During the study, the East Fork Hood River at the EFID diversion also was an average of 5 °F warmer than the spring-fed West Fork Neal Creek just above the end spill discharge point.

4.7.3.2 Biological Criteria

Under Oregon's water quality standards, waters of the state must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities. This standard is not met year-round in four of the seven waterbodies affected by District operations including Lenz Creek, Neal Creek, the Hood River, and the East Fork Hood River (Table 4-10). Toxic substances, sedimentation, excess nutrient inputs, associated algae growth and die-off, and elevated stream temperatures can result in detrimental changes in aquatic insects, crustaceans, worms, and other macroinvertebrates that live in the stream environment and support the food chain for many fish and wildlife species. Using data from reference sites, water quality impairment for biological criteria is based on the number and types of macroinvertebrates expected to be present in a waterbody under least-disturbed conditions.

4.7.3.3 Turbidity

Turbidity is a measure of the clarity of water. Effects on aquatic ecosystems include changes in primary production,[17] interference with fish feeding, and the visual attributes of streams. End spills in the EFID system transfer silt from the glacially influenced East Fork Hood River to receiving streams, increasing water turbidity in Hood River tributaries including West Fork Neal, Neal, Odell, Whiskey, and Lenz creeks, which are naturally clear water streams. In the West Fork Neal Creek, monitoring indicated that turbidity increased by an average of 206 percent downstream of EFID's end spill discharge over the 2009 to 2011 irrigation seasons (Stampfli et al. 2012). Total suspended solids were also higher downstream of the end spill discharge in Neal Creek.

[17] Primary production is the rate at which plants and algae use photosynthesis to produce organic compounds in an ecosystem.

The East Fork Hood River's high glacial sediment load requires that sand and silt be separated from irrigation water before delivery to patrons. Accumulated sediment in the District's sand trap facility is released back to the river during maintenance operations. In a typical irrigation season, up to 1,350 cubic yards of sediment can be flushed into the river 10 to 12 times per month from June through September, and four times during October (EFID 2011). These sediment-laden discharges periodically result in sharp increases in turbidity levels and suspended sediment downstream of the sand trap (RM 6.1).

4.7.3.4 Guthion and Chlorpyrifos

Neal Creek and Lenz Creek do not meet the year-round criteria for the toxic substances Guthion and chlorpyrifos (Table 4-10). Guthion, also called azinphos-methyl, is a pesticide that was used on many crops including apples, pears, cherries, and others. Many of its former uses have been cancelled by the EPA, and its few remaining uses are being phased out. A voluntary Pesticide Stewardship Program is ongoing in the Hood River basin among fruit growers, Oregon State University, CTWS, Hood River Soil and Water Conservation District, and ODEQ. This program includes water quality monitoring, education, and other measures to improve pesticide application practices. Pesticide monitoring since the early 2000s has shown a significant reduction in most pesticide levels in Hood River tributaries (ODEQ 2018). However, the open canals in EFID are exposed to contamination by pesticide drift, fertilizer runoff, and accidental spills of fuels or other toxic substances. These contaminants can be transferred to streams though the end spills of canal water that are maintained by the District, increasing the risk of contamination in receiving streams.

4.7.3.5 Heavy Metals and pH

Four of the seven waterbodies affected by District operations are listed for one or more heavy metals: arsenic, lead, silver, thallium, iron, and copper (Table 4-10). Reported sources of heavy metals in the global environment include natural geologic processes as well as industrial, agricultural, pharmaceutical, domestic effluents, and atmospheric sources. Many of these metals can be an essential nutrient at trace levels, but are toxic to aquatic organisms, humans, and wildlife at higher concentrations. Open canals in EFID are at risk of contamination by agricultural and other sources of heavy metals. Contaminants can be transferred to streams through the end spills that are maintained by the District, increasing the risk of contamination. The potential for District operations to affect pH in waterbodies associated with EFID operations is likely low based on pH monitoring conducted from 2005 to 2011 in Neal Creek upstream and downstream of the end spill discharge, which detected no significant difference in pH level (Stampfli et al. 2012).

4.7.3.6 Dissolved Oxygen

Oregon's water quality standards for dissolved oxygen include criteria for freshwater supporting several types of aquatic life, including sensitive fish species and life stages. The criteria apply at different time periods throughout the year. Two of the waterbodies affected by District operations (West Fork Neal Creek and Neal Creek) do not meet the standards for dissolved oxygen (Table 4-10). Dissolved oxygen levels in Neal Creek are not high enough to meet the applicable criteria during the salmon and steelhead spawning season from October 15 to May 15 (ODEQ 2012). In the West Fork Neal Creek, dissolved oxygen levels are not high enough to meet the criteria for salmonid spawning from October 15 to June 15 (ODEQ 2012). Low dissolved oxygen can affect habitat suitability for fish and aquatic life, cause major shifts in the kinds of organisms found in waterbodies, reduce the growth rate and impair swimming ability of fish, and increase susceptibility to disease, among other effects. The solubility of oxygen in water decreases as water temperature increases; therefore, warmer water contains less dissolved oxygen content than cool water. Because the District's irrigation diversion and end spills have the potential to affect water temperatures, they may also indirectly affect dissolved oxygen levels. However, other factors such as excess nutrients, associated algae growth and die-off, and naturally low oxygen-content groundwater inflow can also contribute to lower dissolved oxygen levels.

4.7.4 Groundwater

Groundwater is not extensively developed in the Hood River basin; therefore, data regarding this resource are limited. Available reports include a groundwater report published by the State of Oregon (Sceva 1966) and the results of a water resources investigation published by the USGS (Grady 1983). Geologic mapping of the basin was completed in 2012 (McClaughry et al. 2012).

The project area overlaps with the gently sloping, lower elevation portion of the basin known as the Hood River Valley, which is underlain by the Columbia River basalt formation at depths ranging from the ground surface to hundreds of feet below ground surface (Grady 1983). Groundwater in this basalt generally occurs in the broken contact zone between individual lava flows. Wells in the Hood River Valley that draw from the Columbia River basalts are generally very productive, yielding from 70 to 400 gallons per minute (Keller 2011). Approximately 514 water supply wells in Hood River County were registered with OWRD as of August 2018 (OWRD 2018b). Of these wells, 412 were for domestic use, 22 were for irrigation, and 22 were for industrial use. The remainder were for community, thermal, and unstated uses, or abandoned. Completed well depths averaged 139 feet.

Surface water quality and quantity concerns could cause more irrigators to turn to groundwater in the future. Adjacent watersheds have observed significant groundwater declines due to over appropriation and the slow recharge of the Columbia River Basalt aquifers. An increase in wells tapped for irrigation could conceivably affect existing domestic wells in addition to surface water flows (Reclamation 2014a).

Recharge of groundwater in the Hood River Valley is primarily from precipitation and is estimated to be several inches per year (Keller 2011). An estimated water budget developed for a groundwater analysis in the Hood River Basin Study attributed 98 percent of annual aquifer inflow to precipitation (Reclamation 2015). Some of the recharged water returns to the rivers and streams as base flow, which provides cool water to streams and acts as an underground reservoir slowly releasing water to the stream (Salminen et al. 2016).

Unlined irrigation canals can contribute to groundwater through seepage, and seepage rates can vary widely depending on the geology and permeability of soils within the canal. Over time, many unlined canals will naturally seal with the deposit of silts and clays (Reclamation 2017). Studies of seepage losses along EFID canals have been limited and, as noted in Section 2.1.1, study results were inconclusive and could not be extrapolated to estimate seepage losses throughout the District (FCA 2018b).

4.8 Fish and Aquatic Resources

Since the development of agriculture in the late 1800s, the diversion of water, construction of reservoirs, land drainage, and other activities have affected the aquatic environment in the Hood River basin. Low streamflow and water quality impairments are recognized as key limiting factors for fish populations in the basin (Shively 2006; NMFS 2013).

The Hood River basin is part of 10 million acres of lands ceded to the United States by the CTWS. Under rights reserved by federal treaty, tribal members harvest salmon and steelhead from the Hood River. Tribal fishing opportunity has become severely restricted because of low fish abundance and the need to protect weak or threatened stocks (Salminen et al. 2016). CTWS and the ODFW are actively engaged in efforts to recover fish populations in the basin through habitat restoration, hatchery supplementation, research and monitoring, and harvest management.

Given its gentle gradient, abundant gravel, and broad floodplain, the lower 6.6 miles of the East Fork Hood River downstream of the EFID diversion has the best potential spawning and rearing habitat in the river for salmon and steelhead (R. French, District Fish Biologist, ODFW, personal communication, August 8, 2018). The lower river is also identified as the highest waterbody of concern for water quantity and water quality in the entire Hood River basin (Shively 2006). Streamflow is lowest in the 0.5-mile bypass reach between the EFID diversion and the point where a portion of the diverted water returns to the river from the District's fish screen facility (RM 6.1). Shallow water and narrow stream width over gravel bars in the bypass reach are identified as a concern for fish passage in adult Chinook (McCanna and Eineichner 2012).

Fish and aquatic species in the East Fork Hood River provide the following ecosystem services:

- *Provisioning Service, Instream Fish Populations (Figure 4-1 [E2]):* The East Fork Hood River and Hood River downstream of EFID's diversion provide year-round fishing opportunities. Rainbow trout, other resident fish species, and, when available, salmon and steelhead provide recreational anglers with opportunities to harvest fish for consumption (WSR 2019). In addition, members of the CTWS have fishing rights and rely on the Hood River basin's fisheries resources for subsistence and ceremonial use.

- *Cultural Service, Threatened Species, Species of Concern (Figure 4-1 [E4]):* Waterbodies in the Hood River basin are home to federally listed threatened species of steelhead, coho, Chinook, and bull trout (Section 4.8.2). Pacific salmon are a premier cultural icon of the Pacific Northwest contributing to educational, recreational, and community values. Of particular importance are the contributions of Pacific salmon to native traditions and religious practices (Bottom et al. 2009). The Hood River basin is part of the ceded lands of the CTWS with usual and accustomed fishing stations. The basin provides subsistence and ceremonial fisheries for tribal members under fishing rights reserved by the treaty with the U.S. government (Treaty with the Tribes of Middle Oregon 1855 | 12 Stats., 963. Ratified Mar. 8, 1859).

  Spring Chinook salmon are a special part of the CTWS and the tribes of the Columbia River's cultural and religious practices. The First Salmon Feast is part of Columbia Basin tribes' traditional religion celebrating spring Chinook, the first salmon to return of the year, and the central role of salmon and water in tribal health and culture (CRITFC 2019a).

Salmon and steelhead populations have declined in recent decades because of impacts to habitat and other factors; however, since 1991, the CTWS has been working in the basin to rebuild these populations for conservation purposes and to provide consistent harvest opportunity (CTWS 2019).

The Hood River basin is also home to the Pacific lamprey. Like salmon, lamprey are a traditional food with cultural importance to CTWS members and are prized for their rich, fatty meat. They are often served alongside salmon at tribal feasts and celebrations (CRITFC 2019b). Populations of lamprey in the basin are currently low due to habitat impacts but appear to be increasing in recent years after fish passage improvements in the Hood River and at Bonneville Dam on the Columbia River. Despite this improvement, the numbers of lamprey available for tribal harvest continue to be low. The effects of low population numbers have been documented as a loss of tribal culture. The decline in fishing opportunities in traditional areas has resulted in a break of the transfer of knowledge from older to younger tribal members about how to catch and prepare lamprey for drying and the loss of important myths and legends associated with lamprey (Close et al. 2002). Rebuilding Pacific lamprey in the Hood River basin is a CTWS goal so that tribal harvest can occur, and tradition and culture can be preserved.

4.8.1 General Fish and Aquatic Species

The Hood River basin has one of the most diverse assemblages of native anadromous and resident salmonids in Oregon. It includes populations of both summer and winter run steelhead, and spring and fall Chinook salmon. The original Hood River spring Chinook salmon population was extirpated in the 1970s. A reintroduction effort from the neighboring Deschutes River stock has been underway since 1993. However, the abundance and range of anadromous fish in the Hood River basin has declined compared to historical conditions.

Nineteen species of fish are known to occur in the basin (Table 4-11). Some or all of these species occur in the East Fork Hood River and in the other waterbodies affected by District operations. As noted previously, the District's water diversion affects the lower 6.6 miles of the East Fork Hood River and the full 14.6-mile length of the Hood River. In addition, five tributaries to the lower Hood River are affected by District's end spills (overflows) of approximately 1 to 5 cfs (Table 4-8).

Upstream fish passage at the EFID diversion weir is provided by a vertical slot fishway. A pipe system at this location was also installed to facilitate passage of Pacific lamprey. No artificial barriers to fish migration occur upstream of the EFID diversion in the East Fork Hood River. The uppermost limit of anadromous fish use extends to RM 26.6 based on ODFW mapping of steelhead distribution (ODFW 2019a). Pacific lamprey, a U.S. Fish and Wildlife Service (USFWS) Species of Concern, are recolonizing the Hood River basin and appear to be expanding their range within the East Fork Hood River. Juvenile lamprey were recently detected as far upstream as the EFID diversion (R. Gerstenberger, Fish Biologist, CTWS, personal communication, January 16, 2019).

Fixed-plate, Coanda-design screens are installed in the District's sand trap near its diversion to prevent fish and aquatic species from entering the irrigation canals. Coanda screens are regarded as experimental technology by NOAA Fisheries (NMFS 2011). Testing of EFID's fish screens following their construction in 1996 found no injuries or mortalities in juvenile steelhead and Chinook passing the fish screens (Buell and Associates 2000). However, in the future the District plans to replace the fish screens at a new location closer to the diversion with a screen design that fully meets NOAA Fisheries fish screen criteria.[18]

The periodic discharge of sediment-laden water associated with sand trap maintenance operations results in sharp increases in turbidity and may promote the deposition of fine sediment in the river's streambed downstream of the sand trap (RM 6.1) (Section 4.7.3.3). Increases in suspended sediment and turbidity have the potential to displace fish, impair feeding, and damage gill tissue (DFO 2000). The deposition of sand and silt can fill the small spaces between gravel and cobble particles required for successful salmonid spawning and egg development and can reduce the productivity and diversity of macroinvertebrates (DFO 2000).

[18] Fish screen replacement is not part of the proposed action.

Table 4-11. Fish Species in Waterbodies Associated with District Operations.

Fish Species	Scientific Name	Origin
Bridgelip sucker	*Catastomus columbianus*	Indigenous
Bull trout	*Salvelinus confluentus*	Indigenous
Brown bullhead	*Ameiurus nebulosus*	Introduced
Chinook salmon (spring and fall)	*Oncorhynchus tshawyscha*	Indigenous
Brook trout	*Salvelinus fontinalis*	Introduced
Brown trout	*Salmo trutta*	Introduced
Chiselmouth	*Acrocheilus alutaceus*	Indigenous
Coastal cutthroat trout	*Oncorhynchus clarkii*	Indigenous
Coho salmon	*Oncorhynchus kistutch*	Indigenous
Dace species	*Rhinichthys* spp.	Indigenous
Largescale sucker	*Catastomus macrocheilus*	Indigenous
Mountain whitefish	*Prosopium williamsoni*	Indigenous
Northern pike minnow	*Ptychocheilus oregonensis*	Indigenous
Pacific lamprey	*Lampetra tridentata*	Indigenous
Rainbow trout	*Oncorhynchus mykiss irideus*	Indigenous
Sculpin species	*Cottus* spp.	Indigenous
Steelhead (summer and winter)	*Oncorhynchus mykiss*	Indigenous
Three-spined stickleback	*Gasterosteus aculeatus*	Indigenous
White sturgeon	*Acipenser transmontanus*	Indigenous

Source: Bonneville 1996; R. Gerstenberger, CTWS, personal communication, July 30, 2018

District canals do not provide functioning habitat for fish and aquatic life primarily because the canals are dewatered every year at the end of the irrigation season. A small number of fish may be able to survive in the canal over the winter at locations where a spring or seep maintains a deep enough pool year-round. For several years following the fish screen construction, electrofishing was conducted to salvage fish still trapped in the District's canals. It is assumed that any fish remaining in the canals today may have originated either from fish that had evaded capture during electrofishing efforts, or from an unknown fish-bearing stream with a seasonal surface water connection to a canal, or from potential leakage in the seals around the District's fish screens (R. French, District Fish Biologist, ODFW, personal communication, March 15, 2019). Fish are not known to occur in any of the District's other canals.

In addition to fish, other aquatic, semi-aquatic, and amphibious species occur in waterbodies that are associated with District operations. These likely include water shrew, water vole, newt, and salamander species, and may also include Pacific treefrog and Cascades frog (C. Fiedler, Fish and Wildlife Biologist, U.S. Forest Service, personal communication, July 25, 2018). These species are native to Oregon and may be present in irrigation canals and adjacent banks in the project area at locations with suitable vegetation and hydrology.

4.8.2 Federally Listed Fish and Aquatic Species

The ESA (16 U.S.C. 1531 et seq.), as amended in 1988, establishes a national program for the conservation of species listed as threatened and endangered, and the preservation of habitats on which they depend. The ESA defines procedures for listing species, designating critical habitat for listed species, and preparing recovery plans. Section 7 of the ESA, as amended, requires organizations to consult with NOAA Fisheries and/or the USFWS if listed species or designated critical habitat may be affected by a proposed federal action. If adverse impacts could occur, the ESA requires federal agencies to evaluate likely effects of the proposed action and ensure that it neither risks the continued existence of federally listed ESA species nor results in the destruction or adverse modification of designated critical habitat.

A list of aquatic species protected under the ESA that are known to occur or may occur in the seven waterbodies associated with District operations was obtained from *Federal Register* notices and the USFWS Information for Planning and Consultation website. Four fish species that are listed as threatened under the ESA occur in the Hood River basin (Table 4-12). All of these species occur in the Hood River, and are also known to occur in the East Fork Hood River with the potential exception of bull trout for which occurrence in the river is not well documented (USFWS 2002). One or more of the listed species may occur within other waterbodies affected by the project including Neal, West Fork Neal, Odell, Lenz, and Whiskey creeks (ODFW 2019a).

Table 4-12. Federally Listed Fish Species in the Hood River Basin.

Species Name (Endangered Species Unit or Distinct Population Segment)	Federal Status	Listing Date	Extinction Risk in the Hood River Basin
Hood River bull trout	Threatened	June 10, 1998	At Risk
Lower Columbia River Chinook (includes spring and fall populations)	Threatened	March 24, 1999	Very High
Lower Columbia River Coho	Threatened	June 28, 2005	Very High
Lower Columbia River steelhead (includes winter and summer populations)	Threatened	January 5, 2006	Very High - Summer steelhead Moderate -Winter steelhead

Source: NMFS 2013

Critical habitat for Lower Columbia River coho, Chinook, and steelhead is designated in each of the waterbodies affected by District operations except in Odell Creek (Figure 4-9.). NOAA Fisheries has identified Primary Constituent Elements (PCEs) for critical habitat that represent the essential biological and physical features for the conservation of a species and describe habitat components that support one or more life stages of the species (70 *Federal Register* 52630, September 2, 2005). The

PCEs for coho, Chinook, and steelhead describe habitat with water quantity and quality conditions supporting spawning, egg incubation, larval development, and migration; water quantity and floodplain connectivity supporting juvenile growth and mobility; shade; complex habitat structure and cover such as submerged and overhanging large wood; aquatic vegetation and boulders; and a sufficient food base supporting growth and maturation.

The USFWS has designated critical habitat for bull trout in the Hood River from its confluence with the Middle Fork Hood River downstream to the Columbia River (RM 14.6 to RM 0).[19] USFWS has identified PCEs for bull trout critical habitat including aquatic connectivity, complex habitat structure, water temperatures no greater than 59 °F, natural variability in streamflow, a sufficient food base, and the absence of non-native predatory and competing fish (70 *Federal Register* 56211, October 26, 2005).

An evaluation of the population viability status for ESA-listed fish species in the Hood River basin concluded that coho salmon, spring Chinook salmon, and summer-run steelhead populations currently have a very high risk of extinction, while winter-run steelhead have a moderate risk of extinction (NMFS 2013; ODFW 2010). Low streamflow, including reduced flows due to irrigation withdrawals, are identified as a key or primary limiting factor to the recovery of listed salmon and steelhead in the basin (NMFS 2013). The ESA Recovery Plan for these species assigned an extinction risk goal[20] of "low" or "very low" to each of the listed population in the basin (ODFW 2010). By addressing the limiting factors and threats to these populations, these goals are expected to be achieved or exceeded for spring Chinook and winter steelhead populations (ODFW 2010).

4.8.3 State-Listed Species

ODFW maintains a list of native fish and wildlife species in Oregon determined to be either "threatened" or "endangered" according to criteria set forth by OAR 635-100-0105 (ODFW 2019b). Lower Columbia River coho salmon are listed by Oregon as endangered and are present in waterbodies associated with EFID operations. There are no other Oregon-listed threatened, endangered, or candidate fish or aquatic species known to occur within the waterbodies associated with EFID operations or in the irrigation canals and laterals within the project area.

[19] The 2.4-mile reach of the Hood River between the West Fork and Middle Fork confluences is sometimes also identified as part of the East Fork Hood River. The USGS National Hydrography data set and topography maps identify this reach as the East Fork Hood River, however, the USGS river mile notations for the East Fork Hood River place RM 0 at its confluence with the Middle Fork Hood River.

[20] Desired de-listing status

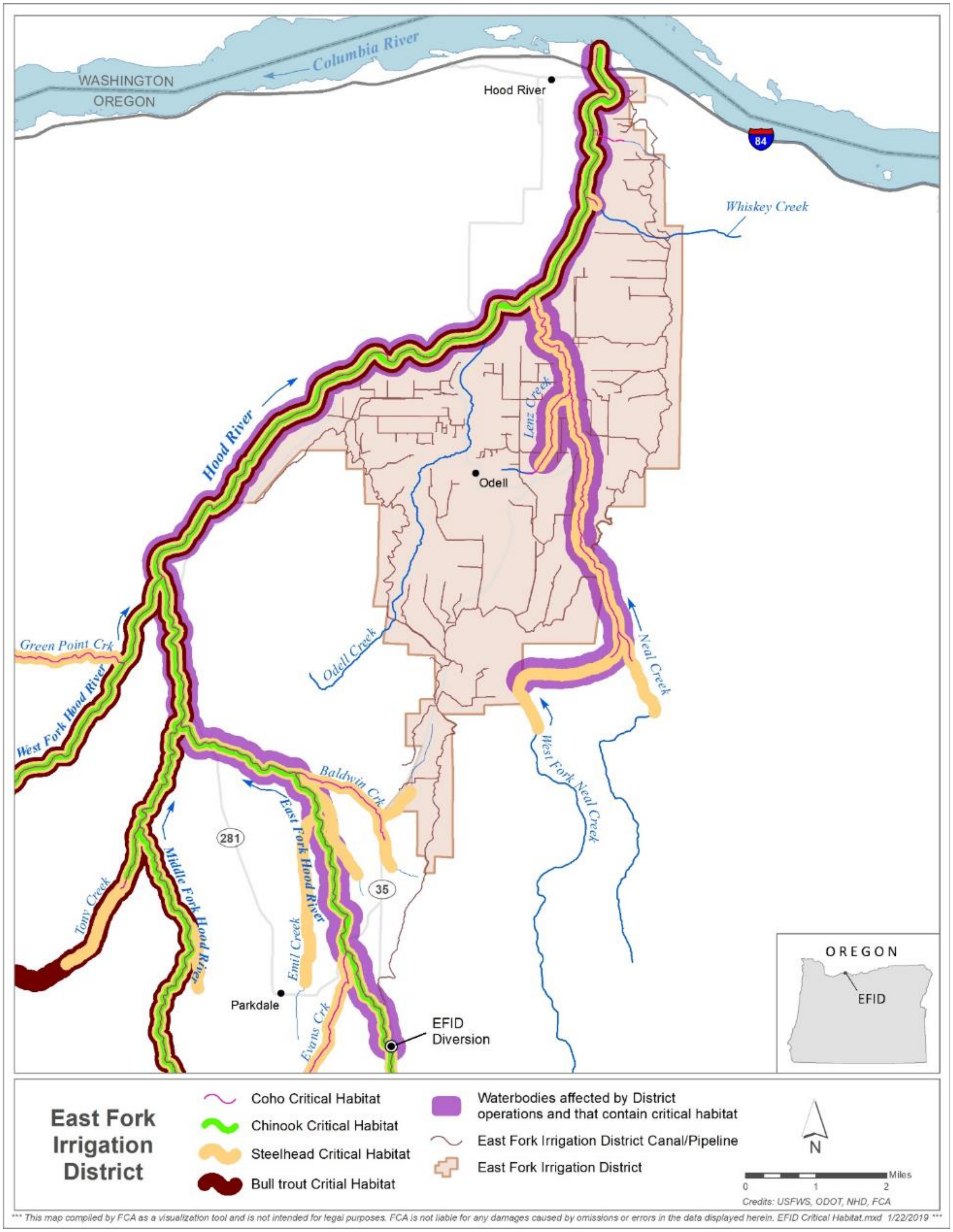


Figure 4-9. Critical habitat designated for bull trout, coho, steelhead, and Chinook in the East Fork Irrigation District watershed planning area.

4.9 Wetlands and Riparian Areas

Wetland and riparian areas affected by District operations occur in two areas: the project area and along 31.8 miles of natural waterbodies associated with District operations (Table 4-7; Figure 4-5.). Wetlands perform a number of valuable functions including water storage, water filtration, and biological productivity. They can also support complex food chains that provide sources of nutrients to plants and animals, and specialized habitat for many aquatic and terrestrial species. Although there are many types of wetlands, they share three essential characteristics: an abundance of water, hydric (wetland) soils, and plants that grow in wetland conditions (ODSL 2015).

Wetlands in the area associated with the proposed action may be subject to federal or state regulations depending on their characteristics. In Oregon, wetlands are managed under two laws, the CWA and the Oregon Removal-Fill Law. The USACE administers Section 404 of the CWA with the oversight of the USEPA. This law regulates the dredge or fill of wetlands over which the USACE has jurisdiction (or "jurisdictional wetlands"). The Oregon Department of State Lands (ODSL) implements the Removal-Fill Law (ORS 196.800-990), which regulates the removal or fill of material in wetlands or waterways, requiring any person who plans to "remove or fill" material within "waters of the state" to obtain a permit from ODSL. Per the Oregon Removal-Fill statute OR 141-085-0515(9), an irrigation ditch is not regulated under Oregon Removal-Fill permitting if it meets both of the following (ODSL 2013):

- The ditch is operated and maintained for the primary purpose of irrigation; and
- The ditch is dewatered[21] outside of the irrigation season except for isolated puddles in low areas.

The 1986 Final Rule for "Regulatory Programs of the Corps of Engineers" indicated that irrigation ditches are generally not considered Waters of the United States for the purpose of determining CWA Section 404(f)(1)(C) applicability. However, USEPA reserved the "right to determine on a case-by-case basis if any of these waters are "Waters of the United States…" including, "…irrigation ditches excavated on dry land…" (USACE 1986). In 2006, a "significant nexus" jurisdiction standard from Rapanos v. United States (547 U.S. 715 (2006)) was established, which has been used to determine if identified waters are Waters of the United States (Supreme Court 2006). In 2015, the Clean Water Rule: Definition of "Waters of the United States" (2015 Final Rule; 80 *Federal Register* 37053) was published and provided clear exclusions for certain types of ditches. However, in September 2019, the 2015 rule was repealed and, in January 2020, a revised definition was published in the *Federal Register*. [22]

Riparian areas are lands that occur along water courses and waterbodies. Typical examples include streambanks and lake shorelines. They are distinctly different from surrounding lands because of

[21] "Dewatered" means that the source of the irrigation water is turned off or diverted from the irrigation ditch. A ditch that is dewatered outside the irrigation season may be used for temporary flows associated with stormwater collection, stock water runs, or fire suppression.
[22] This revision will become effective 60 days after it is published in the *Federal Register*.

unique soil and vegetation characteristics that are strongly influenced by the presence of water (NRCS 1996).

4.9.1 Project Area

The project area covers approximately 662 acres and is defined as 50 feet along either side of the canals and pipelines where construction would occur. Approximately 42.2 acres in the project area are identified as wetlands in the National Wetland Inventory (NWI) geographic information system (GIS) data (USFWS 2016). The NWI classifies 17 acres of these as artificial, seasonally flooded, riverine, and palustrine wetland features as "excavated by humans," and the remaining 25 acres as natural wetlands. However, FCA conducted a further GIS analysis of the NWI mapping information to compare the NWI data to the EFID canal alignment data. That analysis indicated that most of the wetlands classified by the NWI as natural wetlands in the project area are instead EFID canals. When excluding the canals, an estimated 6.1 acres of natural wetlands may occur within the project area (FCA 2019). These natural wetlands are predominantly classified in the NWI as riverine and freshwater forested/shrub wetlands.

Water typically flows through EFID canals in the project area from March through October to supply agricultural uses of frost control, irrigation, and spray water. Water may also flow through these canals during the winter due to storm runoff or be present as standing water following rain or snow events. A few isolated pools that remain wet year-round may occur in one or more of the District's canals. Although some irrigation canals may have hydrology and vegetation indicative of a wetland, they do not meet the functional criteria of wetlands and are not regulated as wetlands by ODSL or USACE. These canals meet exemptions under the Oregon Removal-Fill Law for specific agricultural activities in wetlands and other waters of the state. As part of construction permitting, a wetland delineation would be performed to determine the presence of jurisdictional wetlands.

Riparian vegetation and development of riparian habitat along the canals in the project area are either limited or absent because the canals do not have water year-round and are maintained to control or remove vegetation. In addition, a maintenance track or road typically runs along one bank of the canals, eliminating opportunity for tree and shrub growth.

4.9.2 Wetland and Riparian Areas along Natural Waterbodies Associated with District Operations

Based on NWI data, natural wetlands are found sporadically along the East Fork Hood River and other waterbodies affected by District operations.

Riparian areas of varying width and quality also occur along natural waterbodies affected by District operations. Low summer streamflow associated with irrigation withdrawals may limit riparian vegetation along the East Fork Hood River downstream of EFID's diversion. Because streamflow is strongly correlated with critical physical and biological characteristics of the river, it influences the functions of associated riparian areas (National Research Council 2002). Reestablishing a more natural hydrologic regime would supply water to riparian areas via infiltration through channel banks, thus enhancing riparian function by facilitating processes such as hyporheic exchange, physical and chemical transformations, and supporting riparian plant communities and aquatic habitat (National Research Council 2002).

4.9.3 Floodplains

The District's existing headwork facilities are located within the 100-year floodplain of the East Fork Hood River based on the Federal Emergency Management Agency's Flood Insurance Rate Maps for Hood River County. These facilities occupy approximately 4 acres of floodplain and include a diversion weir, fish ladder, sand trap, gravel access road, and the approach canal between the diversion and the sand trap. Construction of these facilities has altered natural floodplain processes such as sediment transport and deposition, flood storage, aquifer recharge, and fish and wildlife habitat development. In general, the effects on floodplain processes and functions have been local to the affected area. No other District facilities occur within the 100-year floodplain.

4.10 Wildlife Resources

4.10.1 General Wildlife

A variety of birds, mammals, reptiles, and other wildlife have the potential to occur in the project area and its vicinity. The native wildlife species that are most likely to occur in the project area are shown in Table 4-13. Wildlife species typically present in the project area are habitat generalists that utilize natural habitat areas within or bordering the agricultural environment. These species are generally tolerant to disturbance. Common examples include deer, coyote, skunk, raccoon, and red-tailed hawk (Blair 1996; Ditchkoff et al. 2006; McKinney 2002). Given the fragmented, disturbed nature of habitat within the project area, it likely supports a lower species diversity compared to native, intact, undisturbed habitat types.

Where not cleared, vegetation along the District's canals may provide food, cover, and breeding sites for some wildlife species throughout the year. Additionally, wildlife may also use the District's open canals as a water source and a travel or dispersal corridor. Other wildlife travel corridors are present along streams in the vicinity of the project area where riparian vegetation is dense or wide enough to provide hiding cover, and in forested areas that border the District. When flowing water is present, the canals can pose a migration barrier for small mammals. Wildlife drownings occur periodically in the District's canals, involving mostly fawns, squirrels, coyotes, skunks, and other small mammals (J. Buckley, EFID Manager, personal communication, October 10, 2018).

Deer and elk are typically highly migratory in response to seasonal conditions, although some occupy a smaller home range when close to an abundant food source, water, and adequate cover. Much of the canal length within EFID lies directly between residential properties and orchards, and may serve as an added attractant for wildlife and a source of human-wildlife conflict, especially for deer, elk, and the carnivores that prey on them (J. Thompson, ODFW District Wildlife Biologist, personal communication, December 5, 2018).

Table 4-13. Wildlife Species Likely to Occur within the Project Area.[1]

Wildlife Species		Scientific Name
Mammals	Bat	*Vespertilionidae* spp.
	Cottontail rabbit	*Sylvilagus* spp.
	Coyote	*Canis latrans*
	Mountain lion	*Puma concolor*
	Mule deer	*Odocoileus hemionus* spp.
	Raccoon	*Procyon lotor*
	Rocky mountain elk	*Cervus elaphus nelsoni*
	Skunk	*Mephitis mephitis*
	Western gray squirrel	*Sciurus griseus*
Birds	American crow	*Aphelocoma californica*
	Dark-eyed junco	*Junco hyemalis*
	Northern flicker	*Colaptes auratus*
	Red-tailed hawk	*Buteo jamaicensis*
	Rufous hummingbird	*Selasphorus rufus*
	Turkey vulture	*Cathartes aura*
	Western scrub jay	*Aphelocoma californica*
Reptiles	Common garter snake	*Thamnophis sirtalis*
	Western rattlesnake	*Crotalus viridus*

Source: ODFW 2019c
[1] Partial list of wildlife species likely to occur in the project area.

4.10.2 MBTA/BGEPA Species

Many bird species have the potential to occur within the EFID project area, some of which are protected under the Migratory Bird Treaty Act (MBTA) or the Bald and Golden Eagle Protection Act (BGEPA). Although migratory birds including bald eagles are known to occur in or near the project area, habitat availability and quality is limited due to agricultural land use and District canal maintenance activities that remove or control vegetation on an annual basis. A list of MBTA and BGEPA species that occur or may occur in the project area was obtained from USFWS and is shown in Table 4-14. Several of these species may be present in or near the project area for as little as 1 week during the year (USFWS 2018). No known bald or golden eagle nests are found in or near the project area based on available surveys (F. Issacs, Oregon Eagle Foundation, email communication December 6, 2018).

Table 4-14. Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act Species Potentially Occurring within the Project Area.

MBTA/BGEPA Species[1]	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Brewer's sparrow	*Spizella breweri*
California thrasher	*Toxostoma redivivum*
Clarke's grebe	*Aechmophorus clarkii*
Golden eagle	*Aquila chrysaetos*
Great blue heron	*Ardea herodias fannini*
Lesser yellowlegs	*Tringa flavipes*
Lewis's woodpecker	*Melanerpes lewis*
Marbled godwit	*Limosa fedoa*
Olive-sided flycatcher	*Cantopus cooperi*
Rufous hummingbird	*Selasphorus rufus*
Sage thrasher	*Oreoscoptes montanus*
Semipalmated sandpiper	*Calidris pusilla*
Peregrine falcon	*Falco peregrinus*
Western screech-owl	*Megascops kennicottii kennicottii*
Willow flycatcher	*Empidonax traillii*

Source: USFWS 2018
[1] Partial list of all migratory birds that potentially occur within the project area.

4.10.3 Federally Listed Species

USFWS maintains a list of wildlife species protected under the ESA that may occur in Hood River County (USFWS 2018). A review of the USFWS Information for Planning and Consultation data indicated that only one federally listed species, the northern spotted owl (threatened, 55 *Federal Register* 26114) may occur in the project area. However, none of the project area overlaps with designated critical habitat for the northern spotted owl. Agricultural and timber harvest activities and other land development in the project area limits the suitability of habitat for northern spotted owl.

4.10.4 State-Listed Species

ODFW maintains a list of native wildlife species in Oregon that have been determined to be either threatened or endangered according to criteria set forth by rule (OAR 635-100-0105) (ODFW 2019b). The state list together with information from the Oregon Explorer Natural Resources Digital Library shows there are no state-listed terrestrial species known to occur within the project area (Oregon State University 2018).

5 Alternatives

5.1 Formulation Process

The formulation of alternatives followed the CEQ's regulations for implementing NEPA, and numerous U.S. Department of Agriculture (USDA)-NRCS watershed planning policies. Scoping comments were also incorporated into the formulation process of alternatives.

A large number of alternatives were initially considered. When formulating an alternative, it was first determined whether the alternative met the project purpose, which is to: (1) improve water conservation in District infrastructure, (2) improve water delivery reliability, and (3) improve public safety along district infrastructure (Section 2.1). After considering whether the alternative met the project purpose, the alternative was further analyzed for four criteria: completeness; effectiveness; efficiency; and acceptability (PR&G 6). Some of the initial alternatives considered did not meet the formulation criteria and were eliminated from further analysis (see Appendix D).

5.2 Alternatives Eliminated from Detailed Study

The following subsections describe alternatives that met the formulation criteria, but after further consideration were not analyzed in detail as viable alternatives. Alternatives that did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or became unreasonable because of cost, logistics, existing technology, or environmental reasons were removed from consideration (National Watershed Program Manual [NWPM] 501.37, PR&G 6.5b). Section 5.2.5 provides a side-by-side comparison of the net present value for each of the alternatives that were eliminated due to cost. The net present value is the total cost of the alternative over 100 years including capital costs, replacement costs, and annual O&M costs.

5.2.1 On-Farm Efficiency Upgrades

On-farm efficiency upgrades refer to EFID patrons upgrading their on-farm infrastructure to use irrigation technologies that provide a more precise application of water. These technologies can have greater application efficiencies. On-farm infrastructure is distinct from District canals and laterals because it is owned and operated by patrons. Based on surveys in 2008 and 2013, it is estimated that farms within the District in 2013 were irrigated using hand line impact sprinklers (31 percent of the total irrigated acreage in EFID), solid set impact sprinklers (28 percent), solid set micro sprinklers (23 percent), and solid set rotator sprinklers (12 percent) (Christensen 2013). Each irrigation system has a different application efficiency (i.e., its ability to deliver the irrigation water to the crop root system across the full field being irrigated).

Voluntary programs to increase on-farm water use efficiency by other agencies and organizations are ongoing within the District and the Hood River basin. On-farm efficiency upgrades would not meet the purpose and need of the project. Water losses would still occur through end spills; canals would remain open; water delivery reliability would not be improved due to operational efficiencies; and public safety would remain an issue.

If PL 83-566 funds were used to develop and implement on-farm efficiency upgrades, the use of these funds would require the District to complete a cultural resource analysis on a private tax lot-by-tax lot basis, as well as receive permission to then operate and maintain the system, including acquiring easements to do so. This approach is logistically complex and would increase project costs. Furthermore, it would be logistically infeasible for EFID to carry out, operate, and maintain on-farm infrastructure owned by EFID patrons. The on-farm efficiency upgrade alternative was eliminated from further study because it would be logistically unreasonable, does not meet the purpose and need of the project, and does not achieve the Federal Objective and Guiding Principles.

5.2.2 Canal Lining

Canal lining would involve covering the bottom and sides of the currently open canals with a geotextile liner and shotcrete to prevent water from seeping into the underlying soils and rock. Canal lining would require sub-grade preparation, geotextile liner installation, and application of a layer of shotcrete to protect the geotextile liner across the District's 17.9 miles of open canals.

Lining would increase water velocity in the canals because the shotcrete cover is a smoother surface than the existing underlying soils and rock. This makes the sides of the canals slippery and more difficult for anyone who might accidently fall in the water to be able to climb out. To address the increased public safety concerns caused by the installation of lining, standard chain link fence with a 3-wire barbed wire cap would be installed along the length of the canals to prevent public access to the channel and reduce District liability. In channels deeper than 2.5 feet, safety ladders would be installed every 750 feet to provide the opportunity for human and animal escape.

The canal lining alternative would meet the project purpose of improving public safety; fences and ladders would increase public safety. However, canal lining would only partially meet the project purpose of conserving water; while lining would reduce water loss from seepage, it would not reduce water loss from end spills. Seepage studies in EFID have been inconclusive, and reliable estimates of seepage loss are unavailable. Seepage loss in an open-lined system with a shotcrete cover is estimated to be 5 percent based on studies of canal lining performance in Central Oregon (Swihart and Haynes 2002). End spill water loss in EFID is estimated to be 18.3 percent of the water diverted, or 5,287 acre-feet annually.

The lining materials would be expected to have a lifespan of 33 years before needing to be replaced. Before replacement, as the system aged it would likely require progressively increasing maintenance to account for lining cracks and tears. Additionally, this alternative would require energy use and other pumping costs for farmers similar to their current operations.

Capital costs of canal lining were estimated based on the size of the existing open canals and laterals, and material unit costs were based on the experience of Three Sisters Irrigation District in Central Oregon. Annual operating costs associated with canal lining were estimated based on EFID's current operating budget, with a 30 percent increase in equipment, maintenance, and labor costs due to the relatively fragile nature of a lined canal compared to an unlined canal. The cost of canal lining over 100 years, including capital costs, replacement costs, and annual O&M costs, is estimated to be $42,069,000 for Project Group 1 and $80,147,000 for Project Group 2 (2019 U.S. dollars). This is roughly twice the cost of the Piping Alternative. Based on this cost, canal lining was eliminated from further study (see Appendix D for cost details). Furthermore, canal lining does not meet the project purpose to improve water delivery reliability and does not achieve the Federal Objective and Guiding Principles.

5.2.3 Piping with Other Materials

Piping with steel or piping with polyvinyl chloride (PVC) was also explored. A cost analysis was completed for each alternative and can be found in Appendix D. In the cost analyses, the lengths, diameters, and range of pressure ratings used for these piping alternatives were estimated based on the engineering analysis completed in the District's SIP (FCA 2018a). The design life for steel and PVC was assumed to be 50 years and 33 years, respectively. Annual operating costs were also taken into consideration. Annual operating costs were estimated based on EFID's current operating budget and an assumption that equipment, maintenance, and labor costs would decrease 10 percent because a fully piped system would minimize the need to inspect, repair, and remove obstructions and make manual adjustments to the system.

The cost of piping with steel over 100 years, including capital costs, replacement costs, and annual O&M costs, is estimated to be $33,657,000 for Project Group 1, $97,507,000 for Project Group 2, and $37,184,000 for Project Group 3 (2019 U.S. dollars). This is nearly twice the total cost of the Piping Alternative.

For piping with PVC, PVC would be used for diameters up to 54 inches, and steel would be installed for a short section of 66-inch diameter pipe because PVC pipe is not manufactured in large diameters. The cost of piping with PVC over 100 years, including capital costs, replacement costs, and annual O&M costs, is estimated to be $30,613,000 for Project Group 1, $124,479,000 for Project Group 2 and $28,536,000 for Project Group 3 (2019 U.S. dollars). The total cost of piping with PVC is over twice the total cost of the Piping Alternative.

Although piping with steel or PVC would meet the project purpose and achieve the Federal Objective and Guiding Principles, both alternatives were eliminated from further study due to the availability of high-density polyethylene (HDPE), a longer lasting material that would achieve the purpose and need at a lower cost (see Appendix D for steel and PVC cost details, pipe specifications, and PVC design life discussion).

5.2.4 Combination of Alternatives

A combination of the eliminated alternatives, and a combination of HDPE with any of the eliminated alternatives, were rejected based on the same reasons the alternatives were eliminated individually. The on-farm efficiency upgrade alternative was eliminated from further study because it is not consistent with PL 83-566 requirements, it would be logistically unreasonable, and it does not fully meet the purpose of the project and the Federal Objective and Guiding Principles. Canal lining, piping with steel, and piping with PVC were eliminated due to cost.

5.2.5 Cost Comparison of Eliminated Alternatives

Table 5-1 shows the total cost (net present value) of the alternatives that were eliminated due to cost for each project group over a 100-year period (see Appendix D for a detailed breakdown of costs).

Table 5-1. Net Present Value of Alternatives Eliminated Due to Cost.[1]

Project Group	Canal Lining	Steel Piping	PVC Piping
1	$42,069,000	$33,657,000	$30,613,000
2	$80,147,000	$97,507,000	$124,479,000
3	N/A	$37,184,000	$28,536,000

[1] Price base: 2019 U.S. dollars, amortized over 100 years at a discount rate of 2.75 percent. Costs are rounded to the nearest $1,000.
N/A = not applicable

5.3 Alternatives Description

Of the alternatives considered for EFID's Irrigation Modernization Project, two were selected for further evaluation:

- No Action (Future without Federal Investment): The District would continue to operate and maintain its existing canal and pipe system. Improvements to irrigation infrastructure would only occur as public funding becomes available and are not reasonably certain to occur; and
- Piping Alternative: Replace existing open canals and aging pipe with an HDPE-pressurized pipeline system.

These alternatives are discussed below and include only EFID-owned infrastructure.

5.3.1 No Action (Future without Federal Investment)

Under the No Action Alternative, federal funding through PL 83-566 would not be available to implement the project. The District would continue to operate and maintain its existing canal, lateral, and pipe system in its current condition. The District would only be able to modernize its infrastructure on a project-by-project basis as public funding became available. This alternative assumes that modernization of the District's system to meet the purpose and needs of the project would not be reasonably certain to occur.

The No Action Alternative would not meet the project purpose and need; water loss to end spills and seepage in District infrastructure, water delivery reliability for farmers, streamflow and habitat conditions for fish and aquatic species, public safety, and sediment levels in irrigation water would not improve. Since no water would be conserved or permanently allocated instream, the No Action Alternative would not achieve the Federal Objective to protect the environment, the Healthy and Resilient Ecosystem Guiding Principle, or the Sustainable Economic Development Guiding Principle.

5.3.2 Piping Alternative

Under the Piping Alternative, federal funding through PL-566 would be available, and the District would pipe and pressurize 56 miles of their system (Figure 5-1.). This would include replacing up to 38.3 miles of existing pipeline made of piping material not rated for pressurization. The delivery system would be piped with HDPE pipe ranging in diameter from 4 to 54 inches, and a very short section of 66-inch diameter steel pipe (FCA 2018a).[23] Approximately one-half mile of the Eastside Canal pipeline would follow a new alignment through both private land and county-owned forest land under a new easement. Along this section, the existing canal would be decommissioned, backfilled, and the disturbed soils would be contoured to match the surrounding land. The Main Canal would be converted to a 48-inch and 54-inch dual HDPE pipeline, so low flows associated with spray water could be conveyed at adequate velocities.[24]

HDPE pipes were selected because they are resistant to pressure from water hammer and have high tensile strength (Najafi et al. 2015). During installation, HDPE pipes are welded together; therefore, the need for expensive fittings and thrust blocks is minimized. HDPE pipe is easy to install, bendable, retains its properties between -220 °F and 180 °F, and has a design life of 100 years. It is also less susceptible to damage due to freezing water compared to other piping materials.

Under this alternative, 61 pressure-reducing stations would be installed and 384 District turnouts would be upgraded to pressurized delivery. Seventy-seven percent of the District (7,350 acres) would receive fully pressurized water deliveries (40 to 100 pounds per square inch; FCA 2018a). Most remaining irrigated land within the District would receive partial pressurization, with the Main Canal service area having limited pressurization as a result of the 0.4-mile segment of canal that would remain open from the diversion to the sand trap (FCA 2018a). This segment would remain open to provide a bypass channel when the new sedimentation basin (described below) is taken offline for maintenance (Wharry 2016); to provide additional sand settling capacity; and to accommodate the potential future construction of a replacement fish screen facility.[25]

Since three in-canal settling basins would be eliminated when the District's canals are piped, a new sedimentation basin would be installed immediately downstream of the existing sand trap. The preliminary design for this element consists of an excavated off-channel pond 100 feet wide by 300 feet long with sloping sides surrounded by an earthen berm on three sides. The total design water depth is 9 feet and the surrounding berm height is 3 feet above the water surface. The approximate total water capacity is 4.93 acre-feet; the approximate water quantity impounded above grade is 1.3 acre-feet. A 36-inch diameter overflow pipe would empty to a 48-inch diameter bypass pipe to the river (see Appendix E for preliminary design drawings). The final design would follow all applicable NRCS engineering standards. The larger volume and longer settling time of the proposed sedimentation basin compared to the District's existing settling facilities is expected to prevent more sand and coarse silt from entering the District's delivery system while improving the quality of

[23] At the time of implementation, the District would select a pipe material based on the material's constructability and cost-effectiveness. The material selected would meet both the NEE cost-effectiveness requirements and construction requirements for the project. The NRCS State Conservationist would possess the final discretion to select the appropriate piping material.
[24] A single 66-inch steel pipeline was considered, but the costs were comparable and steel is not expected to last as long as a dual HDPE pipeline.
[25] Leaving this segment open would not reduce future hydropower generation capacity in the District because, if piped, any gained pressure would be eliminated at the sand trap and sedimentation basin (M. Bossler, FCA Water Resources Engineer, personal communication, July 24, 2019).

irrigation water. [26] The sedimentation basin would serve as the District's primary sediment management facility. Accumulated sediment would be removed from the basin using an excavator and stockpiled or hauled off site. The existing sand trap would remain in place.[27]

Construction of the Piping Alternative would occur in three project groups (Figure 5-1.) over the course of 10 years. More detailed maps of the Piping Alternative are shown in Appendix C. Construction would occur during the non-irrigation season (October to April), with Project Group 1 construction beginning as early as the 2020 non-irrigation season. Construction of each project group is anticipated to require two to five non-irrigation seasons to complete.

Construction of the Piping Alternative would include mobilization and staging of construction equipment, delivery of pipe to construction areas, excavation of trenches, fusing of pipelines, removal of existing, outdated pipe in certain areas, placement of pipe, compaction of backfill, and restoration and reseeding of the disturbed areas. Pipe installation would require storage areas for pipe, construction equipment, and other materials. Areas that have been previously disturbed and are accessible through existing access routes would be used when possible.

Canals and laterals identified for piping would be accessed from EFID's existing maintenance roads when possible. Existing maintenance roads may require some improvements for use during construction. In some locations, temporary overland travel routes would be necessary to access certain laterals that do not have established maintenance roads. To facilitate restoration, temporary travel routes would be left in their natural condition, with only minimal altering when necessary to allow travel during construction. Construction of the sedimentation basin would include clearing of the land, pond and trench excavation, rock placement, concrete construction, and restoration and reseeding of the disturbed areas.

Vegetation clearing before construction, vegetation and weed management during construction, and reseeding after construction within EFID's easements would be completed according to the NRCS "Oregon & Washington Guide for Conservation Seedings and Plantings" (NRCS 2000). During construction, vegetation clearing would be minimized to the extent practicable. Trees would only be removed if there was no other alternative to access the construction site or if they pose a safety threat to construction crews working in the canal or lateral trench.

O&M under the Piping Alternative would include an ongoing pipe inspection program that would systematically cover the entire system over a period of several years (most likely a 10-year cycle). During the irrigation season from April to October, work would be performed on an as-needed basis. Outside the irrigation season, EFID would perform system component maintenance and/or repairs to District meters, valves, and other infrastructure.

[26] The proposed sedimentation basin is 7.8 times the volume of the existing sand trap (Wharry 2016). It is expected to settle at least 29.8 percent and potentially as much as 47.3 percent of sediment particles in the diverted water (FCA 2018a). For comparison, the existing sand trap is estimated to be able to settle out 12 percent of the overall incoming sediment load (Christensen 2013).

[27] The sand trap would remain in place for secondary sediment settling as needed and for use by the CTWS for several weeks each spring to acclimate and release hatchery fish as in the past.

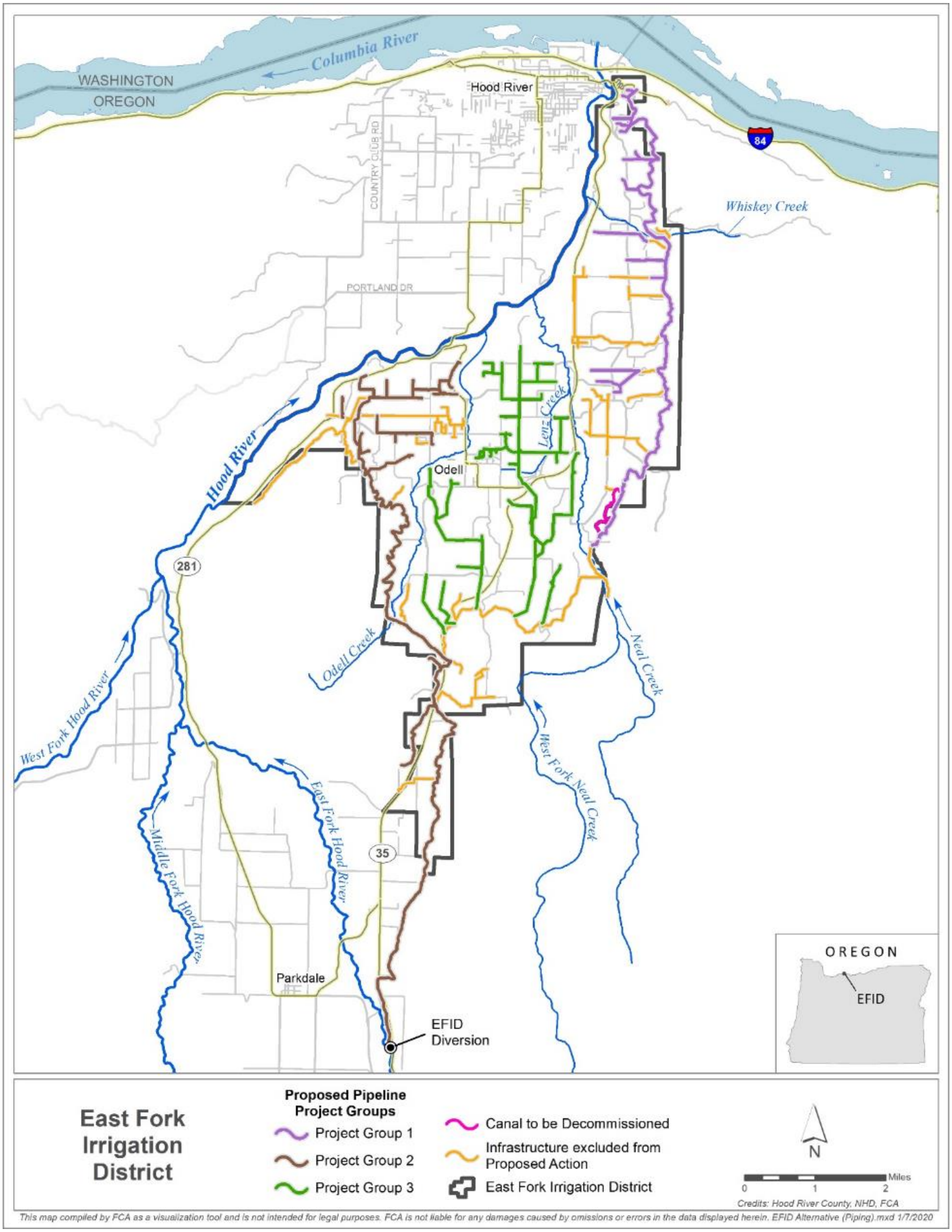


Figure 5-1. The Piping Alternative project groups for the East Fork Irrigation District Infrastructure Modernization Project.

The Piping Alternative contributes to the project's purpose and need as follows:

- Improve water conservation: This alternative would eliminate all of the existing water losses from end spills, saving an estimated 16.6 cfs (5,287 acre-feet annually) and an additional unknown amount of seepage losses from open canals.[28] As a result, the conveyance efficiency of the District's infrastructure is anticipated to improve from its current estimate of 82 percent to nearly 100 percent.
- Improve operation inefficiencies and water delivery reliability: This alternative would immediately improve water delivery reliability for patrons in a majority of the District by providing pressurized deliveries. Under this alternative, up to 25 percent or 4.15 cfs (1,322 acre-feet annually) of conserved water would be allocated to the District to increase the reliability of irrigation water supply. The conserved water allocation for irrigation use would allow EFID to better meet irrigation demand in drought years. A piped and pressurized system greatly increases conveyance efficiency, allowing patrons to adjust their deliveries to take the amount of water that they need when they need it. A piped system would eliminate the need to inspect, repair, and remove obstructions from open canals and debris from screens. This alternative would greatly reduce the need for staff to manually adjust diversion and spill amounts throughout the system. Additionally, the pressurized pipeline would reduce patron pumping costs. Sediment management improvements would reduce the labor and equipment costs currently needed to remove sediment from multiple locations along the District's conveyance system.
- Improve streamflow and habitat conditions for fish and aquatic species: This alternative would enhance streamflow and habitat conditions for fish and aquatic species, including four federally threatened fish species, and would create instream water rights through the State of Oregon's Allocation of Conserved Water Program (ORS 537.470). The District would allocate 75 percent of the conserved water, or up to 12.45 cfs, to instream use during the irrigation season. The allocation would occur incrementally following completion of each project group and the verification and measurement of the water savings. Streamflow and water quality along 21.2 river miles in the East Fork Hood River and the Hood River would benefit incrementally, with the greatest benefit in the East Fork Hood River below the diversion.

  Water quality would also improve in several other tributaries in the lower basin because this alternative would eliminate end spills of canal water discharged to natural drainages and streams. These end spills transport heat, glacial silt, and potentially pesticides and other contaminants into receiving streams.
- Improve public safety: Converting open canals to buried pipe would eliminate the risk of drowning, flooding, and other serious accidents associated with open canals.

[28] An additional, unquantified amount of water loss likely occurs from seepage along the District's open unlined canals. Seepage studies within the District have been inconclusive due to the large number of turnouts along canals, associated measurement errors, and other uncertainties. Canal seepage in EFID is not thought to be a major source of water loss given local geology and natural sealing of canal substrates over time through intrusion of silt and fine sediments.

- Limit sediment in irrigation water: The addition of a 30,000-square foot sedimentation basin would reduce the amount of sand and silt that enters the District's conveyance system, improving the quality of irrigation water.

The Piping Alternative achieves the Federal Objective to protect the environment by protecting and restoring streamflow in the Hood River. By improving operational efficiencies and eliminating end spills, thereby conserving water and improving water quality in Hood River tributaries, the Piping Alternative achieves the Federal Objective and Guiding Principle of sustainable economic development. The alternative also achieves the Guiding Principles of Healthy and Resilient Ecosystems by contributing to a more resilient ecosystem in the face of changing climate and the Guiding Principle of public safety through eliminating the public safety risks of open canals.

The estimated total installation project cost for the Piping Alternative is $62,189,000. With additional project administration and technical assistance costs, the total project cost would be $67,029,000.

5.4 Summary and Comparison of Alternatives

Table 5-2 compares the No Action Alternative (Alternative 1) and the Piping Alternative (Alternative 2). The table summarizes measures addressed as well as environmental, social, cultural, and economic effects.

Table 5-2. Summary and Comparison of Alternatives.

	Alternative 1: No Action (Future without Federal Investment)	Alternative 2: Piping (NEE Recommended)
Alternative Plans		
Locally Preferred		✓
National Economic Efficiency (NEE)		✓
Socially Preferred		✓
Guiding Principles		
Healthy and Resilient Ecosystems		✓
Sustainable Economic Development		✓
Floodplain		✓
Public Safety		✓

	Alternative 1: No Action (Future without Federal Investment)	Alternative 2: Piping (NEE Recommended)
Environmental Justice		✓
Watershed Approach		✓
Provisioning Services—Trade-Offs		
Irrigation water	The District's open canals would continue to lose water and make it difficult to deliver the right amount of water at the right time for farmers.	Would help provide more secure and reliable irrigation water for farmers.
Instream fish species	Low streamflow past the District's diversion would continue to diminish habitat conditions for fish in the East Fork Hood River.	In total, 12.45 cfs of conserved water left instream would help improve habitat for fish, which would benefit fish populations. Spawning habitat would increase for federally listed Chinook and coho salmon, and rearing habitat would increase for federally listed steelhead trout.
Regulating Services—Trade-Offs		
Water quality	Low streamflow in the East Fork Hood River would continue to affect stream temperatures. End spills of canal water would continue to discharge warm water, glacial silt, and potentially pesticides or other contaminants into small tributaries to the lower Hood River. Periodic increases in turbidity in the East Fork Hood River associated with maintenance operations at the sand trap would continue at the existing rate and frequency.	In total, 12.45 cfs of conserved water left instream would help improve temperatures in the East Fork Hood River. Eliminating end spills would improve water quality in affected tributaries. The sedimentation basin would improve the quality of irrigation water by removing up to 35 percent more sand and silt compared to the District's existing sand trap facility. Periodic increases in turbidity in the East Fork Hood River associated with maintenance operations at the sand trap would be sharply reduced or eliminated.

	Alternative 1: No Action (Future without Federal Investment)	Alternative 2: Piping (NEE Recommended)
Cultural Services—Trade-Offs		
Threatened species, species of concern	Low streamflow past the District's diversion would continue to impede recovery of three ESA-listed fish species in the East Fork Hood River as well as Pacific lamprey, a species of concern and traditional tribal food.	In total, 12.45 cfs of conserved water left instream would improve threatened fish and aquatic species habitat and may help improve their populations. Improving populations would benefit cultural, tribal, and religious values and bequest values.
Installation Costs		
Federal PL 83-566	$0	$29,549,000
Local only or Matching PL 83-566	$0	$37,480,000
Total	$0	$67,029,000
Project Group 1[1]		
Average Annual Cost Installation OMR[2] Total	 $0 $0 $0	 $395,000 $1,000 $396,000
Annual Benefits[3]	$0	$462,000
Annual Costs[4]	$0	$396,000
Annual Net Benefits[5]	$0	$66,000
Annual Remaining Flood Damage	N/A	N/A
Project Group 2[1]		
Average Annual Cost Installation OMR[2] Total	 $0 $0 $0	 $1,018,000 $10,000 $1,028,000
Annual Benefits[3]	$0	$1,218,000

	Alternative 1: No Action (Future without Federal Investment)	Alternative 2: Piping (NEE Recommended)
Annual Costs[4]	$0	$1,028,000
Annual Net Benefits[5]	$0	$190,000
Annual Remaining Flood Damage	N/A	N/A
Project Group 3[1]		
Average Annual Cost Installation OMR[2] Total	 $0 $0 $0	 $332,000 $7,000 $339,000
Annual Benefits[3]	$0	$633,000
Annual Costs	$0	$339,000
Annual Net Benefits[4]	$0	$294,000
Annual Remaining Flood Damage	N/A	N/A
N/A = not applicable [1] All costs and benefits presented in this table for the Piping Alternative are included as a change from the No Action Alternative. Costs and benefits for the No Action Alternative are shown as $0 to represent there would be no change to the existing costs and benefits. [2] O&M and replacement of the sedimentation basin. [3] For the Piping Alternative, a decrease in O&M costs of the canals and laterals was included in the benefits rather than the costs. Quantified benefits include instream flow benefits, agricultural yield benefits, reduced O&M costs, reduced carbon outputs, and reduced energy costs from pumping. [4] Annual net benefits shown for the Piping Alternative are the additional net benefits compared to the No Action Alternative.		
Regional Economic Impacts		
Local Jobs During Construction	No effect	80 jobs
Annual Jobs from agriculture (including direct/indirect/induced)	1,540 jobs	1,600 jobs
Beneficial Effects Annualized (million, 2019$)[1]		
Region	$64.1	$66.9
Rest of Nation	Some ripple income/employment effects expected, but not estimated.	Some ripple income/employment effects expected, but not estimated.

	Alternative 1: No Action (Future without Federal Investment)	Alternative 2: Piping (NEE Recommended)
Adverse Effects Annualized (Millions, 2019$)[2]		
Region	Not available	-$0.6 (reduced OMR costs compared to No Action)
Rest of Nation	N/A	$1.8

N/A = not applicable; OMR = operate, maintain, and replace

[1] Beneficial effects include only those related to labor income, and do not include the net economic benefits quantified in the National Economic Efficiency (NEE).

[2] This includes only the direct costs (no indirect/induced costs are included).

6 Environmental Consequences

This section evaluates the environmental consequences of the No Action Alternative and the Piping Alternative. The beneficial and adverse effects of the two alternatives on each resource in Section 4 were evaluated. The intensity of an adverse effect was classified as negligible, minor, moderate, or major. The duration of an effect was classified as temporary, short-term, or long-term. Appendix E presents the intensity threshold matrix used to categorize and define the range of expected effects.

6.1 Cultural Resources

6.1.1 No Action (Future without Federal Investment)

The District's ongoing O&M activities are not expected to affect historic or archaeological resources because these activities are expected to occur in previously disturbed areas.

6.1.2 Piping Alternative

NRCS has initiated consultation with SHPO for the proposed action by providing a project description and a map identifying the Area of Potential Effect.

In addition, Bonneville has executed a Memorandum of Agreement with SHPO to mitigate adverse effects on the EFID. The undertaking consisted of converting open irrigation canals to closed piped irrigation, and installation of a permanent water diversion, headworks, and fishway.

Effects on historic canal structures would be completed in compliance with the NHPA. The EFID is eligible for inclusion in the NRHP as an Historic District under Criterion A (36 CFR 60.4(a)) for its association with the development of irrigated agriculture in the Hood River region. Additionally, EFID is eligible for inclusion in the NRHP under Criterion C (36 CFR 60.4(c)) as a "significant and distinguishable entity whose individual components may lack individual distinction" (NPS 1995). The period of significance for EFID ranges from 1914 to 1917, when the majority of the EFID system was planned and built. This includes the system that EFID acquired from the East Fork Irrigation Canal Company in 1914. The integrity of the system as a whole has not been assessed.

Piping projects could impact the integrity of the irrigation ditches and may have an adverse effect on the resource. If projects are determined to constitute an adverse effect on the EFID Historic District, the Advisory Council on Historic Preservation (ACHP) would be notified and SHPO and appropriate consulting parties would be consulted to develop mitigation measures and a Memorandum of Agreement.

While a variety of cultural resources could be impacted by the modernization actions, it is likely the main impacts would be to developed infrastructure associated with EFID's operations and historical agricultural practices. Minimization, avoidance, and mitigation measures developed through consultation under Section 106 of the NHPA would be used to offset site-specific project effects.

Minimization and avoidance are typically achieved by modifying the project design to lessen the amount or type of impacts proposed in areas where cultural resources are known to exist. Sometimes protective measures can be incorporated into the project design and implementation that can also minimize or avoid affecting cultural resources. Other times creative implementation techniques can be explored and utilized. An example would be to use introduced fill to construct temporary access roads across an archaeological site to protect it from ground disturbance. Other methods might consist of using temporary fencing to restrict project activities from impacting adjacent cultural resources.

Post-review discovery plans may be used to communicate how to protect a site, when to stop work, and to outline the steps to take in the event a cultural resource is discovered or impacted during construction. In some cases, it may be that an impact to a cultural resource is unavoidable. For example, the focus of this modernization effort may directly affect features of EFID. In these circumstances, site-specific consultation with the consulting parties, including SHPO and interested tribes, is critical in developing the appropriate approach to avoid loss of valuable historic information and values.

Effects on cultural resources could be avoided, minimized, or mitigated after thorough evaluation and consultation with tribes, states, and other consulting parties.

The District is in the process of having a cultural resource specialist complete site surveys for historic and archaeological resources in the project area. If eligible resources are documented in the project area by a cultural resource specialist, consultation would occur between the District, NRCS, and SHPO to determine the effect on such resources and identify appropriate mitigation. Based upon previous mitigation measures implemented by other districts in the basin, if mitigation were to be required, it could include actions such as working with the historic society to create photographic documentation and an archival research document of the canal and laterals. Mitigation measures, if required, would be identified before construction and completed concurrent with or after construction. The potential cost of mitigation for effects on cultural resources is included in the project cost.

If historic resources, including human remains, are encountered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop in the vicinity of the discovery, the area would be secured and protected, a professional archaeologist would assess the discovery, consultation with SHPO and NRCS cultural resources staff would occur as appropriate, and the appropriate tribes would be notified. Continuation of construction would occur in accordance with applicable guidance and law.

6.2 Land Use

6.2.1 No Action (Future without Federal Investment)

The No Action Alternative would not have a direct effect on land use within the project area and lands served by the District. The District's irrigation system would continue to operate as open canals and pipelines. Irrigated agriculture producers would continue to face increasing water supply uncertainty. Water supplies would continue to be unreliable, and agriculture producers may irrigate fewer acres of land or grow different crops in the future. Compounded with anticipated population growth and potential developmental pressures, agricultural lands could be increasingly vulnerable to transitioning to a different land use.

The periodic use of herbicides to control nuisance algae in District canals would continue to be a concern to some patrons as this could affect organic farm certification. Periodically high levels of sand and silt in the water delivered to patrons would continue and may potentially increase as a result of climate impacts to glacial recession and on the frequency of landslides in the upper East Fork Hood River.

6.2.2 Piping Alternative

The Piping Alternative would have negligible effects on land use in the project area; easements would continue to be used for the conveyance of irrigation water and O&M, including installation of the sedimentation basin, and best management practices (BMPs) would be implemented. Following construction, the District would continue to maintain its access to the buried pipelines via a trail, track, or gravel road within its easement. The District would install gates and signs at select locations to prevent unauthorized motorized vehicle usage of maintenance roads or trails after construction.

Prior to construction, the District would consult with Hood River County to determine if a National Scenic Area permit would be required. All construction would occur within District easements, and adjacent landowners would be notified of the specific construction schedule for their property. In limited areas, the District would work with landowners to obtain any new easements needed for the project. For example, approximately one-half mile of the pipeline that would replace the EC would not follow the existing canal alignment, but instead would follow a shorter route through both private land and county-owned forest land under a new easement. There would be no change in property ownership. After construction, ground that was disturbed in the project area would be reseeded with a mix of native grasses and forbs.

Implementation of the Piping Alternative would support the existing agricultural land use. Current zoning designations and planning goals would also be supported under the Piping Alternative. Construction would take place outside of the irrigation and growing season, and there would be no interruption to water deliveries. There would be negligible effects on agricultural land served by the project during or after construction.

6.3 Public Safety

6.3.1 No Action (Future without Federal Investment)

Under the No Action Alternative, the existing canals would remain open and the risk of drowning and injury would remain. The risk of drowning, flooding, and other serious accidents would increase as residential development and population grows and surrounds more of the District.

6.3.2 Piping Alternative

During construction of the Piping Alternative, public safety would be affected by vehicle and heavy equipment traffic entering and leaving the project area. Construction traffic could interact with motor vehicles, pedestrians, and bicyclists traveling through farmlands and urban and suburban zones along Oregon Route 35 and county and community roads that intersect the project area. Standard safety protocols and BMPs would be followed during construction to minimize any risk to public safety; therefore, only a minor, short-term effect on public safety is anticipated during construction.

This alternative would eliminate the drowning risk from open canals. This would result in beneficial effects on public safety since the possibility of a serious accident or loss of life associated with open canals would be eliminated in all but a 2,300-foot long section of canal inside the District's gated headworks area that would remain open for operational purposes. This alternative would also nearly eliminate any potential flooding risk from canal breaches and overflow, and the durability of the pipeline would increase seismic resiliency.

6.4 Socioeconomic Resources

To estimate the total economic effects of the No Action Alternative and Piping Alternative in terms of jobs and incomes supported, this analysis uses a 2015 IMPLAN economic impact model of Hood River County.[29]

6.4.1 No Action (Future without Federal Investment)

Under the No Action Alternative, the total economic activity supported by EFID agricultural production is estimated at approximately 1,540 jobs (approximately 1,210 jobs in agriculture and an additional 330 jobs in other economic sectors) and $64.1 million in average annualized income ($39.1 million in agricultural income and an additional $25 million in income in other sectors benefiting from agricultural expenditures and income).

6.4.2 Piping Alternative

6.4.2.1 Regional Economic Impact

The Piping Alternative construction expenditures of approximately $67 million would support construction sector jobs and income and would have economic ripple effects increasing jobs and income in other economic sectors in Hood River County. Economic ripple effects would result from the construction sector spending more on labor, materials, and services, which would spur increased sales and economic activity in other sectors (e.g., hardware stores and construction equipment businesses). Effects of construction sector spending in these other sectors are known as indirect effects. As household income rises in construction and indirectly affected economic sectors, household spending would also increase and generate increased economic activity in such sectors as retail, wholesale trade, personal services industries, and real estate (known as induced effects). Total job and income effect of the economic activity that would be supported are the sum of the direct effects (construction sector) and the indirect/induced effects (in other economic sectors).

The approximately $67 million in construction expenditure would be spread over 10 years, supporting approximately 80 jobs and $3.1 million in average income over the 10-year construction period (annualized over 110 years,[30] equating to approximately $0.8 million in annualized average

[29] Total construction expenditures were modeled in IMPLAN Construction Sector 57, construction of new commercial structures, including farm structures.
[30] Note that each project has a 100-year life; however, since construction takes 10 years, benefits extend out to year 100, so the analysis period for all project groups is 110 years.

income benefits). Of these effects, approximately 60 jobs and $2.3 million in annual income would be in the construction sector (direct effects), while the remaining 20 jobs and $0.8 million income would be in other sectors.

The Piping Alternative is also expected to result in additional agricultural production due to increased water supplies that are expected to improve water supply reliability, which would decrease crop damages resulting from future projected water shortages due to climate change. Under this alternative, the average annual total economic activity supported by EFID agricultural production is estimated at approximately 1,600 jobs (approximately 1,250 jobs in agriculture and an additional 350 jobs in other economic sectors) and $66.2 million in average annualized income ($40.4 million in agricultural income and an additional $25.8 million in income in other sectors benefiting from agricultural expenditures and income).

The Piping Alternative would also result in reduced O&M expenses for EFID and pumping costs for its patrons. However, there are no anticipated effects on District wages and employment. Reduced O&M and pumping costs may largely result in an income transfer between EFID patrons, EFID staff, and the local construction/repair/electricity sectors. As such, there are expected to be limited Regional Economic Impact effects of this reduced expenditure (i.e., less than the rounding margin of error) so effects are not quantified in this analysis. To the extent that increased flows enhance recreation and support additional recreation visitation and spending in Hood River County, the long-term, positive regional economic contribution of the project would be much larger, and vice versa.

The Piping Alternative would have a beneficial effect on employment and income in Hood River County from construction activities, and a beneficial effect on agricultural production and related farm household income in the County. A National Economic Efficiency (NEE) benefit cost analysis has been performed to evaluate the benefits of the Piping Alternative (Appendix D).

6.5 Vegetation

6.5.1 No Action (Future without Federal Investment)

Under the No Action Alternative, vegetation along the network of open irrigation canals and buried pipelines would persist and adjacent native upland vegetation would remain in its current condition. Ongoing maintenance along the District's system would have a minor effect on existing vegetation conditions in the project area.

6.5.2 Piping Alternative

6.5.2.1 General Vegetation

Vegetation within the project area may be disturbed by construction activities including clearing, excavation, and trenching for pipe placement; replacement of existing piping; disturbance of lands adjacent to canals and pipelines where required for construction equipment access or staging of equipment and materials; and clearing for the construction of a sedimentation basin facility.

During construction, existing access roads, lanes, and tracks within the District's existing easements would provide access to most of the project area. Selection of construction areas and travel routes adjacent to canals and laterals would consider existing vegetation and avoid mature trees to the extent practicable. Herbaceous, shrub, and woody vegetation along the canals, laterals, and delivery turnouts within the project area would be temporarily disturbed through activities such as clearing and digging.

Construction of the sedimentation basin near the EFID diversion would clear an additional, partially forested area of approximately 1.1 acres. Construction of a new pipe alignment at the south end of the EC would clear approximately 0.7 acre of mature, mostly Douglas fir trees on county-owned forest land. Restoration of disturbed areas on this land would occur as negotiated with the Hood River County Forestry Department during the easement acquistion process.

After construction, the project area would be recontoured and all disturbed areas would be planted with a seed mix of native grasses and forbs (Figure 6-1 and Figure 6-2). For the large-diameter pipelines that would replace the open DVC, EC, and Main Canal, a layer of gravel or crushed rock would be placed over or alongside the buried pipeline to serve as an access road, and disturbed soils at the road margins would be planted with a seed mix of native grasses and forbs. Planting would occur in consultation with NRCS. Vegetation within the affected areas would return to historic upland habitat. Some trees that are dependent upon the canal for water may not survive due to a lack of water following construction of the Piping Alternative. The District would continue to remove any fallen trees within its easement to maintain access. However, the District would not remove potential hazard trees that could fall within its easement.

In the long term, a net gain in native vegetation in the project area would occur because the overall project footprint after piping would generally be narrower than the footprint of the existing open canals with the adjacent maintenance tracks or roads. This change in corridor width would allow for additional native vegetation or forest cover growth. Over the project's life, planted vegetation within the District's easements would be maintained according to the NRCS "Oregon & Washington Guide for Conservation Seedings and Plantings" (NRCS 2000). Trees would not be allowed to establish above the buried pipe because roots may interfere with future O&M activities.

The Piping Alternative would have a minor, short-term effect on vegetation in the project area during construction because disturbance would occur on 1 percent of the District; over half the disturbance would occur on cultivated or developed land. Erosion control measures and materials would be free of weeds and weed seeds. Disturbed areas would be revegetated with native grasses and forbs in consultation with NRCS. Weeds would be managed according to the guidelines in the NRCS "Oregon & Washington Guide for Conservation Seedings and Plantings" (NRCS 2000). These guidelines focus on weed control through proper seedbed preparation, seed selection, seeding timing and rate, and seeding depth and cover, with herbicide or other control of weeds on an as needed basis.

Figure 6-1. A section of the Central Lateral Pipeline 9 years after construction.

Source: Google Earth Pro v. 7.3.2.5776; imagery date 9/3/2018

Figure 6-2. Vegetation along a buried District lateral pipeline 5 years after construction.

6.6 Visual Resources

Effects on visual resources occur when project activities visually stand out from the existing landscape or introduce disruptive visual characteristics. The visibility of the activity or modification and the sensitivity of the viewer influence the magnitude of the effect. For example, there would be less of an effect from construction of a project feature that is surrounded by thick vegetation or that blends into the landscape than from one that is constructed in an open area.

This visual analysis was based on evaluations of aerial and ground-based photographs of the proposed project sites and preliminary design information. The duration over which any changes would occur was also considered.

6.6.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be no changes to visual resources, and residents and visitors would continue to see open canals from public and private viewpoints.

Ecosystem services related to visual resources are impacted by the No Action Alternative in the following ways:

Cultural Service, Culturally Appreciated Landscape (Figure 4-1 [E5]): Under the No Action Alternative, there would be no effect on the value that private landowners would derive from the open canal system. The views would remain the same as would any value private landowners gain from use of the easement for walking along the open canals (although this is not a permitted use of the easement).

6.6.2 Piping Alternative

Construction activities would have a negligible effect on visual resources because most construction would be short term and occur out of public view, and because large equipment commonly used for agricultural production and current canal maintenance is typically seen in project and surrounding areas.

After construction, the project area would be recontoured and all disturbed areas would be planted with a seed mix of native grasses and forbs. Rural residences that previously had views of open canals and people that walk along the maintenance roads or trails along the canals would have a view of a vegetated area similar to the surrounding landscape. Although the maintenance roads and trails along the District's canals and pipelines are used for recreation by some area residents, the District's easements are only for maintaining irrigation infrastructure and conveying irrigation water. Public use of the property alongside the District's canals and laterals is not a purpose of the District's easements and occurs at the discretion of each property owner. In any areas where trees were removed, viewers would experience a change from seeing trees along an open canal to seeing a vegetated area.

Overall, the Piping Alternative would have a minor, long-term effect on visual resources in the project area because there are relatively few public viewpoints of the canals and the vegetated project area would blend in with the natural landscape.

Ecosystem services related to visual resources are impacted by the Piping Alternative in the following ways:

Cultural Service, Culturally Appreciated Landscape (Figure 4-1 [E5]): Under the Piping Alternative, there would be minor effects. Although there would be a change in the value that was gained from the view of an open canal versus a vegetated corridor and from walking along an open canal versus a vegetated corridor, there is a limited number of private individuals that would be affected. The change in this ecosystem service would be offset by improvements to the other cultural, provisioning, and regulating services that would be gained by the greater public.

6.7 Water Resources

6.7.1 No Action (Future without Federal Investment)

6.7.1.1 Water Rights

Under the No Action Alternative, the District would maintain its water rights at the current amount and would not create instream water rights through Oregon's Allocation of Conserved Water Program (ORS 537.470). A portion of the water diverted at the EFID diversion would continue to be spilled at the end of canals and laterals, and an additional unquantified portion would continue to seep into the ground before reaching any orchards and farms. The District would continue to call on its patrons to curtail irrigation during drought years, and as the climate warms, the frequency of curtailment requests may increase. Instream water rights would continue to be unmet in the East Fork Hood River during the irrigation season.

6.7.1.2 Surface Water Hydrology

During the irrigation season, streamflow in the lower East Fork Hood River (RM 6.6 to RM 0) would continue to be very low compared to natural levels as a result of the District's water diversion. The amount of streamflow in the river during the summer is predicted to decrease over time as a result of climate trends. The District would continue to divert more water than is directly used for irrigation to maintain the end spills that are required to ensure water delivery to all patrons. Streamflow in East Fork Hood River would continue to fall short of the instream water rights established to protect fish and wildlife, and no additional water would be permanently protected instream. End spill discharges of canal water maintained by the District would continue to alter the amount and variability of streamflow in affected tributaries. The District's open canals would continue to capture and redirect stormwater runoff from adjacent hillsides or intermittent streams at some locations in the project area.

6.7.1.3 District Operations and Water Supply

Under the No Action Alternative, current District operations would continue and provide the current level of water delivery reliability. The District would continue to lose an estimated 16.6 cfs, or 18.3 percent of the water that it diverts, through end spills. Pressurized water deliveries would not increase, and up to 4.15 cfs of the total water saved by piping would not be allocated to the District to benefit EFID patrons. Water management and water supply would become more challenging over time as a result of climate trends. According to climate modeling study of the Hood River basin, climate change is expected to result in water supply shortages of 10 to 12 percent in the

EFID, or roughly 12.9 cfs occurring in 1 out of 10 years beginning in 2030 under the warmest and driest climate scenario, with greater shortages occurring less frequently (Reclamation 2014b). The actual shortage is expected to be larger since the study did not account for a recent agreement between EFID and CTWS to maintain at least 15 cfs instream in the bypass reach below the District's diversion (Section 4.7.2.1). When accounting for the minimum instream requirement, the total EFID future water supply shortage due to climate change under the No Action Alternative would be 22 percent or roughly 25.8 cfs[31] in 1 out of 10 years (Appendix D).

The sand and silt concentration in the water supply under the No Action Alternative would not improve and may increase as a result of future climate impacts to glacial recession and landslide activity along the upper East Fork Hood River. Furthermore, the District would not have enhanced sediment settling capacity to mitigate these impacts.

6.7.1.4 Surface Water Quality

The District's diversion would continue to affect stream temperatures in the East Fork Hood River and the Hood River (ODEQ 2001). End spills of canal water would continue to discharge heat and turbidity in Neal, West Fork Neal, Lenz, Whiskey, and Odell creeks and continue having the potential to transport herbicides, pesticides, and other contaminants to the aquatic ecosystem. The periodic flushing of sediment into the East Fork Hood River at RM 6.1 associated with the operation of the District's existing sand trap facility would continue at the current rate and frequency, resulting in temporary increases in turbidity levels during flushing events. Under the No Action Alternative, District operations would continue to have minor to moderate effects on surface water quality.

6.7.1.5 Groundwater

Continued District operations are not anticipated to affect groundwater resources. Precipitation is the major source of aquifer recharge in the Hood River basin, while canal seepage is estimated to contribute only 1 percent of the total recharge (Reclamation 2015).

Ecosystem services provided by water in the East Fork Hood River are impacted by the No Action Alternative in the following ways:

Provisioning Service, Irrigation Water: Under the No Action Alternative, there would be no effect on irrigation water because the amount of water diverted from the East Fork Hood River for irrigation purposes would largely remain the same. The District would continue to pipe open canals at a pace dependent on the availability of public funding, which is not reasonably certain to be available at a scale large enough to fully modernize the District's infrastructure. Any increase in irrigation water conveyance efficiency would, therefore, match the pace of this slow modernization if it occurs. Patrons would likely continue to participate in voluntary water cutbacks, particularly during the end of irrigation season and during drought years when surface water flow in the East Fork Hood River is low.

[31] EFID current system demand is 117 cfs based on its maximum diversion rate (2001-2017) (FCA 2018a). Subtracting the estimated 16.6 cfs of water lost through end spills in the conveyance system, the current EFID irrigation demand is approximately 100.4 cfs.

Regulating Service, Water Quality: Under the No Action Alternative, there would be no effect on water quality. Low streamflow in the East Fork Hood River downstream of the District's diversion would continue to contribute to water temperatures that are often warmer than state standards during the irrigation season. Low quality water from end spills would continue to contribute glacial turbidity, any non-source pollutants, and warm water to cool, smaller tributaries.

6.7.2 Piping Alternative

6.7.2.1 Water Rights

Following construction of the Piping Alternative, EFID would create permanent instream water rights in the East Fork Hood River through Oregon's Allocation of Conserved Water Program (ORS 537.470). The amount of water allocated instream through this program would be determined based on the amount of water saved throughout the irrigation season of April 15 to September 30. The District has estimated that the elimination of end spills under this alternative would save up to 16.6 cfs or 5,827 acre-feet annually. Under this alternative, the District would legally reduce their water right and protect 75 percent[32] of the total water saved instream, or up to 12.45 cfs. The District would allocate this water instream in increments after completing each project group, protecting this water downstream from EFID's diversion with a water right having the same priority date as the District's original 1895 right. Following the completion of each project group, EFID would work with OWRD and its partners to verify and measure all water savings prior to creating instream water rights.

This alternative is expected to benefit patrons by helping to ensure the delivery of water rights throughout the irrigation season. As project groups are completed, 25 percent of the total water saved (estimated to be up to 4.15 cfs) would be allocated to the District and would remain on its original water right certificate for irrigation. The District would use this water to increase the reliability of its water supply and improve its resilience to projected climate impacts. Additionally, by delivering cleaner irrigation water, patrons would be able to use smaller sized nozzles in sprinkler systems, which would lead to more efficient on-farm water use (EFID 2014).

No effects on any other water rights in the basin are anticipated, although the potential for effects on other water rights in the basin would be evaluated by OWRD as part of the conserved water application process. In particular, no effects on water rights are anticipated due to the elimination of end spill discharges. No water rights have been issued on the District's end spill water, and no water rights rely on the specific contribution of end spill water (R. Wood, Watermaster, OWRD District 3, personal communication, June 18, 2019).

6.7.2.2 Surface Water Hydrology

Under the Piping Alternative, end spill discharges of water maintained by the District would be eliminated and would not continue to alter the amount and variability of streamflow in Neal, West

[32] EFID's Conserved Water Policy, adopted in 2007 and amended in 2014, states that if more than 25 percent of the funds used to finance the conservation measures are from federal or state public sources and are not subject to repayment, the instream percentage will equal the percentage of public funds used to finance the conservation project. The District anticipates that 75 percent of the funding for the proposed action would be from public sources not subject to repayment.

Fork Neal, Whiskey, Odell, and Lenz creeks during the irrigation season. Numerous additional, minor end spills would not return to other surface waters in the lower basin. This change is anticipated to have a minor effect on surface water hydrology because the affected streams would return to a more natural flow regime.

Enclosing canals may change local stormwater or surface water runoff patterns along the project area at locations where a canal may accept water from natural drainages and seeps along hillsides. This alternative is anticipated to have a minor effect on surface water hydrology because drainage measures would be incorporated into the engineering design that consider existing land use, and where feasible, restore the natural runoff patterns.

To address the identified watershed problems and resource concerns related to fish and aquatic habitat, the District would allocate 75 percent of the total water saved, or up to 12.45 cfs, to instream water rights, improving streamflow in the East Fork Hood River and the Hood River during the irrigation season. The remaining 25 percent of the total water saved, or up to 4.15 cfs, would be allocated to the District, increasing the reliability of the water supply for irrigation. Additionally, as sections of the District become piped and pressurized, the conveyance system would convert to an on-demand system, allowing more water to remain instream when not being used. The increased streamflow would lessen the impact of diversion on the natural flow regime in these rivers and improve the functioning of the aquatic and riparian ecosystem. These increases would occur throughout the irrigation season but provide the greatest benefits during the low flow period from late July through September. Effects on individual reaches are identified below.

East Fork Hood River Bypass Reach (RM 6.6 to RM 6.1): The District's allocation of conserved water to instream water rights would allow the District to increase its current minimum streamflow in the bypass reach below the diversion by up to 80 percent, resulting in a change from 15 cfs to 27 cfs. A recent study by CTWS identified 27 cfs as the minimum streamflow required for the passage of adult Chinook salmon in the bypass reach (see Section 4.8.2); therefore, this project would provide a specific benefit to fish passage for a threatened fish species as well as improve overall aquatic habitat conditions, resulting in a major beneficial effect on this reach of the river.

East Fork Hood River to confluence with the Middle Fork Hood River (RM 6.1 to RM 0): The District's allocation of conserved water to instream water rights would increase the historic August monthly average streamflow in the lower East Fork Hood River by up to 15 percent.[33] Compared to the average August streamflow during the 2015 drought, streamflow would increase by up to 38 percent, while the minimum daily August flow would increase by up to 60 percent. This change in streamflow would have a moderate, beneficial effect on this reach of the river with the greatest beneficial effect in dry and drought periods.

Hood River from the East Fork Hood River and Middle Fork Hood River confluence to Whiskey Creek (RM 14.6 to RM 3): The District's allocation of conserved water to instream water rights would increase the historic August monthly average streamflow at the Tucker Bridge stream gage in the Hood River by

[33] Based on average August monthly streamflow of 85 cfs at RM 1 for the period 1996 to 2017 (P. Simpson, ODFW, personal communication, November 15, 2019).

up to 3 percent.[34] Compared to the average August streamflow during the 2015 drought, the August monthly average would increase by up to 5 percent. This change in streamflow would have a measurable, minor beneficial effect on the Hood River.

Hood River from Whiskey Creek to the Columbia River (RM 3.0 to RM 0): Under the No Action Alternative, all of the estimated 16.6 cfs of end spill returns to the Hood River at points that are upstream of, or at, RM 3.0, with the majority of end spill returning through Odell, Neal, and Whiskey creeks. Under the Piping Alternative, up to 75 percent of the conserved water would remain instream while up to 25 percent or 4.15 cfs would be allocated for out of stream use for irrigation. As a result, this reach of the Hood River would experience a decline of up to 4.15 cfs or approximately 1 percent of August monthly average streamflow and up to 2.3 percent during extreme drought conditions such as those occurring in September 2005.

6.7.2.3 District Operations and Water Supply

Implementation of the Piping Alternative would benefit District operations and irrigation water supply. Patrons would benefit from an on-demand system that would operate with the flow rate and pressure required by on-farm irrigation systems with timing, duration, and frequency decided by the farmers (Calejo et al. 2008). Converting to a piped conveyance system would allow for improved system operation, greater system efficiency, and more responsive water management.

The Piping Alternative would result in a total water savings of up to 16.6 cfs, of which 4.15 cfs would be allocated to the District to benefit EFID patrons. In a basin where climate warming is predicted to reduce summer streamflow and intensify competing demands for water, EFID would be able to provide a more reliable water supply to patrons without increasing the amount of water diverted. The projected water shortage in EFID from climate change impacts under the Piping Alternative would be 9 percent, or roughly 9.2 cfs at least 1 year every decade, compared to 22 percent (roughly 25.8 cfs) under the No Action Alternative (Appendix D and Section 6.7.1.2). While this alternative is not intended to eliminate all future drought and climate-related water shortages in EFID, it would reduce the severity of water shortages compared to the No Action Alternative.[35]

Enhanced sediment settling capacity under the Piping Alternative would limit the sand and silt concentration in the District's water supply and mitigate potential future climate-related increases in the East Fork Hood River's sediment load due to accelerated glacial recession and landslide activity.

6.7.2.4 Surface Water Quality

Additional streamflow would affect water quality in the East Fork Hood River which currently does not meet Oregon water quality standards and is listed as water quality limited under Section 303(d) of the CWA (33 U.S.C. 1251 et seq.). Section 4.7.3 provides more detail on water quality impairment in the East Fork Hood River and in other waterbodies affected by the Piping Alternative. Although the allocation of conserved water to an instream water right under this alternative would not provide a sufficient water volume to reduce temperatures enough to ensure meeting Oregon water temperature standards, the increased streamflow is expected to reduce maximum daily water temperatures and the frequency at which temperature standards are exceeded compared to the No Action Alternative following completion of all project groups. The increased streamflow would have

[34] Average monthly streamflow of 358 cfs for the period 1996 to 2017. USGS Gage No. 14120000 Hood River at Tucker Bridge.

[35] Other District strategies to address future shortages include additional water savings from on-farm irrigation upgrades, a potential Hood River basin water bank, and a longer-term plan to develop reservoir storage.

a negligible effect on water temperature in the Hood River. Additional streamflow would also benefit wetland and riparian areas along these streams by improving their ecological function, subsequently enhancing water quality.

The Piping Alternative would eliminate approximately 25 end spill return flows to lower basin streams including Neal, West Fork Neal, Odell, Lenz, and Whiskey creeks and the Hood River. This end spill water is typically warmer than the receiving waterbody, has high glacial turbidity, and contains a high risk of nonpoint source contamination due to the interaction of the District's open canals with agricultural lands and roads. The potential for contaminant delivery to streams through air, wind, infiltration, runoff, and other pathways would continue; however, the risk of nonpoint source pollution from the irrigation system would be eliminated. This change would result in a negligible to moderate improvement in turbidity and temperature, with the most improvement expected in the Neal Creek system because of the volume of the end spill removed relative to streamflow in the creek. The proposed project would not be expected to affect the pH of the water delivered by the District.

The proposed sedimentation basin element would improve water quality in the East Fork Hood River by dramatically reducing or eliminating sediment flushing operations at the District's existing sand trap and the associated increases in turbidity levels. Accumulated sediment in the basin would not be flushed back to the river but instead would be excavated for upland disposal.

Eroded soil from construction sites could be carried to nearby streams during construction and for a short time thereafter; however, the effect of construction activities on water quality is expected to be negligible and temporary because construction BMPs to control soil erosion would be used in the proposed action.

In summary, water quality would improve in the East Fork Hood River due to increased streamflow under the proposed action. The effect on water quality in the Hood River would be beneficial but negligible due to the small quantity of added streamflow relative to the volume of the river. Although streamflow in Neal, West Fork Neal, Odell, Whiskey and Lenz creeks would be reduced during the irrigation season under this alternative, water quality would be expected to improve in these tributaries because end spills containing glacial silt, heat, and potentially herbicides, pesticides, and other nonpoint source contaminants would be eliminated.

6.7.2.5 Groundwater

No groundwater would be used as part of the Piping Alternative; however, piping the irrigation canals could affect groundwater by reducing canal seepage. This alternative is expected to have a negligible long-term effect on groundwater resources and wells in the project area because the vast majority of aquifer recharge in the basin is from precipitation as previously noted in Section 4.7.4

Ecosystem services provided by water in the East Fork Hood River are impacted by the Piping Alternative in the following ways:

Provisioning Service, Irrigation Water: There would be a moderate, long-term effect on irrigation water after implementation of the Piping Alternative. Water conveyance through closed pipe would improve efficiency by eliminating water loss due to end spills which, in turn, would allow the District to deliver a more reliable water supply to patrons while diverting less water from the East Fork Hood River. Modernization of District irrigation infrastructure would allow EFID to allocate up to 25 percent of the conserved water to improve the reliability of irrigation water supply, particularly during drought years (Section 6.7.2.1). Currently, the District undergoes voluntary curtailment of water during drought, which has occurred approximately 1 in 10 years, resulting in economic losses from decreased agricultural yield. The Piping Alternative would reduce the effect of future water shortages; enable the District to be more resilient to environmental changes; and reduce agricultural yield losses, which would provide an average economic annual benefit of $1.36 million (see Appendix D for details).

Regulating Service, Water Quality: After modernization of District infrastructure, less water would need to be diverted from the East Fork Hood River to fulfill patron's water rights, leaving more water instream by eliminating end spills. Additional streamflow during the irrigation season would assist in regulating water temperature against hot, ambient temperatures in summer months, moving water temperatures towards ODEQ's temperature criteria for the East Fork Hood River and other affected waterbodies downstream (Section 4.7.3.1). Although elimination of end spill discharges would reduce streamflow in tributaries such as West Fork Neal Creek, an associated reduction in turbidity and pollutant risk would improve water quality in these waterbodies. For example, end spill discharges into West Fork Neal Creek were found to be warmer and more turbid than the creek upstream of the discharge location (Section 4.7.3.1). Quantitative data regarding water quality under the Piping Alternative is not available, however, eliminating poor water quality end spills would improve stream water quality and the instream resources that water quality regulates.

6.8 Fish and Aquatic Resources

6.8.1 No Action (Future without Federal Investment)

6.8.1.1 General Fish and Aquatic Species

The District would continue to divert water at the current rate from the East Fork Hood River for consumptive use and maintain end spills that return to streams in the lower Hood River basin. This would continue to alter the natural streamflow regime in the East Fork Hood River, the Hood River, and the tributaries receiving end spills. Fish screens near the District diversion would continue their current function to prevent fish from entering the irrigation system from the East Fork Hood River. Ongoing water quality impacts from end spills would continue to affect fish and aquatic life in receiving streams. Under the No Action Alternative, habitat supporting general fish and aquatic species would be similar to current conditions. During the irrigation season, reduced streamflow in the lower East Fork Hood River would continue to diminish the availability of fish habitat, impede adult fish passage, and contribute to warmer temperatures for fish and aquatic species. Periodic sediment discharges into the river associated with the District's existing sand trap operations would continue at the current rate and frequency (Section 4.7.3.3). These would continue to affect turbidity levels and potentially affect instream habitat conditions for fish and macroinvertebrates (Section 4.8.1).

6.8.1.2 Federally Listed Fish and Aquatic Species

Under the No Action Alternative, designated critical habitat supporting ESA-listed threatened populations of Lower Columbia River steelhead, and coho and Chinook salmon, and Hood River bull trout, would remain similar to its current state except that habitat quantity and quality would be at greater risk from the projected warmer temperatures and lower summer streamflow associated with the changing climate. The minimum instream flow provided by the District in the East Fork Hood River at the EFID diversion would remain at its current level of 15 cfs. The District would not be able to provide the 27 cfs minimum flow that has been identified as necessary to maintain the upstream passage of adult Chinook through the bypass reach below the diversion (Eineichner 2018).

Ecosystem services provided by fish and aquatic species in the East Fork Hood River are impacted by the No Action Alternative in the following ways:

Provisioning Service, Instream Fish Populations: Harvest of anadromous fish would not be affected and would be available when runs are sufficiently large to sustain fishing. Rainbow trout would continue to be stocked in lakes and reservoirs to provide recreational fishing opportunity in the basin. Although ODFW and CTWS are working to restore anadromous fisheries in the basin, the pace is likely to be slow and limited by available instream habitat.

Cultural Service, Threatened Species, Species of Concern: Habitat supporting populations of threatened fish species would not be affected. Any improvement would depend on the future pace of modernization and streamflow restoration, for which the timing and certainty of implementation would be unknown. Habitat limitations for Pacific salmon and lamprey would continue to negatively affect fishing, community, health, cultural identity, subsistence, and religious tribal values.

6.8.2 Piping Alternative

6.8.2.1 General Fish and Aquatic Species

The District's allocation of up to 12.45 cfs of conserved water to instream water rights would improve streamflow and water quality in the lower East Fork Hood River downstream of the EFID diversion and in the Hood River, improving habitat for fish and aquatic species over 21.2 river miles. The lower East Fork Hood River is identified as the highest priority for streamflow restoration in the basin (Shively 2006). Streamflow would increase by up to 83 percent immediately below the diversion (RM 6.6) and by as much as 50 percent near the river mouth during the critical late summer period.[36] The additional streamflow would improve the quantity of suitable habitat for spawning, rearing, and migration of salmon and steelhead, and contribute to improved water quality and riparian habitat for these species. Resident fish species and their macroinvertebrate prey would also benefit from improved habitat with the additional streamflow. State instream water rights have been established in the East Fork Hood River to protect fish and wildlife resources. Currently, these junior water rights are not met during the latter half of the irrigation season. Although the allocation of up to 12.45 cfs to instream uses under this alternative would not be sufficient to meet the state instream rights during the summer months, it would help to decrease the magnitude of the shortfalls

[36] Compared to the current minimum instream flow requirement of 15 cfs in the bypass reach below the diversion, and to an observed 7-day low flow of 25 cfs at RM 1 above the confluence with the Middle Fork Hood River (8/17/2015 to 8/23/2015, P. Simpson, ODFW, personal communication, November 15, 2019).

Similarly, although the 12.45 cfs instream allocation would not be sufficient to guarantee that state water quality standards for temperature are met, it is expected to reduce maximum daily water temperatures and the frequency at which these standards are exceeded compared to the No Action Alternative.

The Piping Alternative would have beneficial effects on fish and aquatic species in the Hood River from its confluence at the East and Middle Forks of the Hood River (RM 14.6) to the Columbia River because enhanced streamflow would increase the amount of available habitat, increase thermal resistance to stream heating, and reduce the potential discharge of contaminants from nonpoint sources of pollution through the elimination of end spills. The benefits to fish and their habitat would be realized incrementally following the completion of each project group and would continue to persist after the project is complete.

The District's fish screens would continue to prevent fish from entering the District's canals and pipelines from the East Fork Hood River. However, a small number of fish may occur within the larger canals from unknown sources (see Section 4.8.1). The District would consult with ODFW and CTWS prior to construction, and a fish salvage effort would likely be required to capture any fish in canals and return them to the East Fork Hood River. Construction activities may cause unavoidable, direct mortality to amphibians or other aquatic species that may overwinter along the canals but have little effect on these populations at the broader watershed or basin level. The habitat function provided by the canals is low given either the absence of year-round flow or shallow water levels over the winter, the annual mortality resulting from canal dewatering, canal maintenance activities, and because a fish salvage effort would be conducted in the canal prior to construction. Therefore, the effect of the Piping Alternative on any resident fish populations, macroinvertebrates, and amphibians is expected to be minor. Further, the increased streamflow provided under this alternative would improve habitat conditions for resident and anadromous fish and aquatic life within the East Fork Hood River and, to a minor extent, within the Hood River. Increased streamflow would incrementally reduce summer stream temperatures and would potentially increase riparian vegetation and shade levels along the East Fork Hood River.

After end spills are eliminated, streamflow during the irrigation season would be reduced in portions of Neal, West Fork Neal, Lenz, Odell, and Whiskey creeks, returning these streams to a more natural hydrologic regime (Section 6.7.2.2). This reduction in streamflow may decrease riparian vegetation growth along affected stream areas. Based on temperature monitoring in West Fork Neal Creek indicating that end spill water was an average of 5 °F warmer than the receiving stream (Section 4.7.3.1), any adverse effect from reduced riparian shade on water temperatures is anticipated to be offset by the removal of warm end spills. Removal of end spills would also remove a source of both glacial turbidity and nonpoint source contaminants, improving water quality in the receiving waterbodies. For example, available monitoring data suggests that removal of end spill could reduce water turbidity in West Fork Neal Creek by 7.6 Nephelometric Turbidity Units (Stampfli et al. 2012). Turbidity affects photosynthesis and the primary productivity that supports the food chain for aquatic species. Turbidity can reduce primary productivity even at very low levels (Lloyd et al. 1987). In general, the improved water quality and return to a more natural flow regime under the Piping Alternative is expected to produce a net benefit to fish and aquatic species in the lower basin streams that are affected by end spill discharges.

Under the Piping Alternative, the operation of the proposed sedimentation basin would eliminate or dramatically reduce the rate and frequency of sediment flushing to the river associated with maintenance of the District's sand trap compared to the No Action Alternative. This change would improve water quality for fish rearing and migration and potentially improve intra-gravel habitat quality for salmonid spawning and incubation and macroinvertebrate production within the diverted reach of the East Fork Hood River. See Section 6.7.2.4 for more information on sediment management operations under the Piping Alternative.

6.8.2.2 Federally Listed Fish and Aquatic Species

The Piping Alternative would affect four federally listed, threatened fish species including Lower Columbia River coho and Chinook salmon (spring and fall populations), steelhead trout (summer and winter populations), and Hood River bull trout. Within the affected area, each of these species occurs in the Hood River from its confluence with its East and Middle forks (RM 14.6) to the Columbia River, and in the East Fork Hood River (RM 6.6 to RM 0) except potentially bull trout, which is not documented to occur in the East Fork Hood River above its confluence with the Middle Fork Hood River. Coho and steelhead are known to occur in Neal Creek and may occur in Odell Creek. Coho salmon have the potential to occur in Whiskey and Lenz creeks.

As noted in Section 4.8.2., coho, spring Chinook, and summer-run steelhead populations in the Hood River basin currently have a very high risk of extinction, while winter-run steelhead have a moderate risk of extinction (ODFW 2010). Low streamflow is identified as a primary limiting factor to the recovery of listed salmon and steelhead in the basin (NMFS 2013). The allocation of up to 12.45 cfs of conserved water under this alternative would enhance streamflow in the East Fork Hood River during the irrigation season, and permanently protect this water for instream use. This additional streamflow would improve the quantity of habitat suitable for coho spawning and migration, and for Chinook and steelhead spawning, rearing, and migration and would enhance water quality and riparian habitat for these species. Improved streamflow would also increase the quantity of habitat available for their macroinvertebrate prey. The allocation of 12.45 cfs would allow the District to raise its current, interim minimum instream flow target of 15 cfs in the half-mile long bypass reach downstream of EFID's diversion. Fish passage conditions for spring Chinook in the bypass reach are marginal at 15 cfs (McCanna and Eineichner 2012). A multi-year study conducted by CTWS indicates that a permanent minimum of 27 cfs is required to improve and maintain fish passage for adult Chinook (Eineichner 2018).

A modeling study of streamflow and fish habitat relationships was conducted in the East Fork Hood River by Normandeau Associates, Inc. (2014) and its results were used to further quantify the benefits to listed species of allocating 12.45 cfs for instream use under this alternative. Streamflow in the lower river downstream of the EFID diversion under dry conditions is typically 40 cfs or less during the spawning period for Chinook salmon and the onset of the spawning period for coho salmon. The study results indicated that even a 10 cfs increase from 40 cfs to 50 cfs would increase the area of suitable spawning habitat for Chinook by up to 34 percent and the area of suitable spawning habitat for coho by up to 23 percent. These study results also indicated that suitable juvenile rearing habitat area in the lower river would increase by up to 8 percent for steelhead and by

1 percent for Chinook, although suitable coho rearing habitat area would decline by 8 percent.[37] Overall, this action would benefit coho, Chinook, and steelhead and their critical habitat. All freshwater PCEs for coho, Chinook, and steelhead would benefit from the Piping Alternative (see Appendix E). The ESA Recovery Plan for Lower Columbia River Salmon and Steelhead (NMFS 2013) identifies a framework for conservation and recovery and a set of goals and actions for each listed population that, if implemented, would lead to recovery. The Piping Alternative would help meet the plan's objectives to implement actions that conserve water and aid in restoring the natural flow regime.

This alternative is likely to have a negligible effect on bull trout because they are not documented to occur in the East Fork Hood River, where no critical habitat is designated for bull trout; and the change in streamflow downstream in the Hood River from the allocation of conserved water would not be sufficient to produce a discernable effect on the bull trout population or on the PCEs for this species in their designated critical habitat in the Hood River.

While the magnitude and direction of effect varies by the species, life stage, and stream reach affected, the Piping Alternative would generally have a moderate to major beneficial effect on federally listed fish species in the East Fork Hood River, and a negligible to minor beneficial effect in the Hood River and in the lower basin tributaries (Section 4.7.2) affected by District operations.

6.8.2.3 ESA Compliance

The ESA establishes a national program for the conservation of threatened and endangered species, and the preservation of the ecosystems on which they depend. The ESA is administered by USFWS for wildlife and freshwater species and by NOAA Fisheries for marine and anadromous species. The ESA defines procedures for listing species, designating critical habitat for listed species, and preparing recovery plans. It also specifies prohibited actions and exceptions. Section 7 of the ESA, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. Under Section 7, federal agencies must consult with USFWS or NOAA Fisheries when any action that the federal agency carries out, funds, or authorizes (such as through a permit) may affect a listed endangered or threatened species. Section 7 informal consultation has been initiated for federally listed Columbia River salmon and steelhead populations and Hood River bull trout.

Within the affected area, the federally listed Chinook salmon, coho salmon, and steelhead occur in the Hood River and in the East Fork Hood River. Coho and steelhead are known to occur or may occur in Neal, West Fork Neal, Whiskey, and Lenz creeks. Steelhead are the only listed species documented to occur in Odell Creek in which no critical habitat is designated (ODFW 2019).

The Hood River local bull trout population is distributed in the mainstem Hood River, Middle Fork Hood River, and a few Middle Fork Hood River tributaries. Current evidence suggests that

[37] This result is attributed to the preference of juvenile coho for slow water velocities that can decrease in mid-channel areas as streamflow increases and be maintained only along the stream margins (Normandeau Associates, Inc. 2014). The availability of slow water habitat in both mid-channel and stream margin habitat is expected to increase following planned large woody debris placement in the lower East Fork Hood River (R. Gerstenberger, Fish Biologist, CTWS, personal communication, November 21, 2019).

reproduction is limited to the Middle Fork basin (ODFW 2010). Bull trout are not documented to occur in the East Fork Hood River, upstream of its confluence with the Middle Fork Hood River (Section 6.8.2.2).

Water saved from the project and protected downstream of the District's diversion as a result of the Piping Alternative would increase streamflow during the irrigation season (Section 6.7.2.2). This action would increase availability of aquatic habitat for migration, spawning, and rearing of listed species, with the largest benefit occurring in the East Fork Hood River during the low flow period from late July through September. The increased streamflow would improve upstream migration conditions.

All listed species utilizing the Hood River mainstem for rearing and migration would see a minor improvement in instream habitat due to increased streamflow. Water quality would also improve as a result of increased streamflow in the East Fork Hood River and affected reaches of Neal Creek, West Fork Neal Creek, Lenz Creek, Odell Creek, and Whiskey Creek (Section 6.7.2.4).

All PCEs of critical habitat of Lower Columbia River Chinook salmon, Lower Columbia River coho salmon, Lower Columbia River steelhead, and Hood River bull trout would benefit from the Piping Alternative (Appendix E).

Due to the long-term water conservation resulting from the Piping Alternative, which would benefit aquatic habitat through increased streamflow, USFWS has provided a "May Affect-Not Likely to Adversely Affect" determination that concurs with the effects determination described in Section 6.8.2.2. NOAA Fisheries concurrence with a "May Affect-Not Likely to Adversely Affect" determination is also anticipated.

Ecosystem services provided by fish and aquatic species living in the East Fork Hood River are impacted by the Piping Alternative in the following ways:

Provisioning Service, Instream Fish Populations: Over the long-term, increased streamflow as a result of the Piping Alternative would improve habitat for resident and anadromous fish species during the irrigation season. Although data are not available to quantify improvements in fish populations with increased streamflow, the benefits of allocating conserved water instream are evaluated in Appendix D. Furthermore, allocation of conserved water instream would likely assist in the recovery efforts of Pacific salmon and lamprey by ODFW and CTWS. Bolstering anadromous fish populations may allow for more consistent fishing for harvest and consumption.

Cultural Service, Threatened Species, Species of Concern: Following the project, the water allocated instream during the irrigation season would have a beneficial effect on instream habitat for Pacific salmon, a tribal trust and treaty fisheries resource of CTWS, and the Pacific lamprey, a tribal icon, which have been in decline for many decades. Instream habitat improvement would assist CTWS efforts to ensure that Pacific salmon and lamprey are not lost from local rivers and that cultural traditions would continue to be passed from one generation to another. At this time, quantification of these cultural ecosystem services is not available; however, benefits to Pacific salmon and lamprey would positively contribute to CTWS goals to enhance fishing, community, health, cultural identity, subsistence, and religious tribal values (Close et al. 2002; CTWS 2019).

6.9 Wetlands and Riparian Areas

6.9.1 No Action (Future without Federal Investment)

The No Action Alternative would have no effect on wetlands as the District's canals would continue to exist as seasonal artificial wetlands and water diversion would continue to alter the natural hydrograph that supports natural wetlands along 6.6 miles of the East Fork Hood River downstream from EFID's diversion. Conditions that have allowed hydrophytic plants to opportunistically grow along open canals and laterals would continue. Streamflow in five lower Hood River tributaries would continue to be artificially supplemented by end spills and potentially affect the growth of riparian vegetation along affected stream reaches.

6.9.2 Piping Alternative

6.9.2.1 Wetland and Riparian Areas in or Adjacent to the Project Area

Approximately 42.2 acres in the project area are identified as wetlands in the NWI GIS data (USFWS 2016). However, a further GIS analysis of the NWI mapping information indicated that most of the wetlands classified by the NWI as natural wetlands are instead EFID canals. When excluding the canals, a total of 36 acres of artificial wetlands and 6.1 acres of natural wetlands may occur within the project area (FCA 2019). The canals themselves are classified as seasonally flooded, artificial wetland features generally within the categories of "PUSCx (Palustrine, Unconsolidated Shore, Seasonally Flooded, and excavated by humans)" or "R4SBCx (Riverine, Intermittent, Streambed Seasonally, and excavated by humans)" (USFWS 2016). Most of the natural wetlands in or adjacent to the project area intersect the canal system and are classified as Freshwater Emergent Wetlands and/or Forested/Shrub Wetlands. These sites have not been field-verified and a wetland delineation has not been performed at the time of the development of this Plan-EA.

Canals within the project area are not anticipated to be jurisdictional wetlands based on a review of the exemptions under the Oregon Removal-Fill statute (OAR 141-085-0515(9)) and in language provided in the 1986 Final Rule for "Regulatory Programs of the Corps of Engineers" (see Section 4.9). Consultation with USACE and ODSL would be completed prior to construction of each project group to ensure that these exemptions apply.

During construction there could be potential temporary effects on wetlands such as sedimentation from stormwater runoff and accidental fuel spills. BMPs such as silt fencing would be utilized to minimize effects. Construction to replace two existing sublateral pipelines that cross Lenz Creek would result in a temporary disturbance to the streambed, riparian area, and any associated wetlands at two locations along the creek. The District would work with the appropriate state and federal agencies to identify specific BMPs to minimize effects at these pipeline crossings. No other construction activity is anticipated to occur in any other waterbody under the Piping Alternative.

Opportunistic hydrophytic plants occurring in some areas along canal banks could be removed or buried during excavation, fill, placement of pipe, or other construction activity. Construction would permanently convert the open canals in the project area from artificial wetlands to vegetated upland areas, and the opportunity for hydrophytic plants to grow alongside canals would no longer exist.

The canals themselves are not functioning wetland habitats due to their artificial flow and inundation pattern based on irrigation needs, and routine canal maintenance activities.

Completion of pipe installation could alter the hydrology of adjacent natural wetlands if they are dependent upon end spill or canal seepage for water. However, conversion of open canals to buried pipe could potentially improve the hydrology of those wetlands that transect the canals because the capture of surface water runoff in the canals would no longer occur. The Piping Alternative would have no effect on existing excavated ponds in or near the project area.

Overall, the Piping Alternative would have a minor effect on wetlands in or near the project area because most wetlands affected would be non-jurisdictional, man-made canals with low habitat function, and the District would follow appropriate reclamation procedures to revegetate disturbed areas as uplands. Disturbance to natural wetlands during construction activity would be avoided to the extent practicable, and any unavoidable effects on natural wetlands would be temporary and minimized through BMPs.

The replacement of an open channel with a pipe is considered an irrigation exemption under USACE Regulatory Guidance Letter No. 07-02 Exemption for Construction or Maintenance of Irrigation Ditches and Maintenance of Drainage under Section 404 Part 323.4(a)(3) of the CWA. Under this exemption, no Nationwide Permit is required for the disturbance to wetlands within the project area. Coordination and consultation with USACE would occur prior to the implementation of each project group to confirm that canals and laterals within the project group meet exemption criteria.

6.9.2.2 Floodplain Areas in or Adjacent to the Project Area

Based on the available Federal Emergency Management Agency Flood Insurance Rate Maps for Hood River County, the proposed sedimentation basin construction site would occupy up to 1.1 acres of 100-year floodplain.[38] Construction activities for the sedimentation basin would include excavation and fill, realignment of approximately 150 feet of existing gravel access road, and removal of approximately 24 trees and additional shrubs. The area that would be affected by these activities has been altered by past District construction and maintenance activities. The proposed action would not directly or indirectly support additional floodplain development. The sedimentation basin plan would be reviewed by all applicable local, state, and federal agencies to comply with floodplain rules and with EO 11988,[39] and mitigation requirements would be employed as required to address any floodplain impacts. The sedimentation basin would not require a County building permit, however the Hood River County Planning Department would review the project for compliance with both Floodplain and Stream Protection overlay zoning rules.

[38] The District would work with a qualified engineer prior to further project review to precisely determine whether the construction site is located within the 100-year floodplain. This step was recommended by the Hood River County Floodplain Administrator (E. Walker, Hood River County Community Development Director, personal communication, November 26, 2019).

[39] EO 11988 requires federal agencies to avoid to the extent possible the long- and short-term effects associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

6.9.2.3 Wetland and Riparian Areas along Natural Waterbodies Associated with District Operations

Allocation of conserved water under this alternative would increase streamflow during the irrigation season in the East Fork Hood River and the Hood River by up to 12.45 cfs, contributing incrementally to a more natural flow regime for natural riverine wetlands and greater access to water to support hydrophytic riparian plants such as willow, cottonwood, alder, sedge, and rush. Studies of semi-arid watersheds have found a positive relationship between seasonal or annual streamflow and the growth, abundance, and diversity of riparian vegetation (Harris et al. 1987; Stromberg and Patton 1990; Caskey et al. 2015). In another study, riparian vegetation abundance and stand width increased most significantly with streamflow volume during the spring and summer (Stromberg 1993). The elimination of end spills under this alternative would reduce streamflow while restoring a more natural flow regime in several small lower Hood River tributaries during the irrigation season (Section 6.7). This reduction in available water may incrementally affect wetlands and riparian vegetation growth along these tributaries, however, the water quality risk from pollutants such as fertilizer, pesticides, and herbicides potentially contained in end spills of canal water would be reduced.

6.10 Wildlife Resources

6.10.1 No Action (Future without Federal Investment)

Under the No Action Alternative, the wildlife communities in the project area would continue to use the artificial wetlands with opportunistic hydrophytic plants created by the District's open canals. Low summer streamflow would continue to limit natural wetland and riparian habitat along the East Fork Hood River and potentially along the Hood River.

6.10.2 Piping Alternative

During construction, terrestrial wildlife could experience noise disturbance due to heavy equipment operation, habitat removal due to tree cutting and other vegetation removal, or injury due to collision with construction equipment or habitat removal. Most of the canal length to be piped and all pipelines to be replaced are in or adjacent to busy agricultural areas where heavy equipment use is commonplace; therefore, most wildlife in the area is accustomed to noise and the disturbances are anticipated to be minor.

Portions of the canals in the project area provide artificial, seasonal riverine wetlands and elements of riparian habitat, as well as a source of water for wildlife. As canals are piped and habitats shift from artificial wetlands to uplands, distribution patterns of wildlife within the area could change. Deer and elk could alter their land use or travel patterns in response to removal of these water sources and the vegetation they support. Local densities of smaller animals dependent on these habitats could decrease as these animals shift to more suitable habitat in the area. Wildlife populations at the broader watershed and basin level would likely remain consistent with pre-project levels.

Water is not a limiting factor for terrestrial wildlife in the project area and vicinity (J. Thompson, ODFW District Wildlife Biologist, personal communication December 6, 2018). Natural streams with perennial flow exist sufficiently close to the canals[40] and would provide alternative drinking water sources for wildlife. As this alternative would be implemented over time, ungulates, other terrestrial wildlife, and pollinator species would have time to adjust and find new water sources. In the absence of the District's canals, some species may once again adopt a seasonal migration pattern that would have existed prior to canal development (J. Thompson, personal communication, February 26, 2020).

Vehicle collisions with wildlife would not be expected to increase as a result of canal piping because wildlife would not be required to cross busy arterials to access alternative water sources. For example, ODFW would not expect wildlife crossings of Highway 35 to increase due to the proposed canal piping project (J. Thompson, personal communication, February 26, 2020). Although some species may use canals as a water source, canals and laterals can also have adverse effects on wildlife due to drowning mortality and the barrier that they present to movement for some terrestrial species (Beier et al. 2008). The Piping Alternative would remove such barriers and drowning hazards for terrestrial wildlife as canals are converted to buried pipelines.

No nest sites for bald or golden eagles are reported in or near the project area. In the event that an eagle nest or active raptor nest is observed in or near the project area, the District would work with a USFWS biologist to determine how best to operate within the project area to minimize any potential effects. Under the Piping Alternative there would be no permanent long-term effects on migratory birds and their habitat. Migratory birds, if present, may experience minor short-term disturbance and displacement during construction.

Construction activities would have short-term, minor effects on wildlife due to increased human presence. Human presence is already fairly high in the project area. Over the long-term, piping of irrigation systems could potentially reduce human presence in the project area, as fewer trips to maintain ditches and delivery gates would be required. This would improve seclusion for wildlife.

The Piping Alternative would have no effect on threatened or endangered terrestrial species.

Allocation of up to 12.45 cfs of conserved water to instream use under this alternative would improve streamflow in the East Fork Hood River and the Hood River during the irrigation season. Improved streamflow would provide more consistent access to water for hydrophytic plants, and this would in turn enhance riparian vegetation and the associated wildlife habitat. Overall, the Piping Alternative would have a long-term, minor effect on wildlife in the project area.

6.11 Cumulative Effects

This section includes a description of past, current, reasonably foreseeable future actions, and cumulative effects organized by resource. Cumulative effects are defined as the effect on the environment which results from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7).

[40] The furthest distance from any point along a canal to a perennial stream is approximately 1.5 miles.

6.11.1 Past Actions

Past actions are summarized as land development activities that include irrigated agriculture (consisting of construction of the canal system, previous piping projects, and diversions), urban and suburban development, industrial land and water uses, commercial development, water diversions for non-agricultural uses, and transportation infrastructure. The nature and extent of these past actions and how they have influenced the existing environment are described for each resource in Section 4.

The first canals in EFID's system date from 1895 or earlier when the East Fork Irrigation Canal Company—formed from the Valley Improvement Company—filed a Notice of Appropriation with OWRD to provide water to surrounding farms (EFID 2011). The District was organized in 1913 and began a program of 1) enlarging canals and ditches with teams of horses and by hand labor, 2) constructing wood stave and concrete pipelines, and later 3) replacing many of these pipelines with steel, asbestos cement, or PVC plastic pipelines. During dry and drought years in the past, the District diverted the entire flow of the river as was authorized under its senior water rights.

Four other major irrigation districts were developed within the Hood River basin during this timeframe, collectively altering the natural hydrology of the Hood River and its tributaries. These other irrigation districts are MHID, Farmers Irrigation District (FID), Dee Irrigation District (DID), and Middle Fork Irrigation District (MFID). These districts have invested significant resources to modernize their systems to fully piped and pressurized water delivery.

6.11.2 Current and Reasonably Foreseeable Future Actions

Current actions are those projects, developments, and other actions that are presently underway, either because they are under construction or are occurring on an ongoing basis. Reasonably foreseeable future actions generally include those actions formally proposed or planned, or highly likely to occur based on available information. Various sources including local, state, and federal agency websites and city and county staff were consulted to obtain information about current and potential future development in the project area. The following sections describe these current actions and reasonably foreseeable future actions.

6.11.2.1 Land Use and Development

Ongoing agricultural activities including fruit orchards and pasture in the project area are not expected to change from current conditions. Land use development in the project area would continue to be managed according to the Hood River County Comprehensive Plan and Hood River County zoning regulations. Under current zoning, the majority of land in or near the project area is EFU land or forest, although residential or other development activities are expected to increase in the future where allowed. Crystal Springs Water District, a domestic water utility serving the EFID area and vicinity, plans to replace and upsize several of its water pipelines over the next 20 years. Public lands would continue to be maintained for their intended uses.

6.11.2.2 Other East Fork Irrigation District Modernization Goals

SIPs completed by the District include the potential addition of one or two small in-conduit hydroelectric generation stations to produce revenue for the District and clean energy for the region. The District has had a longtime goal to find a suitable site and construct a storage reservoir to reduce its reliance on natural streamflow and better meet future water supply needs given a highly variable snowpack and climate trends. The District also plans to replace its existing fish screen facility with a horizontal fish screen design, and to install a telemetry system to relay flow information from various points in the system and automatically adjust its diversion. Another long-term goal of the District is to establish a metering system that at a minimum could measure water usage at key points in the system. The installation of meters in the piping network at key laterals and branches would provide the District with water usage data over time that could be utilized to help prioritize future improvements, identify localized areas of leakage, and determine water use patterns (Wharry 2016).

6.11.2.3 Basinwide Irrigation District Modernization Goals

The four other major irrigation districts, the MHID, FID, DID, and MFID in the Hood River basin are either fully piped and pressurized, or working to complete full pressurization of their infrastructure at this time. DID and FID have allocated or plan to allocate up to 100 percent of the water saved as result of recent modernization projects to instream use. FID is currently working to increase storage in their Kingsley Reservoir, and MFID is working to complete fish passage improvements and increase storage at their Laurence Lake Reservoir.[41] These districts have begun to pursue the necessary funding and permitting for these projects, which are scheduled for completion over the next 10 years. Each of these projects is contingent on the availability of funding.

6.11.2.4 Dog River Pipeline Replacement

The City of The Dalles plans to replace its aging municipal water supply pipeline, which conveys water that is diverted from Dog River, a small tributary entering the East Fork Hood River approximately 3.5 miles upstream of the EFID diversion. The pipeline capacity would be expanded from 12.4 cfs to 26.3 cfs to meet the City's future water demand (Eineichner 2018).

6.11.3 Cumulative Effects by Resource

Cumulative effects are considered for each resource in consideration of past, present, and reasonably foreseeable future actions.

6.11.3.1 Cultural Resources

Cultural resources in the project area have likely been affected due to past, present, and ongoing development activities such as agriculture, land development, forestry, and any other ground disturbing projects. Like the proposed action, other reasonably foreseeable future actions in the vicinity of the project area have the potential to disturb previously undiscovered cultural resources. Mitigation measures for reasonably foreseeable future projects could be similar to any measures identified for the proposed action.

In addition, Bonneville has executed a Memorandum of Agreement with Oregon SHPO to mitigate adverse effects on the EFID. The undertaking consisted of converting open irrigation canals to closed piped irrigation, and installation of a permanent water diversion, headway, and fishway.

[41] These reservoirs are not associated with EFID operations.

Effects on historic canal structures would be completed in compliance with the NHPA. EFID is eligible for inclusion in the NRHP as an Historic District under Criterion A (36 CFR 60.4(a)) for its association with the development of irrigated agriculture in the Hood River region. Additionally, EFID is eligible for inclusion in the NRHP under Criterion C (36 CFR 60.4(c)) as a "significant and distinguishable entity whose individual components may lack individual distinction" (NPS 1995).[42] The period of significance for EFID ranges from 1914 to 1917, when the majority of the EFID system was planned and built. This includes the system that EFID acquired from the East Fork Irrigation Canal Company in 1914. The integrity of the system as a whole has not been assessed.

Piping projects could affect the integrity of the irrigation ditches and may have an adverse effect on the resource. If projects are determined to constitute an adverse effect on the EFID Historic District, the ACHP would be notified and SHPO and appropriate consulting parties would be consulted to develop mitigation measures and Memorandum of Agreement.

6.11.3.2 Land Use

The project area has been substantially altered over the past century by a variety of human activities, including agricultural development, livestock grazing, timber harvest activities, residential development, and road construction. EFID would coordinate with Crystal Springs Water District to explore whether an opportunity may exist to coordinate activity for planned domestic pipeline construction prior to construction of each project group in the proposed action. It has already initiated such coordination as requested by the Water District for a portion of Project Group 1. The proposed action and future irrigation modernization actions would support existing land uses. Since these actions would collectively support existing land use (predominantly agriculture), the proposed action would have negligible cumulative effects on land use.

6.11.3.3 Public Safety

Past and ongoing operation of agricultural equipment and vehicle traffic in the project area would continue to create risks to public safety, but these risks are not expected to change from current conditions. Additional irrigation piping would improve public safety by eliminating the risk of drowning in open canals. In combination with past, present, and reasonably foreseeable future actions, the proposed action is anticipated to have minor cumulative effects on public safety.

6.11.3.4 Socioeconomic Resources

Past actions including agricultural development, other land development, and recently completed projects have had effects on socioeconomics. There are no other known future projects that would affect socioeconomic resources in Hood River County. Since the effects on socioeconomics from the proposed action are considered minor, the cumulative effects on socioeconomics from the proposed action in combination with other past, present, and reasonably foreseeable projects are also considered minor.

6.11.3.5 Vegetation

Agriculture, forest management, transportation, and rural residential development have affected vegetation in the project area since the late 1800s. Agricultural activities have altered habitat in the

[42] Concurred by the Oregon SHPO on May 1, 2013 (Case No. 12-1871).

region by removing native vegetation communities in some areas and replacing it with crops and fields, and by activities such as stream channelization and drain tile placement. Livestock pasture occurs in and around the project area and can result in the introduction and spread of weed species, degradation of native habitat, and trampling of riparian and wetland areas. Fire suppression has contributed to encroachment of Douglas fir stands within former native oak woodlands. These ongoing activities would continue to affect vegetation in the project area. Agricultural activities, forest management, livestock grazing, vegetation control along roads, and urban and suburban development are responsible for most of the past and ongoing effects on vegetation in the project area. In addition, vegetation control activities generally include herbicide applications to control vegetation and noxious weeds, and mechanical cutting of vegetation. The amount of vegetation that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural and forest management activities, livestock grazing, vegetation control along roads, and other utility corridors in the area. In addition, these past actions are not expected to change measurably from current conditions, resulting in minor cumulative effects.

6.11.3.6 Visual Resources

Past land use actions have changed the visual character of the project area. Agricultural and development activities have altered visual resources in the region by removing native vegetation, adding new infrastructure, and creating increased human activity within the landscape. Within the project area, these types of actions are anticipated to continue and expand in the future. There would be minor effects on the developed and rural visual character of the landscape in the project area, resulting in minor cumulative effects when combined with other past, present, and reasonably foreseeable future actions.

6.11.3.7 Water Resources

Past actions over the last 149 years, since the first water rights were developed in the basin, have affected water resources. These actions include urban and agricultural land development, road construction, reservoir development, water diversion, canal construction, as well as other land use practices and irrigation projects. The earliest water right priority date in the Hood River basin is August 1, 1870 held by the City of The Dalles for municipal supply. Since the late 1990s there has been increasing interest in conserving water in the Hood River. The District and other Hood River Valley irrigation districts have implemented various water conservation projects including piping existing irrigation canals, outreach and partnerships promoting on-farm conservation, and water management changes that have contributed to increased streamflow in the Hood River. Water savings from infrastructure improvements and on-farm water use efficiency measures have increased the amount of water that is managed for instream use, and 4.58 cfs of this water to date has been legally protected instream within the basin by EFID and DID. EFID and FID have recently applied to OWRD to allocate an additional total of 2.025 cfs of conserved water for permanent instream use; these applications will be finalized within the next 5 years.

Further measures in EFID that are likely to occur following modernization include system metering with telemetry and continued outreach and partnership efforts to assist patrons with on-farm water use efficiency upgrades. Additional District goals that may be achieved in the future include the development of small in-conduit hydropower generation and reservoir storage.[43] These actions together with the Piping Alternative would affect streamflow and irrigation water supply in the East Fork Hood River and the Hood River. In-conduit hydropower is expected to have a negligible effect on streamflow since it would generate power with water already diverted for irrigation. A metering system is anticipated to have a minor effect since it would conserve additional water for instream and irrigation use. Construction of reservoir storage would have a minor effect on streamflow and a moderate effect on irrigation water supply as it would reduce winter and early spring streamflow while increasing water available for irrigation in the summer. These actions in combination with the proposed action are anticipated to benefit water resources and would help to mitigate the effects of climate trends on summer streamflow and irrigation water supply.

Planned actions by other irrigation districts and water utilities may affect streamflow and water supply in the basin. No reservoirs are connected with EFID operations, however, increases in water storage are planned by MFID at its Laurance Lake Reservoir, and by FID at its Greenpoint Reservoir. Voluntary cost-sharing, education, and technical assistance programs are ongoing in the basin to increase on-farm water use efficiency. These actions, accompanied by the proposed action, are expected to help mitigate the effects of water diversion and climate trends on summer streamflow while increasing the resiliency of irrigation water supplies. Crystal Springs Water District, which diverts water from springs on the East Fork Hood River above the EFID diversion, plans to construct a 550,000-gallon closed concrete reservoir to address water pressure and drinking water quality concerns and to upsize several of its pipelines to meet projected growth in water demand and for fire protection. Maximum water system demand (i.e., peak day diversion from its East Fork Hood River spring sources) is projected to increase modestly from 3.39 cfs in 2020 to 3.56 cfs in 2035 (Pace Engineers, Inc. 2016). The City of The Dalles plans to expand the capacity of its Dog River Pipeline by 13.9 cfs to meet future water demand (Eineichner 2018). The City's water right allows for the diversion of all available streamflow in the Dog River (GSI 2014). In late summer and early fall, the City currently diverts the entire streamflow, typically 2.5 cfs to 3.5 cfs (D. Anderson, City of The Dalles, Public Works Director, personal communication, October 10, 2019). Therefore, any future increase in diversion associated with an expanded pipeline capacity is not expected to reduce streamflow in the Dog River, East Fork Hood River, or Hood River during the late summer low-flow period. As a project mitigation measure, the City has proposed to release 0.5 cfs to Dog River past their diversion.

Most if not all canals elsewhere in the Hood River basin are already piped. Increased well development for residential or irrigation use in the basin may result in a minor local reduction in groundwater levels.

Water quality could be affected due to nonpoint source pollution such as erosion and runoff associated with ongoing and potential construction and land development activities, including the proposed action. The proposed action would be constructed when there is no water in the canal system and construction BMPs would be used to avoid or minimize water quality effects; construction practices for other potential construction and development projects are anticipated to

[43] Although there is no plan for reservoir construction at this time, it remains a District goal to have a moderately sized reservoir (e.g., 5 to 6 thousand acre-feet capacity) within the next 15 to 20 years if a feasible site and funding can be identified.

be similar. The proposed action is anticipated to contribute to water quality improvements from the elimination of end spills and increased streamflow in the East Fork Hood River.

The proposed action and other reasonably foreseeable future actions are anticipated to have a moderate cumulative effect on water resources; irrigation piping projects would eliminate water loss, increase the amount of water that is conserved in the Hood River basin, and improve water quality.

6.11.3.8 Fish and Aquatic Species

Past actions including agricultural development, railroad construction, road construction, road maintenance, timber harvest, and urban and residential development would have minor effects on fish in combination with the proposed action. The potential effects from these past projects in EFID and the Hood River basin, such as sediment entering waterbodies or aquatic habitat disturbance, would be temporary and likely complete before construction of the proposed action.

Because EFID's irrigation diversion is screened and the conveyance system does not provide functioning habitat for fish and aquatic species, the Piping Alternative would not have a direct effect on fish and aquatic species in the irrigation infrastructure itself. Irrigation diversion and end spill discharges are responsible for most of the past and ongoing direct and indirect effects on water quantity and quality for aquatic life and riverine habitat in the area affected by District operations.

Ongoing land use activities in the project area are not expected to change from current conditions. Future land developments and irrigation district modernization projects may cause indirect effects on fish, such as sediment inputs or aquatic habitat disturbance, and could potentially affect waters within the same watershed as the proposed action. However, reasonably foreseeable future actions would either improve aquatic habitat conditions or have a neutral effect. These future actions include upgrading EFID's existing fish screens with a horizontal screen that would fully meet current NOAA fish screen criteria; enhanced on-farm water use efficiency; modest increases in reservoir storage capacity to reduce reliance on diversion of live flow in summer; instream and riparian habitat restoration; and installation of small in-conduit hydropower stations.

The proposed action, when combined with other future actions, is anticipated to have a beneficial cumulative effect on fish, aquatic species, and available habitat for steelhead, Chinook, coho, and other species. Implementation of other irrigation efficiency, piping, and water conservation-related projects in the basin could have an additive effect on the amount of water conserved, and therefore would provide additional flexibility in managing water rights in the Hood River basin and may help to mitigate the effects of climate trends on streamflow and aquatic life.

6.11.3.9 Wetlands and Riparian Areas

Past actions that may have affected wetlands, riparian areas, and floodplains consist of the original construction of the irrigation canals as well as agricultural activities, livestock grazing, vegetation control, and development. Irrigation water flows in and along the banks of the canals and laterals has contributed to localized areas of hydrophytic and/or wetland vegetation within or adjacent to the project area. The proposed alternative would reduce the amount of water available to vegetation and these potential wetland features during the irrigation season. These sites, however, are expected to be non-jurisdictional (Section 6.9.2). An estimated 6 acres of natural wetlands, most of which transect the canals, are known to occur within 100 feet of the project and may be affected by the project. While effects on these wetlands would be avoided, minimized, or mitigated, the project may have the potential to restore a more natural hydrologic pattern in those wetlands. Reasonably foreseeable future actions in the project area that could affect vegetation along irrigation canals include agricultural activities, livestock grazing, vegetation control along roads and utility corridors, and urban and suburban development. Changes to riparian area vegetation in the project area caused by the proposed action would be minor compared to these activities. The cumulative effect of the proposed action and other past, present, and reasonably foreseeable future projects on wetlands and opportunistic hydrophytic vegetation is expected to be minor.

6.11.3.10 Wildlife

Some wildlife currently use open canals as a drinking water source. While the proposed action would require wildlife to find other water sources, as they did prior to installation of the canals, it would also create connected habitat corridors through which wildlife could travel. Water is not considered a limiting factor for wildlife populations in the project area or the surrounding area. Since effects of the proposed action on wildlife would happen incrementally over the time required to complete the project, animals would be able to adapt. Additionally, because other past, present, and reasonably foreseeable future actions affect wildlife across a broad geographic area in the Hood River basin, the cumulative effect on wildlife from the proposed action would be minor.

In addition, vegetation control activities, including herbicide applications to control noxious weeds and mechanical cutting of vegetation, are ongoing actions by various landowners and land managers in or near the project area that contribute to wildlife habitat changes. The amount of wildlife habitat that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural activities, livestock grazing, outdoor recreation, vegetation control, and urban and suburban development in the area. In addition, the intensity of these ongoing actions is not expected to change measurably in the future, resulting in minor additional cumulative effects.

6.11.3.11 Ecosystem Services

All reasonably foreseeable actions regarding modernization of irrigation infrastructure in the Hood River basin would work in concert to improve water conservation and water availability to irrigators. Past and ongoing actions described in the sections above have contributed to water availability for irrigators and instream flow. Past, ongoing, and reasonably foreseeable actions in the Hood River basin could all impact ecosystem services in the watershed. When combined with other future actions, the proposed action is anticipated to have a beneficial cumulative effect on all ecosystem services assessed.

7 Consultation, Coordination, and Public Participation

In the development of the Draft Plan-EA, the District and its partners planned and conducted a public scoping meeting, issued press announcements, and had frequent correspondence with federal, state, and local resource agencies, agriculture interests, and other interested groups and individuals. The project development process was designed to work collaboratively with partners, agencies, tribes, and stakeholders to ensure transparency and cooperation towards a solution that fits within the framework of the purpose and need for action.

A Preliminary Investigative Report (FCA 2018c) was prepared to provide sponsors, local partners, agencies, and the public with information to evaluate the goals and objectives of the project. During the development of the Preliminary Investigative Report, project sponsors conducted initial consultation with natural resource agencies and stakeholders in the Hood River basin.

Public participation activities prior to release of the Draft Plan-EA included the following:

Public Announcements

- NRCS public notice (October 3, 2018) https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/pnotice/?cid=nrcseprd1422829
- Hood River News—three public notices (October 3, October 10, October 17, 2018)
- Postcard to District patrons (October 9, 2018)
- NRCS news release (October 11, 2018) https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/releases/?cid=NRCSEPRD1423728

Public Involvement Website

Information about the proposed project was added to Oregonwatershedplans.org, a website created to involve and inform the public. Oregonwatershedplans.org includes the following information:

- Overview of NRCS' PL 83-566 funding program
- Overview of the NEPA and EA public participation process
- Frequently Asked Questions about the EA process
- Background on the District, the Draft Plan-EA and appendices, the Preliminary Investigative Report and appendices, and presentations and handouts from public meetings
- Contact information and how to submit public comments
- Email signup option for more information; subscribers receive updates over the course of project development

7.1 List of Persons and Agencies Consulted

The following lists include persons and agencies with a vested interest in this Plan-EA or those consulted during the planning process. This includes agencies that provided formal or required consultation, or individuals who were conferred with and who provided substantial input. Coordination with state and local agencies has been ongoing since project inception.

Local entities that have land ownership or a shared resource within the District include:

- City of Hood River
- Hood River County
- Hood River Soil and Water Conservation District
- Hood River Valley Parks and Recreation

Agencies that have been notified of or involved with the project include the following:

- Bonneville Power Administration (Bonneville)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Environmental Quality (ODEQ)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of State Lands (ODSL)
- Oregon Governor's Office
- Oregon Water Resources Department (OWRD)
- Oregon Watershed Enhancement Board
- State Historic Preservation Office (SHPO)
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- U.S. Army Corps of Engineers (USACE)
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service
- Wy'east Fire District

Tribes that have been consulted regarding the project include:

- Confederated Tribes of Warm Springs (CTWS)
- Confederated Tribes of the Umatilla Indian Reservation
- Confederated Tribes and Band of the Yakama Nation

Other stakeholders that were notified about the project include:

- District patrons
- Columbia Gorge Fruit Growers
- Columbia Land Trust
- Oregon Water Resources Congress
- Farmers Irrigation District (FID)

- Middle Fork Irrigation District (MFID)
- Mount Hood Irrigation District (MHID)
- Thrive Hood River (formerly Hood River Residents Committee)
- Hood River Watershed Group
- WaterWatch of Oregon
- Trout Unlimited
- Interested public

Table 7-1 describes communications with agency personnel that were consulted during development of this Plan-EA.

Table 7-1. Agency Consultation Record.

Date	Contact, Agency	Communication
March 7, 2018	Rod French, ODFW	Description of EFID Coanda fish screen
June 6, 2018	Philip Simpson, ODFW	East Fork Hood River flow monitoring
July 25, 2018	Blayne Eineichner, CTWS	Fish Species within waterbodies associated with district operations and reach of anadromous habitat
July 25, 2018	Christina Mead, U.S. Forest Service	Plants along irrigation canals East Fork Hood River Irrigation District
July 25, 2018	Chuti Fieldler, U.S. Forest Service	Potential aquatic and semi-aquatic species use of EFID irrigation canals
August 10, 2018	Bonnie Lamb, Oregon DEQ	303d listed waterbodies
September 14, 2018	Scott MacDonald, U.S. Forest Service	Firefighting and piping irrigation canals
September 18, 2018	Nancy Munn, NOAA	Programmatic consultation for NRCS project
October 24, 2018	Bonnie Lamb, Oregon DEQ	Information about Clean Water State Revolving Fund loans
November 26, 2018	Christina Mead, U.S. Forest Service	Requested review of a draft vegetation section of East Fork Draft Plan-EA
December 4, 2018	Jeremy Thompson, ODFW	Wildlife use of irrigation canals
December 12, 2018	John Buckley, EFID Cindy Thieman, Hood River Watershed Group Blayne Eineichner, CTWS Rachel Gebauer, NRCS Tom Makowski, NRCS	Discussion about cultural resources surveys, timeline, and next steps, particularly for the EC

Date	Contact, Agency	Communication
January 7, 2019	Rachel Gebauer, NRCS Austin Green, CTWS Carey L. Miller, Confederated Tribes of the Umatilla Indian Reservation V. Kate Valdez, Confederated Tribes and Band of the Yakama Nation	Cultural resources consultation letters sent to SHPO, CTWS, Confederated Tribes of the Umatilla Indian Reservation, and Yakama Tribes
March 12, 2019	Rachel Gebauer, NRCS Cindy Thieman, Hood River Watershed Group Blayne Eineichner, CTWS Tama Tochihara, Bonneville Israel Duran, Bonneville	Overview of Draft Plan-EA, planning for cultural resources survey on EC, and Bonneville's role in past and future surveys
March 15, 2019	Rod French, ODFW	Request for input about report of fish remaining in two pools in the Main Canal following shutdown of diversion
November 7, 2019	Doug Thiesies, HRC Forestry	Request for input on proposed pipeline realignment through a portion of county land
November 26, 2019	Eric Walker, HRC Community Development	Request for preliminary input on proposed sedimentation basin and associated floodplain or land use requirements
February 26,2020	Jeremy Thompson, ODFW	Additional input regarding wildlife use of canals
March 5, 2020	Kathy Ferge, NRCS CTWS	Since CTWS has been an active participant, they felt that no meetings were necessary. No comments on the Draft Plan-EA were received.
March 26, 2020	Rod French, ODFW	Confirmation of statement concerning extinction risk of listed fish populations in the Hood River basin
March 26, 2020	Tom Hausmann, National Marine Fisheries Service	Discussion about potential saved water and allocation of instream flow in the East Fork Hood River and effects on Lower Columbia River coho, Chinook, and steelhead.
March 30, 2020	Chris Allen, USFWS Ann Gray, USFWS	Discussion about potential saved water and allocation of instream flow in the East Fork Hood River and effects on bull trout.
June 18, 2020	Robin Shoal, U.S. Forest Service, Columbia River Gorge National Scenic Area	Discussion about National Scenic Area permits.

Date	Contact, Agency	Communication
June 18, 2020	Nick Kraemer, Hood River County Community Development	Discussion about National Scenic Area permits.

7.2 Review of the Draft EA

NRCS published the proposed Draft Plan-EA on oregonwatershedplans.org for public review on January 8, 2020 for a 30-day comment period ending on February 18, 2020. During the comment period, NRCS hosted a public outreach meeting on January 29, 2020. Specific public outreach activities for the Draft Plan-EA included:

- NRCS Public Notice (January 8, 2020): https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/pnotice/?cid=nrcseprd1527620
- NRCS News Release (January 8, 2020): https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/releases/?cid=NRCSEPRD1528017
- EFID postcard to patrons (January 8, 2020)
- Hood River News public notice (January 8, January 15, January 22, 2020)
- FCA emails to stakeholder list (January 8, January 27, February 10, 2020)
- Public outreach meeting (January 29, 2020) from 6:30 p.m. to 7:30 p.m. at the Pine Grove Grange, 2835 Van Horn Drive, Hood River, OR

NRCS sent initial consultation letters to the CTWS Tribal Historic Preservation Officer, the Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes and Band of the Yakama Nation outlining the project and initial planning. Since CTWS has been an active participant in the Plan-EA process, they felt that a meeting was not necessary. CTWS provided no comments on the Draft Plan-EA.

Comments on the Draft Plan-EA were submitted in person at the public meeting, by email to eastforkcomments@gmail.com, online at oregonwatershedplans.org, and by mail to Farmers Conservation Alliance, 101 State St, Hood River, OR 97031.

During the review period 27 comments on the Draft Plan-EA were received. These comments were received from 26 individuals and the ODFW.

NRCS has reviewed all public comments and has made changes, as appropriate, to the final Plan-EA based on those comments and internal review. Each comment received consideration in the development of the final rule. According to the NEPA Handbook 6.9.2.1, substantive comments do one or more of the following:

- Question, with reasonable basis, the accuracy of information in the EIS or EA.
- Question, with reasonable basis, the adequacy of, methodology for, or assumptions used for the environmental analysis.
- Present new information relevant to the analysis.
- Present reasonable alternatives other than those analyzed in the EIS or EA.
- Cause changes or revisions in one or more of the alternatives.

A summary of recurring comments received on the Draft Plan-EA are listed below. For a full list of comments and responses, see Appendix A.

- Request that additional alternatives be considered.
- Effect on wildlife along the canal and laterals from piping.
- Effect on trees and vegetation along the canal and laterals from piping.
- Effect on scenic quality of the canal from piping.
- Effect on sediment in the East Fork Hood River and in irrigation water.
- General support for water that would be conserved by the project.

8 Preferred Alternative

8.1 Selection and Rationale for the Preferred Alternative

NRCS has selected the Piping Alternative as the Preferred Alternative,[44] based on its ability to meet the purpose and need for the project, best address the Federal Objective and Guiding Principles, and provide the most beneficial effects on environmental, social, and economic resources. The District has agreed that the Piping Alternative is their Preferred Alternative.

Although the Piping Alternative has been identified as the Preferred Alternative, there are other available steps towards conserving water and/or improving water delivery reliability within EFID. The Piping Alternative does not represent an endpoint to improving the use and conveyance of water throughout the District; rather, it details one step that would complement other methods for improving water conservation and/or delivery reliability in EFID.

Although the Piping Alternative would have minor effects on various resources (Section 6), those effects would be mitigated through BMPs and other compliance measures. As a tradeoff to those effects, the Piping Alternative would permanently protect instream flows in the East Fork Hood River and the Hood River, supporting ecological resources in and along the river system, particularly habitat and water quality resources. Additionally, as analyzed in the NEE, there would be positive economic benefits including increased instream flow, agricultural yield enhancement, reduced O&M costs, reduced carbon outputs, and reduced pumping costs. When compared to the No Action Alternative, in the face of current conditions and future environmental changes, the Piping Alternative would support the health and resiliency of the ecosystem downstream of the District's diversion as well as the agricultural resiliency of District patrons.

8.2 Measures to be Installed

The District would pipe and pressurize 56 miles of its system with HDPE gravity-fed pressurized buried pipe. Pipe would range in diameter from 4 to 66 inches. Approximately one-half mile of the Eastside Canal pipeline (Project Group 1) would follow a new alignment and the existing canal would be backfilled and decommissioned. Additionally, a 30,000 square foot sedimentation basin would be installed immediately downstream of the sand trap for additional sediment settling.

In total, 61 pressure-reducing valve stations would be installed and 384 turnouts would be upgraded to pressurized delivery systems. The improvements would be split into three project groups as summarized in Table 8-1. Section 5.3.2 provides more detailed information on construction and O&M of the Preferred Alternative. Appendix D includes a detailed breakdown of project costs.

[44] The "Preferred Alternative" is defined in the National Watershed Program Handbook as "The option and course of action that the Sponsoring Local Organization and NRCS agree best addresses the stated purpose and need" (NRCS 2014).

Table 8-1. Summary of the District Canals and Laterals to be Piped under the Preferred Alternative.

Project Group	Project Components			Anticipated Year Construction Would Begin
	Length of Piping (mi)	Upgraded Turnouts	PRV Stations	
1	15.5	86	23	2020
2[1]	26.4	158	15	2023
3	20.4	140	23	2028
Total	**62.3[2]**	**384**	**61**	**-**

[1] The sedimentation basin would be installed in Project Group 2.
[2] The total length of EFID's system to be piped is 56 miles, but the installation of dual pipelines along the Main Canal would increase the total length of piping to 62.3 miles.

8.3 Minimization, Avoidance, and Compensatory Mitigation Measures

Project design features and BMPs that would be applied during and after construction of the Preferred Alternative to avoid and minimize effects on environmental and social resources are described below.

- Engineering designs will consider natural runoff patterns, stream or drainage capacity, existing land use and level of development, infrastructure concerns and public health and safety. Where feasible, designs will restore the natural runoff patterns.
- Ground disturbances would be limited to those areas necessary to safely implement the Preferred Alternative.
- Adjacent landowners would be provided a construction schedule before construction begins. Access to residences, farms, and businesses would be maintained during construction.
- Work would be confined within the existing easements whenever possible and construction limits would be clearly flagged to preserve existing vegetation and private property.
- Disturbance of jurisdictional wetlands would be avoided during construction.
- Silt fencing, straw wattles, geotextile filters, straw bales, or other erosion control measures would be used to minimize soil erosion and prevent soil erosion from entering waterbodies during construction. Erosion control measures would be free of weeds and weed seeds.
- Drainage measures would be incorporated into the engineering design to minimize local flooding effects from enclosing canals.

- Construction would occur during the daytime in the winter to minimize disturbance to any recreationists, landowners, or other individuals in the construction area vicinity. A potential exception to the winter construction timing would exist for one pipeline segment.[45]
- Bald and golden eagles typically use the same nest sites year after year. No nest sites for either species are reported in or near the project area. In the unlikely event that an eagle nest is observed in or near the project area, the District would work with a USFWS biologist to determine how best to operate within the project area to minimize any potential effects. Construction would occur outside USFWS-approved buffer distances where possible. If operating within the recommended buffer distance, the District would operate outside the nesting season.
- Construction except as noted above would occur in the winter outside the primary nesting period for migratory birds of concern (April 15 through July 15), although it could overlap with the early portion of the nesting period of raptors (February through July). Should an active raptor nest be found, construction would pause and a consultation with a local USFWS biologist would occur to determine the following steps.
- In appropriate cases and under consultation with ODFW, ramps would be placed in open pipeline trenches during construction to avoid the potential for wildlife to become trapped overnight.
- Work crews would carry spill cleanup kits, and in times of burn bans or wildfire concerns, each crew would have a fire suppression kit.
- Temporary travel routes and construction staging areas would be selected and used to minimize effects on vegetation and avoid the removal of trees.
- Pruning would occur entirely within EFID's easements and would not exceed what is required for equipment clearance.
- Standard construction safety procedures and traffic control measures would be employed to reduce the risk of collisions between construction vehicles and other vehicles, pedestrians, or bicyclists while construction is ongoing.
- Prior to construction activities, the District would consult with ODFW and CTWS and a fish salvage effort would be conducted in canals to capture any fish remaining in the canals and return them to the East Fork Hood River.
- Where possible, lane closures on roadways would be avoided during peak travel periods to reduce potential traffic delays and pedestrian safety issues.
- An Inadvertent Discovery Plan would be followed if cultural materials including human remains were encountered during construction. Construction would stop accordingly, SHPO and NRCS cultural resources staff would be consulted, and appropriate tribes would be

[45] Construction of the 2,600-foot realignment segment at the south end of the Eastside pipeline may occur during spring and summer months (J. Buckley, Manager, EFID, personal communication March 25, 2020).

notified. Continuation of construction would occur in accordance with applicable guidance and law.

- After construction, the project area would be re-contoured and planted with a seed mix of native grasses and forbs. Planting would be done in consultation with NRCS and would follow NRCS Oregon and Washington's Guide for Conservation Seedings and Plantings (NRCS 2000).
- The District would continue to remove any fallen trees within its easement area to maintain access.
- The District would start a pipe inspection program that would systematically cover inspection of the entire system over a period of several years.
- The District would mechanically remove accumulated sediment from the sedimentation basin and stockpile it temporarily in an adjacent upland location or haul it off site. The sedimentation basin and its intake and outlet piping would be inspected for any required repairs at minimum on an annual basis.
- To the extent possible, the Preferred Alternative and construction activities would be located entirely within the District's existing easements. Prior to construction, the District would assess the existing easements for the construction segment and work with adjacent landowners.
- After construction, the District would install gates and signs at select locations to prevent unauthorized motorized vehicle usage of maintenance roads or trails.

8.4 Permits and Compliance

As discussed in Section 8.2, the Preferred Alternative would be implemented in project groups. Permitting specific to each project group would be conducted at the time that funding is available. Prior to implementing each project group, NRCS would complete an on-site EE utilizing the NRCS CPA-52 form. This process would determine if that project group meets the applicable project specifications and other conditions as developed in this Plan-EA and assess the environmental effects of any alternatives to the project group. If it is determined that there are significant issues or concerns, or if resource concerns have not been adequately evaluated through the programmatic approach in this Plan-EA, a separate analysis and appropriate agency consultation would be prepared as necessary. Further, EFID would acquire all necessary permits prior to construction. These may include the following.

8.4.1 Local and County

- **Hood River County Planning**: Under OAR Chapter 340, Division 18, a Land Use Compatibility Statement would be submitted for county approval prior to construction. The District would also consult with the County to determine any permitting requirements for the section of the project located within the Columbia River Gorge National Scenic Area.

- **Hood River County Floodplain Administrator**: All work, except for construction of the sedimentation basin, would be outside of the 100-year floodplain; consultation with the county floodplain administrator would determine appropriate permitting requirements for the sedimentation basin.

8.4.2 State

- **Department of Environmental Quality**: The National Pollutant Discharge Elimination System program, implemented by ODEQ, would require a stormwater permit for construction activities including clearing, grading, excavation, materials or equipment staging, and stock piling that would disturb 1 or more acres of land and have the potential to discharge into surface waters or conveyance systems leading to surface waters of the state.

- **Oregon Water Resources Department**: To change the place of use, character of use, and/or point of diversion/appropriation of a water right, a water right transfer application must be approved by OWRD. The District would apply for an Allocation of Conserved Water under ORS 537 for 75 percent of the water saved through the Preferred Alternative. The remaining 25 percent of the saved water would be used to alleviate water supply shortages within the District. Although the application would need to be reviewed and approved by OWRD prior to issuing the instream water right, the estimated water allocated instream would be 12.45 cfs during the irrigation season (April 15 to September 30).

- **Department of State Lands**: A removal-fill permit from ODSL would not be required for work in existing canals and laterals. Prior to beginning construction of each site-specific project, consultation with ODSL would occur to verify that the District meets exemptions.

- **Oregon Fish Passage Law:** Since August 2001, the owner or operator of an artificial obstruction located in waters in which native migratory fish are currently or were historically present must address fish passage requirements prior to certain trigger events, such as the construction, installation, replacement, extension, or repair of culverts, roads, or any other hydraulic facilities. Laws regarding fish passage are found in ORS 509.580 through ORS 509.910 and in OAR 635, Division 412. A contemporary weir and fish ladder system and a functioning fish screen are in place at EFID's irrigation diversion. Several small fish of unknown origin have been seen during the winter in the Main Canal in two areas where a spring or seep maintains a deep pool after canal shutdown (Section 4.8.1). The District would consult with ODFW and with a CTWS tribal salmon co-manager prior to construction regarding the need and extent of fish salvage efforts to remove any fish present in canals. No additional consultation or permitting related to this law is anticipated to be required.

8.4.3 Federal

National Historic Preservation Act Section 106: Pursuant to 36 CFR Part 800 of the NHPA (1966, as amended in 2000), and the regulations of the ACHP implementing Section 106 of the NHPA (54 U.S.C. 306108), federal agencies must take into account the potential effect of an undertaking on "historic properties," which refers to cultural resources listed, or eligible for listing, in the NRHP. Consultation with SHPO to fulfill Section 106 obligations would be completed for each project group prior to implementation.

Clean Water Act:

- **Section 404**: Under Section 404(f)(1)(C) of the CWA, discharges of dredged or fill material associated with construction or maintenance of irrigation ditches, or the maintenance (but not construction) of drainage ditches, are not prohibited by, or otherwise subject to, regulation under Section 404. Discharges of dredged or fill material associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities as are appurtenant to and functionally related to irrigation ditches are included in the exemption for irrigation ditches. Under 33 CFR 323.4(a)(1)(iii)(C)(1)(i), "[c]onstruction and maintenance of upland (dryland) facilities such as ditching and tiling, incidental to the planting, cultivating, protecting, or harvesting of crops, involve no discharge of dredged or fill material into Waters of the United States, and as such never require a Section 404 permit." The construction and maintenance of irrigation ditches and maintenance of drainage ditches may require the construction and/or maintenance of a farm road. Subsection 404(f)(1)(E) exemption for discharges of dredged or fill material associated with the construction or maintenance of farm roads applies where such related farm roads are constructed and maintained in accordance with BMPs. However, in 33 CFR 323.4(a)(6) and 40 CFR 232.3(c)(6), there must be assurance that flow and circulation patterns and chemical and biological characteristics of Waters of the United States are not impaired, that the reach of the Waters of the United States is not reduced, and that any adverse effect on the aquatic environment would be otherwise minimized. Prior to construction activities, continued coordination and consultation with USACE would occur and measures taken as required to identify and mitigate impacts to potential jurisdictional wetlands and Waters of the United States.
- **Section 401**: Section 401 of the CWA authorizes the OEDQ to review proposed activities or facilities that require a federal permit and that may discharge into the waters of Oregon.

Farmland Protection Policy Act: The Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) directs federal agencies to identify and quantify adverse effects of federal programs on farmlands. The Act's purpose is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to nonagricultural uses. The project occurs primarily in EFU zones; however, all work would be done within EFID's easements. The project would support agricultural productivity and the intention of the Act.

Endangered Species Act: The ESA establishes a national program for the conservation of threatened and endangered species and the preservation of the ecosystems on which they depend. The ESA is administered by the USFWS for wildlife and freshwater species, and by NOAA Fisheries for marine and anadromous species. The ESA defines procedures for listing species, designating critical habitat for listed species, and preparing recovery plans. It also specifies prohibited actions and exceptions. Section 7 of the ESA, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. Under Section 7 of the ESA, federal agencies must consult with USFWS or NOAA when any action the agency carries out, funds, or authorizes (such as through a permit) may affect a listed endangered or threatened species.

Magnuson-Stevens Act: The Magnuson-Stevens Act established requirements for including Essential Fish Habitat (EFH) descriptions in federal fishery management plans, and it requires federal agencies to consult with the NOAA Fisheries on activities that may adversely affect EFH (Pub. L. No. 104-297). EFH can include all streams, lakes, ponds, wetlands, and other viable waterbodies, and most of the habitat historically accessible to salmon necessary for spawning, breeding, feeding, or growth to maturity. As the project may affect EFH, consultation under the Magnuson-Stevens Act may be required.

Safe Drinking Water Act: Since the project would have no direct or indirect discharge to groundwater, permitting under the Safe Drinking Water Act is not required.

Migratory Bird Treaty Act: The MBTA implements various treaties and conventions between the United States and other countries, including Canada, Japan, Mexico, and the former Soviet Union, for the protection of migratory birds (16 U.S.C. 703–712). Under the Act, taking, killing, or possessing migratory birds, or taking, destroying, or possessing their eggs or nests, is unlawful. The Act classifies most species of birds as migratory, except for upland and nonnative birds such as pheasant, chukar, gray partridge, house sparrow, European starling, and rock dove.

Bald and Golden Eagle Protection Act: The BGEPA prohibits the taking or possessing of, and commerce in, bald and golden eagles, with limited exceptions (16 U.S.C. 668–668d). The Act only covers international acts or acts in "wanton disregard" of the safety of bald or golden eagles.

8.5 Costs

Table 8-3 presents the total project cost of $67,029,000 for the Preferred Alternative. PL 83-566 funds and Regional Conservation Partnership Program (RCPP) funds through PL 83-566 authority would support $29,549,000 of the total project cost and the $37,480,000 remainder of the cost would be contributed by other, non-federal funds. The RCPP funds ($1,430,000) were provided to the project in 2018 and pertain to a single, separate project within the larger PL 83-566 Project Group 1. The RCPP project is not receiving funds through this Watershed Plan, rather it has received funds through RCPP and needs an authorized watershed plan in order to implement that portion of the RCPP. Table 8-4 itemizes the costs for each project feature and the distribution of how the costs would be shared by the sponsors and NRCS for each cost item.

- Construction costs account for all material, labor, and equipment necessary for the installation of piping associated with the Preferred Alternative. These costs were estimated based on costs for similar installations at irrigation districts in Central Oregon. The planning construction costs are estimated using the best available information about the project without having detailed design information.

- Engineering costs were estimated as a percentage of the cost of construction.

- The potential cost of mitigation for effects on cultural resources were factored into the costs shown.
- The costs presented are planning level estimates and do not reflect final costs. Detailed designs and construction cost estimates would be completed prior to initiating the project. Final construction costs would only reflect the time and materials to perform the work.

8.6 Installation and Financing

The following sub-sections present the installation and financing of the Preferred Alternative. Included in this section is a framework for implementing the Preferred Alternative, the sequence of installation, responsibilities, contracting, real property and relocations, other agencies, cultural resources, financing, and conditions for providing assistance.

8.6.1 Framework for Carrying out the Plan

The Preferred Alternative would be implemented in a planned sequence as discussed in Section 8.6.2. The responsibilities of NRCS and the sponsors for the project are outlined in Section 8.6.3. No cost-shared on-farm measures are involved with this project; therefore, the responsibilities of individual participants do not need to be discussed. No preconditions are anticipated for installing the project.

8.6.2 Planned Sequence of Installation

The District would obtain all approvals and permits for the project prior to the start of construction. The project would be implemented in three project groups as presented in Table 8-2. The entire project would be completed over a 10-year period commencing in 2020 and ending by 2030. The District developed an appropriate project-phasing schedule that focused on sections of the system with high end spill loss, and also worked within engineering and funding constraints to meet District, patron, and community development needs.

Table 8-2. Construction Timeline and Installation Costs by Funding Source for the Piping Alternative, Hood River Watershed, Oregon, 2019$[1]

Construction Year	Works of Improvement	Public Law 83-566 Funds	Other, Non-Federal Funds	Total Construction Costs
0	Project Group 1: Eastside	$10,252,000	$3,510,000	$13,762,000
3	Project Group 2: Main	$18,572,000	$12,116,000	$30,688,000
6	Project Group 2: Dukes Valley	$270,000	$8,111,000	$8,381,000
8	Project Group 3: Central	$455,000	$13,743,000	$14,198,000
	Total	**$29,549,000**	**$37,480,000**	**$67,029,000**

[1] Price Base: 2019 U.S. dollars Prepared June 2020

8.6.3 Responsibilities

NRCS is responsible for leading the planning efforts, providing engineering design and construction oversight assistance, and certifying completion of the project. The District would be responsible for engineering design, project administration, environmental permitting, contracting, and construction implementation. The District has the needed authorities as an irrigation district organized under ORS 545 and has agreed to exercise those authorities to implement the actions described in this Plan-EA.

8.6.4 Contracting

The piping and pressurization of the delivery system would be completed using NRCS funding mechanisms. The District would be primarily responsible for overseeing and administering the construction of the project in coordination with NRCS.

8.6.5 Real Property and Relocations

The majority of construction would take place in EFID's existing easements. Prior to construction EFID would obtain a new easement agreement for the one piping segment that would be re-aligned. No property would be purchased.

8.6.6 Financing

NRCS would provide 45 percent of the total project cost for the Preferred Alternative through PL 83-566 and RCPP funding. The District is responsible for securing funding for the remaining 55 percent of the costs, including funds that are not eligible under the National Watershed Program (project administration and technical assistance). Table A in the NEE (Appendix D) presents annual installation costs of each project piping group and the proportion of funding through PL 83-566 and other funding sources.

The District has a strong history of securing public and private funding through grants, loans, and patron assessments. The majority of the required funding would be expected to be provided through grants. The District has been successful in securing grants for past improvements and would continue to work with partners such as the Hood River Watershed Group to obtain similar funds. If necessary, a portion of the project cost would be financed through loans. If financing is required, EFID expects to apply for funding through the ODEQ Clean Water State Revolving Fund. The District expects that funding from this source would be at an interest rate of 2.5 percent with a 0.5 percent annual fee paid on the remaining loan balance. These financing costs are not included in the NEE analysis. The District does not anticipate changing per acre annual rates or the overall base assessment fee as a result of any capital improvement project that is fully funded through grants.

O&M costs after project completion would be provided through the revenues of EFID. O&M costs would not increase due to the project and would be budgeted on an annual basis.

NRCS reserves the authority and right to discontinue or reduce program benefits based on changes in agency priorities, funding availability, or the failure of EFID to fulfill the provisions of their agreement.

Bonneville has been asked to cooperate on this Plan-EA due to Bonneville's proposed cost share funding of a discrete component of the project through the CTWS, specifically the Eastside Piping Project (Project Group 1). Bonneville would provide CTWS with up to $1 million to fund certain design work and materials for the Eastside Piping Project.

8.6.7 Conditions for Providing Assistance

Conditions for the District to receive program funds for the proposed action include completion of a Final Watershed Plan-EA, NRCS issuing a Finding of No Significant Impact, and authorization of funding by the Chief of NRCS.

8.7 Operation, Maintenance, and Replacement

The District would be responsible for the O&M of the project for the 100 years of its design life. Prior to construction, a separate O&M agreement based on NRCS Title 180, *National Operation and Maintenance Manual*, Part 500, Subpart C would be made between NRCS and the District. The agreement would continue through the design life of the project and could be modified with NRCS's approval.

Project sponsors and NRCS would make annual inspections of project measures to assure the quality of ongoing O&M. The District would be in charge of scheduling O&M inspections and be responsible for any necessary work. The District's O&M would consist of a pipe inspection program that would systematically cover inspection of the entire system over a period of several years.

The proposed system would continue its current operation schedule of April to October, in which work would be performed on an as-needed basis. During the winter months, outside of the operation time, the District would perform system component maintenance including valve battery changes, magnetic meter maintenance, District operational valve maintenance, air and vacuum valve maintenance, pressure reducing station filter maintenance, and valve repairs. The District would expand their current vegetation and weed management to include the areas on top of the newly piped system. All procedures would be followed as specified in the O&M agreement between the project sponsor and NRCS.

8.8 Economic and Structural Tables

A summary of the economic analysis of the Preferred Alternative (NEE Alternative) and the No Action Alternative is provided in Section 5.4. The full NEE Analysis can be found in Appendix D. The Preferred Alternative would result in varying average annual benefits, costs, and benefit cost ratios depending on which project group would be implemented at the time. Average annual benefits range from $462,000 to $1,218,000; average annual costs would be between $339,000 and $1,028,000, and benefit cost ratios fall between 1.17 and 1.87. Additionally, Appendix D contains an incremental analysis of the benefits and costs of completing each additional increment of the Preferred Alternative. The costs and benefits associated with each individual project group are gone into more detail in the following tables in this section. Table 8-3 (NWPM 506.11, Economic Table 1) presents the projected installation costs and the percentages of costs to be shared by the sponsors and NRCS for each project group.

Table 8-4 presents the project's cost distribution across project groups, as well as the proportion of PL 83-566 funding and other funding sources. The average annual NEE costs are shown in Table 8-5.

Table 8-3. Economic Table 1—Estimated Installation Cost of the Piping Alternative, Water Resource Project Measures, Hood River Watershed, Oregon, 2019$.

Works of Improvement	Unit	Number			Estimated Cost (dollars) [1,2]						
					PL 83-566 Funds			Other Funds			
		Federal Land	Non-Federal Land	Total	Federal Land NRCS	Non-Federal Land NRCS	Total	Federal Land	Non-Federal Land	Total	Total
Project Group 1[3]	feet	0	81,834	81,834	$0	$10,252,000	$10,252,000	$0	$3,510,000	$3,510,000	$13,762,000
Project Group 2[4]	feet	1,056	138,208	139,264	$264,000	$18,578,000	$18,842,000	$172,000	$20,055,000	$20,227,000	$39,069,000
Project Group 3	feet	0	107,583	107,583	$0	$455,000	$455,000	$0	$13,743,000	$13,743,000	$14,198,000
Total		**1,056**	**327,625**	**328,681**	**$264,000**	**$29,285,000**	**$29,549,000**	**$172,000**	**$37,308,000**	**$37,480,000**	**$67,029,000**

1/ Price base: 2019 U.S. dollars. Prepared: November 2019

2/ Project cost as identified in the EFID SIP, updated to 2019 U.S. dollars and including construction, project administration, engineering, technical assistance, and permitting costs. Based on input from EFID, the total length of piping in Project Group 1 was decreased from the SIP and the costs for Project Group 1 were updated accordingly.

3/ Project Group 1 cost includes $1,430,000 RCPP funds, using PL 83-566 Authority.

4/ Includes sedimentation basin cost of $767,000.

Table 8-4. Economic Table 2 —Estimated Piping Alternative Cost Distribution, Water Resource Project Measures, Hood River Watershed, Oregon, 2019$.

Works of Improvement	Installation Costs—PL 83-566 Funds[1,2]				Installation Cost—Other Funds[1,2]				
Piping	Construction	Engineering	Project Admin[3]	Total PL 83-566	Construction	Engineering	Project Admin[3]	Total Other	Total[1,2]
Project Group 1	$9,023,000[4]	$297,000	$932,000	$10,252,000	$3,007,000	$99,000	$404,000	$3,510,000	$13,762,000
Project Group 2[5]	$15,977,000	$1,176,000	$1,689,000	$18,842,000	$18,562,000	$392,000	$1,273,000	$20,227,000	$39,069,000
Project Group 3	$0	$455,000	$0	$455,000	$13,049,000	$152,000	$542,000	$13,743,000	$14,198,000
Total	**$25,000,000**	**$1,928,000**	**$2,621,000**	**$29,549,000**	**$34,618,000**	**$643,000**	**$2,219,000**	**$37,480,000**	**$67,029,000**

Notes: Totals may not sum due to rounding. Prepared: November 2019

1/ Price base: 2019 U.S. dollars

2/ Project cost as identified in an addendum to the EFID SIP updated to 2019 U.S. dollars and including additional costs for project administration, technical assistance, and permitting.

3/ Project Admin includes project administration, technical assistance costs, and permitting costs.

4/ Project Group 1 cost includes $1,430,000 RCPP funds, using PL 83-566 Authority.

5/ Project Group 2 includes the sedimentation basin which was originally priced in 2015$ and adjusted to 2019$ using the RS Means Construction Cost Index.

Table 8-5. Economic Table 4—Estimated Average Annual NEE Costs, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement[2]	Project Outlays (Amortization of Installation Cost)[2]	Project Outlays (OMR cost)[3]	Total
Project Group 1	$395,000	$1,000	$399,000
Project Group 2	$1,018,000	$10,000	$1,028,000
Project Group 3	$332,000	$7,000	$339,000
Total	**$1,745,000**	**$18,000**	**$1,763,000**

Notes: Totals may not sum due to rounding. Prepared: November 2019
1/ Price base: 2019 U.S. dollars, amortized over 100 years at a discount rate of 2.75 percent.
2/ Project groups would be completed over the course of multiple years such that Project Group 1 would be completed in Year 3 and Project Group 2 would be completed in Year 9.
3/ OMR = operate, maintain, and replace. Operation, maintenance, and replacement costs include the expense of running EFID and maintaining District infrastructure, including replacement costs for the sedimentation basin.

The Preferred Alternative damage reduction benefits include agricultural yield enhancement, reduced O&M, power cost savings, avoided carbon emissions, and increased instream flow. Table 8-6 (NWPM 506.20, Economic Table 5a) presents the average annual watershed protection damage reduction benefits across all project groups.

Table 8-6. Economic Table 5a—Estimated Average Annual Watershed Protection Damage Reduction Benefits East Fork Irrigation District Watershed Plan, Hood River Watershed, Oregon, 2019$.

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-Related[1]	Non-Agricultural- Related[1]
Project Group 1		
On-Site Damage Reduction Benefits		
Other - Agricultural Damage Reduction	$91,000	
Other - Reduced O&M	$119,000	
Other - Power Cost Savings	$134,000	
Subtotal	$344,000	
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon (Avoided Carbon Emissions)[2]		$3,000
Water Conservation		$115,000
Subtotal		$118,000
Total Quantified Benefits	**$344,000**	**$118,000**
Project Group 2		
On-Site Damage Reduction Benefits		
Other - Agricultural Damage Reduction	$760,000	
Other - Reduced O&M	$200,000	
Other - Power Cost Savings	$91,000	
Subtotal	$1,051,000	
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon (Avoided Carbon Emissions)[2]		$1,000
Water Conservation		$166,000
Subtotal		$167,000
Total Quantified Benefits	**$1,051,000**	**$167,000**

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-Related[1]	**Non-Agricultural- Related[1]**
Project Group 3		
On-Site Damage Reduction Benefits		
Other - Agricultural Damage Reduction	$522,000	
Other - Reduced O&M	$0	
Other - Power Cost Savings	$54,000	
Subtotal	**$576,000**	
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon (Avoided Carbon Emissions)[2]		$1,000
Water Conservation		$56,000
Subtotal		$57,000
Total Quantified Benefits	**$576,000**	**$57,000**

Notes: Totals may not sum due to rounding. Prepared: November 2019
1/ Price base: 2019 U.S. dollars amortized over 100 years at a discount rate of 2.75 percent.
2/ Indicates the benefit of avoided carbon emissions from eliminated on-farm pumps. These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

Using the resulting benefits and costs from the previous two tables, Table 8-7 (NWPM 506.21, Economic Table 6) presents a comparison of the NEE average annual benefits and average annual costs.

Table 8-7. Economic Table 6— Comparison of Average Annual NEE Costs and Benefits, East Fork Irrigation District Watershed Plan, Hood River Watershed, Oregon, 2019$.

Works of Improvement	Agriculture-Related[1]			Non-Agricultural[1]		Average Annual Benefits[1]	Average Annual Cost[1,2]	Benefit–Cost Ratio
	Agricultural Yield Enhancement	Reduced O&M	Patron Pumping Cost Savings	Carbon Value	Instream Flow Value			
Project Group 1	$91,000	$119,000	$134,000	$3,000	$115,000	$462,000	$396,000	1.17
Project Group 2	$760,000	$200,000	$91,000	$1,000	$166,000	$1,218,000	$1,028,000	1.18
Project Group 3	$522,000	$0	$54,000	$1,000	$56,000	$633,000	$339,000	1.87
Total	**$1,373,000**	**$319,000**	**$279,000**	**$5,000**	**$337,000**	**$2,313,000**	**$1,763,000**	**1.31**

Notes: Totals may not sum due to rounding.
Prepared: April 2019

1/ Price base: 2019 U.S. dollars amortized over 100 years at a discount rate of 2.75 percent.

2/ From Economic Table 4.

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10 List of Preparers

Under the direction of NRCS, the Plan-EA was primarily developed by FCA and its subcontractor, Highland Economics. The staff responsible for preparation of the Plan-EA are included in Table 10-1.

Table 10-1. List of Preparers.

Name	Title	Education	Professional Experience	Area of Responsibility
FCA Watershed Plan-EA Team				
Kristin Alligood	Program Specialist	Ph.D. Biology B.A. Neuroscience	6 years	Ecosystem Services
Raija Bushnell	Program Specialist	M.P.A Natural Resource Policy M.S.E.S Natural Resource Management B.A. Political Science	6 years	General
Holly Coccoli	Program Specialist	M.S. Environmental Engineering and Science B.S. Fisheries Science	31 years	Fish and Aquatic Species, Wildlife, Water Resources, Vegetation, Wetlands, Cumulative Effects
Brett Golden	Director of Impact	M.E.M Environmental Management A.B. Environmental and Evolutionary Biology	14 years	General
Kate Hart	Program Specialist	M.S. Earth Science B.A. Earth Science	5 years	Socioeconomics, Alternatives, Preferred Alternative
David McKay	Program Specialist	M.P.A. Environmental Policy B.A. Political Science	6 years	Cultural Resources, Visual, Public Safety, Public Scoping
Amanda Schroeder	Program Specialist	B.S. Natural Resource Management	5 years	General
Alexis Vaivoda	Team Lead	M.S. Environmental Science B.S. Biology	18 years	General
NRCS-Oregon				
Gary Diridoni	Natural Resource Specialist	Fisheries Management Graduate Certificate B.S. Wildlife Management B.S. Interdisciplinary Studies, Ecosystem Conservation	17 years	General

Name	Title	Education	Professional Experience	Area of Responsibility
Tom Makowski	Assistant State Conservationist-Watershed Resources and Planning	Ph.D. Rural Sociology M.S. Social Psychology B.S. Recreation Resource Management	32 years	General
Lakeitha Ruffin	Agricultural Economist	M.S. Agricultural Economics B.S. Agricultural Economics	10 years	Economic and Socioeconomic Analysis, Alternative Analysis, Overall Watershed Planning
Employees from Firms Under Contract with FCA				
Barbara Wyse	Principal and Senior Economist, Highland Economics	M.S. Environmental and Natural Resource Economics B.A. Environmental Sciences and Policy	15 years	Economic Analysis
Winston Oakley	Research Economist, Highland Economics	M.S. Applied Economics B.S. Environmental Sciences, Policy, and Management	6 years	Economic Analysis
Sandy Slayton	Senior Project Manager, ERM	M.A. Ecology B.A. Environmental Science	17 years	General

11 Distribution List

A Notice of Availability for the Plan-EA will be distributed to federal, state, and local agencies, community representatives, and area non-governmental organizations.

Governmental organizations and agencies to be notified:

- Bonneville Power Administration (Bonneville)
- Business Oregon
- City of Hood River
- Hood River County
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- Oregon Department of Agriculture (ODA)
- Oregon Department of Environmental Quality (ODEQ)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of Forestry (ODF)
- Oregon Department of State Lands (ODSL)
- Oregon Governor's Office
- Oregon Water Resources Department (OWRD)
- Oregon Watershed Enhancement Board (OWEB)
- State Historic Preservation Office (SHPO)
- U.S. Army Corps of Engineers (USACE)
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture, U.S. Forest Service, Mount Hood National Forest
- U.S. Fish and Wildlife Service (USFWS)

Other organizations and individuals to be notified:

- Columbia Gorge Fruit Growers
- Columbia Land Trust
- EFID patrons
- Farmers Irrigation District (FID)
- Hood River Soil and Water Conservation District
- Hood River Valley Parks and Recreation
- Hood River Watershed Group
- Interested public
- Middle Fork Irrigation District (MFID)
- Mount Hood Irrigation District (MHID)
- Thrive Hood River (formerly Hood River Residents Committee)
- Trout Unlimited
- WaterWatch of Oregon
- Wy'east Fire District

In accordance with EO 13175, Consultation and Coordination with Indian Tribal Governments, NRCS will contact the CTWS, Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes and Band of the Yakama Nation regarding the availability of the Plan-EA.

The names of private stakeholders and members of the public who will receive notice of the Plan-EA are not listed for privacy.

12 Acronyms, Abbreviations, and Short-forms

°F	degrees Fahrenheit
ACHP	Advisory Council on Historic Preservation
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
Bonneville	Bonneville Power Administration
CLP	Central Lateral Pipeline
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CTWS	Confederated Tribes of Warm Springs
CWA	Clean Water Act
DID	Dee Irrigation District
District	East Fork Irrigation District
DVC	Dukes Valley Canal
EA	Environmental Assessment
EAP	Emergency Action Plan
EC	Eastside Canal
EE	Environmental Evaluation
EFH	Essential Fish Habitat
EFID	East Fork Irrigation District
EFU	Exclusive Farm Use
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FCA	Farmers Conservation Alliance
FID	Farmers Irrigation District
GIS	geographic information system
HDPE	high-density polyethylene
MBTA	Migratory Bird Treaty Act
MFID	Middle Fork Irrigation District
MHID	Mount Hood Irrigation District
N/A	not applicable
NEE	National Economic Efficiency

NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NWPM	National Watershed Program Manual
O&M	operation and maintenance
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
OMB	Office of Management and Budget
OMR	operate, maintain, and replace
ORS	Oregon Revised Statute
OWRD	Oregon Water Resources Department
PCE	Primary Constituent Element
PL 83-566	Watershed Protection and Flood Prevention Act, Public Law 83-566
project	East Fork Irrigation District Infrastructure Modernization Project
PR&G	Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies
proposed action	East Fork Irrigation District Infrastructure Modernization Project
PRV	pressure reducing valve
PVC	polyvinyl chloride
RCPP	Regional Conservation Partnership Program
RM	River Mile
SHPO	State Historic Preservation Office
SIP	System Improvement Plan
U.S./US	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

13 Index

14 Appendices A-E

See Appendices in separate document.

Appendix A. Comments and Responses
Appendix B. Project Maps
Appendix C. Supporting Maps
Appendix D. Investigation and Analysis Report
Appendix E. Other Supporting Information

Appendix A

Comments and Responses

All acronyms used in the responses in Table A-2, unless defined herein, are defined in and can be found in Section 12 of the Plan-EA. All references used in the responses in Table A-2, unless listed herein, are listed in Section 9 of the Plan-EA.

Table A-1. Topics and Associated Codes.

Topic	Topic Code	Topic	Topic Code
Alternative Analysis	ALT	Patron Delivery	PATD
Construction Practices	CONS	Public Process	PUB
Project Cost	COST	Purpose and Need	PURP
Cultural Resources	CUL	Recreation	REC
Fish and Aquatic	FISH	Resource Concerns	RES
General	GEN	System Design	SYS
Maps	MAP	Vegetation	VEG
National Economic Efficiency	NEE	Water	WAT
Non-economic Development	NONV	Wildlife	WILD

Table A-2. Responses to Comments Received During the Public Comment Period for East Fork Irrigation District Watershed Plan-EA.

Comment ID	Topic Code	Comment	Response
1.01	SYS	About a 100 years ago or so the East Fork Irrigation Canal was built through property on Miller Road owned by my wife and I today. In order to convey and deliver water, the irrigation district holds a legal right of way for a ditch, canal or flume for irrigation water to flow through our property. We also have rights to draw certain water from the Canal. The irrigation district does NOT hold a legal right of way for a pipeline through our property. Therefore, there is no legal right allowing construction of piping by the irrigation district through our property. Since piping is not a legal option for the district, at least through our property (and I suspect many others in this area), leaving the Canal as is and/or other options must be revisited.	The Plan-EA adopts a tiered approach to evaluating potential effects associated with the proposed project under the National Environmental Policy Act. The Plan-EA describes potential effects to resources within the greater project area, while site-specific effects are described in subsequent site-specific studies. Additional information on tiering is available in Section 1.4 of the Plan-EA and in the National Environmental Compliance Handbook Title 190 Part 610 (NRCS 2016). Following this approach, EFID would work with landowners to resolve property-specific design questions during the design process for the associated project group.

Comment ID	Topic Code	Comment	Response
			As a general rule in Oregon, an easement owner has the right to improve its easement to the extent that the improvement does not substantially increase the burden on the servient property (i.e. the landowner). Regarding a legal dispute involving a similar project in the Swalley Irrigation District, the U.S. District Court for the District of Oregon determined that the conversion of an irrigation canal to an irrigation pipeline was lawful, where the right-of-way at issue had been granted for irrigation purposes, and where the conversion from canal to pipeline did not increase the burden on the servient properties (Swalley v. Alvis, 2006). Thus, piping open canals and ditches may be allowed even when an express, written easement does not explicitly identify piping as the specific means for conveying water. Reference: Swalley Irrigation District v. Gary Clement Alvis, et al. Civ. No. 04-1721-AA. (Oregon March 1, 2006 opinion and order).
1.02	ALT	In the winter the Canal acts as a catch basin for snow. In the spring and fall the Canal acts as a catch basin for rain. Keeping the surface open to capture the snow and rain – as well as seepage into the Canal from the mountainside above – can all be collected down by the Hanel Mill area for later use.	Please see Section 6.7.2 in the Plan-EA for a discussion of the potential effects of the proposed project to stormwater and surface water management.
1.03	WILD	The Canal has morphed into the landscape as a natural resource unto itself and should continue providing water and serving as a swimming hole for the ducks, geese and birds that have come to call the Canal home now for many generations.	The phasing of the project is expected to allow waterfowl and other avian wildlife ample time to adapt to other water sources. Please see Sections 4.10, 6.10.2, and 8.3 in the Plan-EA for further information about wildlife and BMPs regarding wildlife.
1.04	CUL	This section of the Canal is a historic, cultural, recreational and natural resource that should be preserved.	The Plan-EA is a programmatic document that addresses resources in the project area and the watershed planning area as a whole, and not at the level of a specific canal or pipeline. Please see Section 6.1.2 in the Plan-EA for a discussion of the potential effects of the proposed project on cultural resources. Language was added to Section 4.6.2 and Section 6.6.2 in the Plan-EA to identify the cultural value that private landowners

Comment ID	Topic Code	Comment	Response
			adjacent to the project area gain from the canal system and how the Piping Alternative would effect that value. Although the maintenance roads and trails along the District's canals and pipelines are used for recreation by some area residents, the District's easements are only for maintaining irrigation infrastructure and conveying irrigation water. Public use of the property alongside the District's canals and laterals is not a purpose of the District's easements and occurs at the discretion of each property owner.
1.05	NON V	The Canal in this area is used, precisely because it is open, for hiking by many property owners, and others. There is a historical walking trail along the Canal. Anyone who's walked along this portion of the Canal knows it is a natural resource, as it is, with the beauty of a river – and that this will no longer be the case if it is piped.	The District's canals and laterals, rather than being natural features, were constructed for the specific purposes of conveying irrigation water and are subject to District operations and maintenance for that purpose. The District's easements are associated with that purpose, and that purpose does not include recreational trail use. People who access the maintenance roads and trails, whether trespassing or otherwise, would continue to do so but would walk along a rural landscape rather than a water feature. See Section 6.6.2 in the Plan-EA for a discussion of how the view in the easement would change if the canal were piped.
1.06	GEN	For the span of the Canal from Tollbridge Park/Hwy 35 down to Pinemont Drive/Hwy 35, the heart of which is through the Miller Road section, it does not make sense to manufacture miles and miles of plastic for the proposed side-by-side pipes, plus creating industrial waste and waste water in the manufacture of these unnecessary pipes. Other smaller sections of the Canal may have different issues whereby piping is appropriate. But in the Miller Road area the Canal is 30' wide, or so, and has taken on a natural life cycle and majesty akin to a brook in the non-irrigation season, and a river in the irrigation season.	Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.
1.07	WAT	Seepage has not been accurately measured and is speculative. Evaporation has not been accurately measured and is speculative.	The estimated water savings in the Plan-EA are based on end spill losses in the conveyance system rather than on seepage or evaporative losses. Available studies of seepage in District canals

Comment ID	Topic Code	Comment	Response
			were determined to be inconclusive, and seepage could not be reliably estimated. Evaporative losses are not included in the water savings estimate. See Section 2.1.1 in the Plan-EA for a summary of water losses. More detailed information on water losses can be found in the District's SIP (FCA 2018a).
1.08	PURP	While the District cites danger, to my knowledge no one has ever drowned in the Canal over its 100 year history. Property owners with the risk of young children accessing the Canal are able to fence off their own property to provide a safety barrier. The District's threat to fence the Canal is an unnecessary waste of money. Fencing would also interfere with its maintenance of the Canal, and quickly become dilapidated by falling trees. Fencing would deprive the owners of their right to enjoy sharing the path along the Canal.	New text was added to Section 2.1.4 in the Plan-EA noting that the drowning of a child occurred in the Main Canal. Fencing was included in the Canal Lining Alternative to address the increase in public safety risk associated with an increase in canal water velocities after lining (Section 5.2.2 in the Plan-EA). However, no fencing is proposed in the Preferred Alternative (Section 8.2 in the Plan-EA). Please see the response to Comment ID 1.04 related to the public's use of the roads and trails along the District's canals and laterals.
1.09	WILD	Wildlife crosses the Canal regularly and an environmental impact study would be warranted.	After the proposed project, wildlife crossings would not be impeded over the buried pipeline. See Sections 4.10.1 and 6.10.2 in the Plan-EA for discussion of existing wildlife resources in the project area and effects of the proposed project on wildlife. NRCS has elected to prepare an EA as allowed under the 1969 NEPA. The finding of the EA regarding the significance of environmental effects would determine whether an EIS is required.
1.10	GEN	But the reality is that the District only has a legal right of way for a ditch, canal or flume -- not fencing. So just like the pipeline, fencing is not allowed.	Please see the response to Comment ID 1.01.
1.11	GEN	Also pressurized irrigation isn't needed in the Miller Road section of the Canal for the most part. Most irrigation is on the down side of the Canal, which is also part of its beauty in that this irrigation is gravity fed and does not require electric pumps.	Piping the Main Canal from the proposed sedimentation basin to its terminus would build up gravity pressure for those patrons who may not have adequate elevation change on their property to avoid the need to pump water, providing system-wide benefits to meet the purpose and need of the proposed project.

Comment ID	Topic Code	Comment	Response
1.12	ALT	Is it possible to leave the Miller Road section open and pressurize the Canal starting around Hanel Mill? It seems the same concept is being proposed with an open river further up, and that process can begin the pressurized portion from an open canal in the Hanel Mill area.	A "Piping Alternative with Open Canal upstream of Hanel Mill" alternative was added to the Alternatives Considered During Formulation section in Appendix D.3.9 of the Plan-EA.
1.13	GEN	It's concerning that this proposed $69M project presumed easements that don't exist, trampling on the property rights of owners and inviting legal challenges. Determining that legal rights for the proposed project don't exist should have been done before jumping to an environmental impact statement. Throwing more money in the wrong direction is wasteful to the District and its partners.	Please see response to Comment ID 1.01.
2.01	WILD	How can you mitigate loss of water for wildlife? Can something be added to provide water?	Please see Section 6.10.2 in the Plan-EA for a discussion of potential effects of the proposed project on wildlife.
3.01	CONS	Fill in old ditches. Do not want ditches left; fill them into avoid safety issues and to prevent mosquitoes.	Most of the open canals would be backfilled after piping. The District would seek input from affected landowner(s) in those locations where engineering plans recommend leaving any decommissioned canal segment open for local stormwater management. See Sections 4.7.2.4 and 6.7.2 in the Plan-EA for a description of existing canals and stormwater, and the effects of piping on stormwater.
3.02	WILD	How will project affect wildlife? Will a nipple be added to the pipe to provide water for wildlife?	Please see Section 6.10.2 in the Plan-EA for a discussion of potential effects of the proposed project on wildlife.
3.03	GEN	No ATVs on trail.	New text was added to Section 6.2.2 in the Plan-EA about the potential effects of the proposed project on the unauthorized vehicle use of maintenance roads or trails. New text was also added to Section 8.3 that describes BMPs that would be employed to address such use.
4.01	PURP	The biggest effect for most growers is removing silt and sediment so that we can be more efficient and economical with the water we do use.	Thank you for your comment.
5.01	PATD	How are the breakout points determined and do they assess the property size when doing?	Assuming that breakout points refer to turnouts along the District's conveyance, each turnout would be sized based on the

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			irrigated acreage served during the detailed engineering design process.
5.02	PATD	If private laterals coming off the turnout go through multiple property owners to reach a single property, how is that managed? How do we ensure existing private laterals match up with new laterals?	No private laterals would be replaced as part of the proposed project. Patrons who want to upgrade private laterals that extend through several properties should work with those respective landowners and with the District for any necessary assistance. Proposed piping would follow existing alignments as much as possible to ensure they are properly tied to any existing private laterals.
5.03	PATD	Can turnouts be located to optimize pressurization of a property (i.e. put turnout on the up slope side of property vs. down slope)?	The District would be able to discuss this type of request if contacted prior to its completing engineering designs for a pipeline.
6.01	COST	Whose responsibility will it be to cover costs of tapping into the turnout?	The District would connect existing private laterals to the newly installed, updated District turnouts.
6.02	GEN	Property line goes half way into canal line, how does the maintenance of trail change after piped?	New text was added to Section 6.2.2 in the Plan-EA to clarify that the District would continue to maintain its access to buried pipeline via a trail, track, or gravel road within its easement.
6.03	CONS	Will the new pipe be a gully or match landscape contours?	The new pipeline would be buried and the trench would be backfilled and contoured to match the existing landscape. See Section 6.5.2 in the Plan-EA for photos of past piping projects in the District. Also, see response to Comment ID 3.01.
6.04	COST	How will patron bills be affected? How will the District find match?	Please see Section 8.6.6 in the Plan-EA for details of how the District would provide match funding and the potential effects on patron bills.
7.01	SYS	If pipe will be pressurized will pump be needed?	Please see Section 5.3.2 in the Plan-EA for details on pressurized water deliveries.
8.01	GEN	Concerned about gate from Fir Mountain, that ATV will use the new buried pipe.	Please see the response to Comment ID 3.03.
8.02	CONS	Interested in crossing the piped area; wants to make sure it can support any heavy vehicle that would cross.	Site-specific pipeline designs would be evaluated and addressed by the responsible design engineer assigned to the project.

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			Subsequent site-specific evaluations would occur prior to construction based on the Plan-EA's tiered approach. See response to Comment ID 1.01 for information on tiering. The design engineer would insure adequate backfill, backfill compaction, and depth of cover over the pipeline. For high traffic pipeline crossings, or crossings where very heavy vehicles are expected, a steel carrier pipe may be necessary. Generally, the pressure from cars and other light vehicles would have little impact to properly installed HDPE pipe (Plastics Pipe Institute 2008). Reference: Plastics Pipe Institute. (2008). Chapter 6: Design of PE Piping Systems. Handbook of Polyethylene Pipe (2nd Edition pp. 191-241). Retrieved from: https://plasticpipe.org/publications/pe-handbook.html.
8.03	CONS	Mistake on 10% stormwater design off of ditch to Thomsen Rd, don't show going off of road. If heavy rain, how will stormwater in seasonal Shelley Creek be affected?	Site-specific stormwater design would be evaluated and addressed in subsequent site-specific evaluations prior to construction based on the Plan-EA's tiered approach. See response to Comment ID 1.01 for information on tiering.
8.04	WILD	Owl nests where Eastside lateral route is. Swyers Drive & Fir Mountain Rd on county property.	Please see Section 8.3 in the Plan-EA for description of BMPs related to wildlife and nesting birds.
9.01	WAT	Plan should include evaporation and seepage losses.	Please see response to Comment ID 1.07.
10.01	MAP	Can you show a closer image of pipe location?	Larger-scale maps of the proposed pipeline alignments have been added to Appendix C.
11.01	MAP	We need a closer map of the project area around the realignment area.	Please see response to Comment ID 10.01.
11.02	CONS	What is the approximate time for construction?	Construction would occur during the non-irrigation season. Please see Section 8.2 for a construction timeline.

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11.03	CONS	We want to have a turnout put in.	Landowners interested in a new turnout should contact the District. As a programmatic environmental document for the proposed project, the Plan-EA does not address this matter.
12.01	GEN	I applaud the efforts to upgrade EFID infrastructure. The increases in irrigation efficiencies are needed, and will help maintain the viability of our area's agriculture.	Thank you for your comment.
12.02	VEG	My comment is with regard to the loss of the long-established, open waterway and the effects it will have on forest trees adjacent to the decommissioned canal. As I have several hundred linear feet of previously decommissioned EFID canal along my property above Neal Creek, I have been dealing with the decline and death of large conifers, some in excess of 100 years old, due to changes in the subsurface hydrology after canal rerouting. I would be happy to send photos, if you might find them helpful. Property owners should be made aware of the gradual decline to established trees adjacent to the existing open canal once it is decommissioned. Perhaps a cost-share program could be considered to aid in tree removal as these declining trees will eventually present a hazard.	The District would not remove potential hazard trees that could fall within its easement. However, the District would continue to remove any fallen trees within its easement to maintain access. Please see updated language in Section 6.5.2 in the Plan-EA for additional discussion of the potential effects of the proposed project to vegetation. Please see updated language in Section 8.3 for discussion of BMPs related to vegetation.
12.03	WILD	Another consideration is that these well-established, open canals have served as a water source for local deer and elk populations for many generations. Possible incorporation of a few open water sources (i.e. ponds) would help prevent movement of local Cervid populations onto agricultural and rural residential properties in their efforts to reach available water sources.	Please see Section 6.10.2 in the Plan-EA for a discussion about the potential effects of the proposed project to wildlife. Water is not considered to be a limiting factor for terrestrial wildlife in the project area and vicinity (J. Thompson, ODFW District Wildlife Biologist, personal communication December 6, 2018). The District's water rights are for irrigation, agricultural spraying, frost, fire protection, and industrial uses only. The water rights do not provide authorization for the creation of ponds for wildlife.
13.01	COST	It was stated that funding for this project will come from a combination of NRCS funding and grants and/or loans that East Fork Irrigation will need to procure. Will any part of this project be funded by increasing rates for East Fork Irrigation patrons who pay for irrigation rights on their property?	Please see Section 8.6.6 in the Plan-EA for details of how the District would provide match funding and the potential effects on patron bills.

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14.01	GEN	My name is Daryl Roberts and I am calling about the EFID project with some questions about how the EF District part of the funding will be handled. My number is 541-XXX-XXXX. I already called the EFID and talked to John Buckley, and he referred me to you guys. Talk to you later.	Thank you for your comment. Two phone calls were made to the number provided, and two messages were left.
15.01	FISH	The Oregon Department of the Fish and Wildlife (ODFW) submits these comments on the East Fork Irrigation District (EA). As the EA correctly identifies, the Hood River and its tributaries support a diversity of fish species, including several species which are listed as either state sensitive, or as threatened under the Endangered Species Act (ESA). Low streamflow in the Hood River basin, associated with water diversions, has been identified as critical limiting factor for recovery of listed fish species (ODFW, 2010). The ODFW commends the East Fork Irrigation District (EFID) Modernization Project for its proposal to improve efficiency, divert less water, and leave additional water instream flow through voluntary water savings and through permanent instream transfer through the Conserved Water Program. Water quality is also an important factor for fish, and aquatic health in Hood River. Increased temperature, turbidity, toxics, and nutrients have all been identified as factors limiting water quality in the Hood River basin. And many of these currently do not meet federal and state standards. Again, the ODFW commends the Modernization Project for decreasing diversion rates thus having less effect on stream temperatures, and reducing end spills to decrease sedimentation and other associated negative water quality impacts. Water diversions generally negatively affect water quality, and the EA mostly describes EFID's operational effects on water quality.	Thank you for your comment.
15.02	FISH	The document does, however, fail to address the significant increase in sedimentation in the East Fork Hood River downstream from the diversion site resulting from the operation of the sand settling basin. As we understand the operation of the sand settling basin, turbidity (sand) is removed from the diverted flow at the settling basin and relatively sediment free water is delivered downstream through the irrigation infrastructure. The diversion site takes approximately 75 to 85 percent of the flow in the East Fork of the Hood River and its associated sediment, the sediment is settled out in the settling basin, but the	Thank you for your comment. Language has been added to Sections 4.7.3.3, 4.8.1., 6.7.1.4, 6.7.2.4, and 6.8.1.2 in the Plan-EA to describe current sediment management operations at the EFID sand trap and their potential effects on the aquatic environment and expected sediment management under the proposed project and their potential effects on the aquatic environment.

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		remaining sediment is then regularly flushed back to the diverted reach of the East Fork Hood River at the sand settling basin. This flushing of sediment back to the 15 to 25 percent of remaining flow in the diverted section of East Fork greatly spikes the sedimentation in the East Fork Hood River far exceeding sedimentation standards, and likely substantially negatively affecting aquatic health in the East Fork Hood River below the diversion site. We ask to please better describe the current operation of the sand settling basin, potential effects on water quality and aquatic health, and any future operational procedures associated with the Modernization Project that may limit sedimentation from this site.	
16.01	GEN	I live in Bowling Green, Kentucky, but I was born and raised in the upper Hood River valley; on a beautiful property on Miller Road, adjacent to the East Fork Irrigation District's main canal. Both of my parents were also born and raised in Hood River, and bought the property in the late 1970's. I can directly credit the maintenance road access to the canal, and the wildlife viewing opportunities that came with it, for a good deal of the development of my passion for wildlife and conservation in childhood. This early interest in wildlife ultimately led me to where I am today: teaching Biology at a community college. When my mother informed me of the East Fork Irrigation District's proposed plan to pipe the canal, I was devastated. When I go home to visit, my first outing is a visit to the canal. Before I leave, I take one last walk along that maintenance path. The canal's maintenance road may be no formal recreation trail; bicycling, hiking, and wildlife photography may not be sanctioned activities; but for many who call this stretch of the east Hood River Valley home, it has become a central part of the joy of life. Though I've lived in several towns in Oregon, Montana, and now Kentucky, and have visited southern Africa twice, the one landscape photograph I have hanging in my office is of the humble irrigation canal behind our home. A line of vegetation overhangs the bank, creating a stark contrast between green leaves and brown soil. The lazy meandering canal sparkles in the sunlight. And in the distance, a glimpse of the newly constructed bridge hints toward paths few take. Those of us who are lucky enough to know those paths have come to appreciate the canal and it holds a special place in our	Please see Section 6.6.2 in the Plan-EA for a discussion of the effects of the proposed project to visual resources. Language has been added in Section 4.6.2 to more accurately describe conditions that may be present in canals during the non-irrigation season. Language was added to Section 6.2.2 to note that the District would continue to maintain a trail, track, or gravel road within its easement to access the buried pipeline following construction. Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system. A new section has been added to the NEE in Appendix D of the Plan-EA that analyzes the effect of piping the canal on property values.

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		hearts. That may sound saccharine, but it is true. I am afraid I just cannot agree with the statement that "the Piping Alternative would have a minor, long-term effect on visual resources in the project area." I did appreciate the addition of "some residents consider the presence of open channels with flowing water to be an amenity that provides a unique water feature on or near their property or an enjoyable view when they walk along maintenance roads aside the canals." Yes, absolutely. I cannot overstate how much walks along the canal have become a part of my life and the lives of my family members. Ask anyone who lives along Miller Road who use the canal's maintenance trail for walking, hiking, horseback riding, bicycling, jogging, and cross-country skiing whether they think this will be a minor effect. Eliminating the open canal will have significant long-term impacts and completely change the character of the land and may even affect property values. Currently, a real estate listing for a home for sale on Miller Road includes the following in its description: "hike out your back door near the canal running through the back of the property"! This is a huge draw for locals and even visitors in the area and is likely a selling point for these properties. Over the years, pedestrian traffic has increased as more homes have been built with access to the maintenance road. It is rare now to walk for any length of time on a clear day and not meet a few neighbors out for a walk as well. There is even a community "Christmas tree" along the path, maintained by multiple families who reside along Hess and Miller Roads that has morphed into an "any holiday" tree with decorations year-round.	
16.02	WILD	Aside from the concerns I have for locals and the disappearance of this water feature, I also have concerns for the flora and fauna that call the habitats that include the canal home. The canal has been a part of the landscape for 70+ years. Though it is not technically "natural," it still provides ecological benefits that generations of wildlife have relied upon. Not only is it a significant water source for birds, mammals, and reptiles, it creates habitat for many species of native plants and their pollinators. Eliminating what has become a year-round source of water and habitat for wildlife is one of the concerns I have with this project. Though the report states that "From November through February, the canals do not carry water except during large storms and are usually	Section 4.6.2 in the Plan-EA has been revised to more accurately describe conditions that may be present in canals during the non-irrigation season. Please see Section 6.10.2 in the Plan-EA for a discussion of the potential effects of the proposed project on wildlife.

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		empty with occasional puddles or pools in low-lying areas and at locations where spring water enters the canals," I can attest that this is demonstrably false. The only times I have seen significant areas of the canal "dry" is when the remaining water freezes solid during the coldest parts of winter. At least within the main canal, there is substantial water year-round that provides habitat and water for wildlife. Even in the middle of winter, water depths range from a few inches to 6" or more in the deeper pools. The canal is never completely drained of water, and snow melt and precipitation add to its value as a year-round low-lying area; a water source for wildlife and plants. Hence, one of my primary concerns with this project on the main canal is its potential to negatively affect local populations of many native species of wildlife. From a biologist's perspective, I can certainly appreciate the desire to attempt to return conditions to more "natural" parameters. But after nearly a hundred years of use by native flora and fauna in the area, to me, it seems difficult to weigh costs and benefits ecologically.	
16.03	FISH	From what I understand in the report, even with all of the modernization projects going forward in addition to unspecified future conservation efforts, instream flow and water temperatures, especially downstream from the diversion point, will still be insufficient to support viable spawning populations of anadromous fishes. If even in the best of circumstances this saved water will be insufficient to support aquatic species thriving in the East Fork, is there really going to be a net ecological benefit once the open canal is eliminated? It certainly provides quality habitat for wildlife currently; piping it renders this water completely inaccessible and useless for any wildlife and plants established in the area.	Please see Section 6.8.2 in the Plan-EA for a discussion of the potential effects of the proposed project on anadromous fish populations. For additional information, see the response to Comment ID 16.06.
16.04	WILD	Many sources of water further down in the valley have already been co-opted for use by residents and agriculture. Natural streams and ponds within the valley are not as accessible to wildlife due to human encroachment, so for many populations, the only viable alternative will be to seek out less dependable small streams within the foothills below Bald Butte. Having hiked this territory for much of my childhood and adult life, I can say that what little water I have come across (in the form of small springs and streams) is in fact largely ephemeral in nature	Please see Section 6.10.2 in the Plan-EA for a discussion about the effects of the proposed project to wildlife.

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		and not likely to support as many species or as many individuals as currently use the area. To my knowledge, many of the large hillsides to the east of the main canal do not have any permanent source of water; hence the removal of the canal will undoubtedly cause considerable disturbance to wildlife, emigration from the area, and lower populations and productivity.	
16.05	WILD	The report states that "the effect of the Piping Alternative on any resident fish populations or macroinvertebrates and amphibians that may utilize the irrigation canals is expected to be minor. The habitat function provided by the canals is low given the absence of year-round flow, the annual mortality resulting from canal dewatering, canal maintenance activities, and because a fish salvage effort would be conducted in the canal prior to construction." As I have addressed earlier, even after irrigation season has ended, there remains in the canal sufficient water to provide habitat for amphibians, macroinvertebrates, and other animals. There are rough skin newts in the canal year-round and during certain times of the year, dozens to hundreds can be counted in and around the canal on an afternoon walk. The construction would certainly cause direct mortality to many of these amphibians due to crushing and other injuries by use of heavy equipment. There are also Pacific tree frogs that utilize the canals, and probably other amphibians that are less common. Bird species including varied thrush, Swainson's and hermit thrush, American robin, yellow bellied sapsuckers, pileated woodpeckers, belted kingfishers, wild turkeys, ruffed grouse, brown creepers, red breasted nuthatches, red-tailed hawks, great horned owls, American dippers, and many others have been observed directly adjacent to the canal. Mallards nest along the canal's banks and their downy offspring find shelter from predators in the horsetails and reeds. Small mammals including chipmunks, western gray squirrels (a species of concern in Oregon), snowshoe hares, etc. have been observed utilizing the canal for a water source. Larger mammals including coyotes, bobcats, black bears, mountain lions, blacktail deer, elk, raccoon, opossum, striped skunk, and even river otters have been observed in and directly adjacent to the canal. Even though the wetland conditions may be deemed unnatural along the main canal, I have personally observed many pollinators,	As a programmatic environmental document, the Plan-EA analyzes potential project effects on species at the population level, rather than at an individual or local level. Please see updated language in Section 6.10.2 for discussion about the effects of the proposed project to wildlife.

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		including native bumblebees, European honeybees, wasps, butterflies, hummingbirds, etc. utilizing the canal as a source of water. Some areas in particular predictably draw in colonies of honeybees that are either naturalized populations or housed within nearby bee boxes. The wildflowers that grow along the canal only as a result of these wetland conditions will be eliminated, and with them, the pollinators which benefit local gardeners, orchardists, and native flora, will be displaced. Mt. Hood lilies, tiger lilies, calypso orchids, bog rein orchids, lupine, and myriad other species of native flora will also experience direct mortality as a result of the canal being piped during the construction, and the subsequent drying of the soils as seepage is eliminated.	
16.06	FISH	I would like some additional clarification regarding the statements concerning proper spawning temperatures and flow. The report states that "The applicable temperature criteria for protection of salmonid fish rearing is 64.4 degrees Fahrenheit (°F) in the East Fork Hood River, Whiskey Creek, and Neal Creek and 60.8 °F in the Hood River (ODEQ 2017). The 64.4 °F criterion is typically exceeded in the East Fork Hood River during the summer, with 7-day average daily maximum temperatures reaching 68° F upstream of the Middle Fork Hood River confluence (ODEQ 2017). Irrigation diversion greatly reduces streamflow in the lower river during the summer, contributing to the warm temperatures. Modeling simulations conducted by ODEQ indicated that without EFID's diversion, the East Fork Hood River would be cooler by approximately 3.5 °F above the confluence with the Middle Fork Hood River, and the Hood River at its mouth would be cooler by 2 °F (ODEQ 2001)." So, without the diversion – any diversion? – temperatures above the East Fork's confluence with the Middle Fork would still exceed the proper temperature by 0.1 degree? How then will saving the relatively small percentage of water by eliminating end spills be sufficient to cool the water to proper fish rearing temperatures? Basically, will what is saved on average from the elimination of end spills actually provide the quantity and quality of fish habitat needed for viable populations? Or is it a battle already lost, and will piping the open canal simply take yet more water away from other species?	Please see updated language in Section 6.7.2.4 in the Plan-EA related to the potential effect of the proposed project on water temperatures. Please see updated language in Section 6.10.2 for more discussion about the effects of the proposed project on wildlife.

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16.07	NONV	Losing the canal as a source of recreation and beauty is hard to fathom, but I understand that costs and benefits must be weighed in these times of overuse of natural resources. If there is a net benefit to wildlife and ecosystem services, then the decision must be made in favor of the data over personal feelings. And realistically, it will be human demands that supersede any ecological concerns. Ultimately, agriculture in the Hood River Valley as it exists today is unsustainable, especially considering the impacts of climate change. The root problem seems to be we are simply using too much water, and a pipeline may provide a temporary Band-Aid in the form of some water savings and help for orchardists struggling with silt in the irrigation water, but it will not be a permanent solution. I do not have the first-hand knowledge to say whether the benefits of piping the canal outweigh the social and ecological costs; I don't know if anyone truly does because it comes down to personal values and subjective analyses for some variables. Maybe dedicating that 16-odd cubic feet per second of additional flow that will potentially be conserved due to the end spills being eliminated will be exactly what the salmon and steelhead need within the East Fork. I just hate to see the beauty of the open canal and benefits it provides to native plants and wildlife simply vanish. I sincerely appreciate the consideration of my letter.	Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.
17.01	CONS	The canal runs right on my property line, how would I be informed of when construction is in progress? Do you ask for permission when working on private land? If so, am I allowed to say no?	The District would complete all work within its easements. The District would contact each landowner to inform them of the specific construction schedule for their property. As a general rule in Oregon, an easement owner has the right to improve its easement to the extent that the improvement does not increase the burden on the landowner or injure the rights of others.
17.02	COST	I am aware that there is some funding in place but for the funding that is not yet, what would happen if the funding runs out during construction? How can we know that each of the 3 separate plans will be complete? Would it even be beneficial to only have the plan 1 and/or plan 1 and 2 complete without plan 3?	The proposed project would be constructed in phases to complete each of the project groups identified in the Plan-EA. PL 83-566 and non-federal match funding would be secured for each phase prior to starting construction of that phase. Each phase could be constructed independently of the other phases. Each phase would provide water conservation, pressurized delivery, and/or District O&M benefits if constructed alone.

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			Additional water conservation, pressurized delivery, and District O&M benefits would be realized if all phases are constructed. Sedimentation basin benefits would not occur in the absence of the Main Canal piping. See Appendix D.1.4 of the Plan-EA for discussion of incremental analysis, which identifies how total costs and benefits change as project groups are added. The District would continue to deliver water to patrons in the event that funding ran out during the construction of a phase.
17.03	COST	Placing a new system requires new equipment for each intake, who is expected to pay for these upgrades?	Please see response to Comment ID 6.01.
18.01	COST	How will secondary irrigation (ex: Mt Hood Irr District) districts be affected and held responsible for funding?	The proposed project would not affect the MHID, which would not be held responsible for funding the proposed project.
18.02	COST	Please provide more detailed funding expectations for matching the federal $31 million grant, as well as the additional $7 million needed to cover total of ~$69 million?	Please see Section 8.6.6 in the Plan-EA for details of how the District would provide match funding.
18.03	PATD	Has on-time and correct amount of water delivery ever been an issue for farmers, examples?	Please see Section 2.1.2 in the Plan-EA for updated information related to District deliveries.
18.04	GEN	Why are environmental studies cited not more current (2012)?	The Plan-EA considered available, relevant environmental studies for the Hood River basin. The publication dates of these studies vary. Refer to Section 9 in the Plan-EA for a complete list of references.
18.05	GEN	In the event of funding running out, what will suspended construction mean for land owners mid-project?	Please see response to Comment ID 17.02.
18.06	CONS	Who is providing insurance coverage in the event of any construction damage to private property, or in the event of an issue leading to crop failure?	The construction contractor would carry insurance coverage for construction damage to property. Construction would occur outside of the irrigation season; therefore, no interruption of irrigation deliveries would occur as a result of construction.
18.07	COST	Have you solicited or considered contractor bids on actual cost of work to compare to numbers in proposal?	The District has not solicited or considered bids this early in the engineering design process. The cost estimates in the Plan-EA are high-level estimates based on the Plan-EA's tiered approach. The District would refine these cost estimates following the

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			completion of the detailed engineering design process for each project group. See the response to Comment ID 1.01 for information on tiering.
18.08	ALT	Could a system of water towers throughout the irrigation district pumping water upward provide both pressurization and water filtration through sediment settling?	A water tower alternative was added to the Alternatives Considered During Formulation section in Appendix D.3 of the Plan-EA.
18.09	GEN	What are land use plans for the area where the canal currently runs and the adjacent walking paths?	No changes in land use would occur as a result of the proposed project. The District would continue to maintain a trail or gravel access road along the former canal alignment for system maintenance purposes as authorized by its easements.
19.01	COST	Currently we pay for irrigation rights. It is not written but there has been talk of raising the price of the rate 5-10% per year, please address this.	Please see Section 8.6.6 in the Plan-EA for details of how the District would provide match funding and the potential effects on patron bills.
19.02	WILD	Have you considered the affects the piping will have on wildlife? What will be done to support the wildlife that have made this their home?	Please see Section 6.10.2 in the Plan-EA for a discussion of potential effects of the proposed project on wildlife.
19.03	ALT	Looking at the proposal on how the piping will make irrigation more efficient because of how it will save water, is rain water taken into consideration?	This question was understood to ask whether capturing rainwater was considered as an alternative to the proposed project. A rainwater alternative was added to the Alternatives Considered During Formulation section in Appendix D.3 of the Plan-EA.
19.04	COST	What happens if you finish Plan 1 but lose funding for Plan 2 and/or Plan 3?	The District would continue to seek other funding sources required to complete Project Groups 2 and 3. Please see the response to Comment ID 17.02 for additional discussion.
20.01	GEN	My wife and I are farmers on the east fork. We use irrigation close to daily Spring, Summer and Fall. I have serious concerns about the piping plan. I do not see the cost benefit. Filtration is our biggest issue. We have invested in filtration systems to combat this and have generally mitigated our issues. The piping plan does included an extra	Please see Section 2.1 of the Plan-EA for a discussion of the watershed problems and resource concerns that the proposed project is intended to address. These include a range of needs and resources in addition to sediment management. The NEE Analysis provides a cost benefit analysis for the

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		settling pond, but that is the last project. I am concerned by that time money will be dried up.	proposed project and is included as Appendix D.1 of the Plan-EA.
20.02	WAT	I am also very concerned with the pH fluctuation. My crops are sensitive to pH. Will I now need to invest in a testing and remediation systems for pH?	The proposed project would not be expected to affect the pH of water delivered by the District. This language was added to Section 6.7.2.4 in the Plan-EA.
20.03	VEG	I am also a hydro-seeding contractor. The revegetation of 56 miles of a piped canal would be a massive logistical issue. Access to the canal with our trucks would not be possible. Our hydro-seeders are mounted on flatbed semis. Our clearance is over 15'. Our smaller machines that are gooseneck trailers have a clearance over 10'. 56 miles of area only 10-15' wide would mean the trucks would constantly have to move. Trying to revegetate without hydro-seeding would ensure a very low success rate while creating an ideal situation for invasive species.	The use of hydro-seeding is not part of the proposed revegetation plan. Please see Section 6.5.2 of the Plan-EA for discussion of revegetation after the proposed project.
20.04	NEE	Cost benefits of this project do not seem to make sense.	Please see Appendix D for a description of the methods for and results of the NEE Analysis prepared for the proposed project.
20.05	COST	I am concerned money will dry up without the project finishing.	Please see response to Comment ID 17.02.
20.06	REC	I am concerned about losing an amazing natural trail to walk along.	Please see response to Comment ID 1.04.

20.07	WAT	I understand the benefit from increased efficiency, but an 18% increase does not pencil out. Water being re-released into groundwater and the aquifer is not lost water.	The proposed project would eliminate end spills from District infrastructure into natural drainages in the lower Hood River basin. Please see Sections 4.7.2 and 6.7.2 of the Plan-EA for more information on water resources. Precipitation is the primary source of groundwater recharge in the basin (Keller 2011; Reclamation 2015). Please see Section 4.7.4 of the Plan-EA for more information on groundwater recharge.
21.01	CONS	As a property owner which the EDID is on, by easement, will more land be required during construction, if so, how much, and when project is completed on my land, will the easement width be reduced from its current width.	The need for temporary construction easements would be determined prior to construction of each project group. Temporary construction easements would be coordinated with affected landowners. These temporary construction easements would only be in place for the duration needed for the construction of the associated project group. Following construction, the easement width would be maintained at its pre-project width. Please see Section 8 in the Plan-EA for BMPs associated with construction.
22.01	ALT	While the irrigation canal pipeline project may modernize the way water is delivered to orchards and other agribusiness that depends on the water of the East Fork of the Hood River I do not believe it is the best course of action to assist in preserving water for instream use. The main issue with the water use is the irrigation practices throughout the valley. This should be the primary focus of the modernization throughout the district. I know that this was addressed in the Draft Plan as an alternative and then quickly discarded as not possible. If the orchardists are struggling with silt issues in their irrigation system, they should be the ones to invest in better ways to remove the silt from the water. This can be done using technology for wells with high silt loads including cyclonic separation systems. The district could also still implement the settlement pond to assist with this, or orchardists could implement settlement tanks for their irrigation systems. For fine sediments a pool filter could be used or something similar. If the orchards are bringing in over 72 million dollars/year annually, the	Please see Section 5.2.2 in the Plan-EA for a discussion of on-farm efficiency upgrades as an alternative. Please see Section 6.4.2 in the Plan-EA and the NEE Analysis in Appendix D for a discussion of the economic effects of the proposed project.

		orchardists having to spend a few thousand dollars to improve their irrigation infrastructure locally would be a better option than spending at minimum (since construction costs are never actually what is initially quoted) 69 million dollars, much of which will not remain in the community as implied in the draft plan, to implement a project that is at its source designed to benefit the orchardists.	
22.02	FISH	The slight and possibly nonexistent benefits to fish species mentioned seem to be an afterthought since even in the best-case scenario (12.45 cfs) the minimum temperature and flow rate will not be met. The 12.45cfs is even less likely to be delivered back into instream use as climate change continues and the snowpack and glaciers become smaller. Is the Salmon population that has been threatened and damaged by the 70 years of the use of the irrigation canal even a viable breeding population at this point? This is one of the major questions that was not even asked in regard to the slight amount of water that this project may save in a good year. This omission coupled with the fact that even this amount of water saved will not be enough to lower the temperature to the maximum temperature tolerable, or the minimum necessary flow rate for the Salmon seems to indicate that this is not a priority for this project and is only being used as a way to justify money savings with disregard to the damage the removal of the open water source canals will cause. The water in the open canals can and does benefit the ecosystem surrounding it while water contained in a pipeline will offer no benefit to the surrounding ecosystem because it is closed off to any use but human.	The ESA Recovery Plan for Lower Columbia River salmon and steelhead identified low streamflow as a key limiting factor for threatened populations in the Hood River basin (ODFW 2010; NMFS 2013). Streamflow restoration resulting from the proposed project would be expected to help improve the viability of listed fish populations. Water savings allocated to instream use through the proposed project would be permanently protected instream and would increase the minimum streamflow at the District's diversion regardless of the effects of climate change. ODFW has assigned an extinction risk goal of "low" or "very low" to each of the listed salmon and steelhead populations in the basin. By addressing the limiting factors and threats to these populations, these goals are expected to be achieved or exceeded for spring Chinook and winter steelhead populations (ODFW 2010). Please see Section 6.8.2 in the Plan-EA for more information on the effects of proposed project on fish and aquatic species.
22.03	WILD	While there may be other water sources available near the canal, are they easily accessible to animals or are they in open exposed areas with nearby human habitation? Along the main canal branch, while wildlife is potentially near human habitation, there is at least seclusion due to the presence of mature trees and brush which helps guard against disturbance by human activity. There are also few if any substantial permanent water sources within the east hills and the main branch of the canal is the best accessible source for many of the animals living in this area. The 70-year existence of the canal has turned it from being an artificial construction into part of the landscape of the valley. To use the fact that it is a manmade artificial creation as a justification for its	Please see updated language in Section 6.10.2 in the Plan-EA related to the potential effects of the proposed project on wildlife resources.

		removal and to justify the installation of a pipeline is laughable. A pipeline is more artificial and less beneficial to the ecosystem than a stream running through a section of woodland and field even if that stream was initially created by something other than erosion.	
22.04	RES	The pipeline will also not cause limited harm along the path of its installation. As evidenced in the preliminary plan in the archives the idea is to lay two pipes as large at 48" and 54" in diameter along the main portion of the canal. Installation of large diameter piping such as this requires heavy machinery which requires large amounts of room to operate leading to the destruction of many mature trees, disturbance of prolific wildlife along the main portions of the canal, and the probable fatality of many smaller animal species such as rough skinned newts, pacific tree frogs, voles, and many other mammal, amphibian, insect, and plant species. The draft plan majorly downplays the effects that the construction of such a pipeline will have on the area in which it is constructed for decades and the disturbances and damages to local flora and fauna from the lack of accessible water.	Construction of the proposed project would include short- and long-term effects on wildlife and their habitat, including some unavoidable construction-related mortality of organisms. See Sections 6.5.2, 6.8.2, 6.9.2, and 6.10.2 in the Plan-EA for discussion of the effects of the proposed project on vegetation, wildlife, aquatic species, and wetlands, respectively. As a programmatic environmental document, the Plan-EA analyzes potential project effects on species at the population level, rather than at an individual or local level. Section 8.3 includes BMPs that would be followed to minimize these effects. See response to Comment ID 16.05 for information related to water availability for wildlife after the proposed project.
22.05	PURP	The public safety issue also seems to be overstated in this article. While it is very tragic that people have lost their lives in the canal system it has been in operation for 70 years. Any open water source can be a danger to unsupervised children and impaired adults, but the slow-moving canal is not difficult for a non-impaired person above the age of 13 to remove themselves from. The opposite of this is stated in the draft plan. The areas along the canal are used by many people every day for a multitude of activities such as walking, horseback riding, and biking and have been since the canal was first installed 70 years ago. This use creates a sense of community among those who inhabit the areas near it. The canal is used as a selling point for homes and land throughout the valley and increases property values for those with property nearby. While the trail along the canal may not be a tourist attraction it provides a needed location for residents to enjoy the beauty of the valley without disturbance from tourists.	Please see Section 2.1.4 in the Plan-EA for a discussion of the public safety risk of the open canal. The NEE Analysis, included as Appendix D.1 of the Plan-EA, quantifies the costs and benefits of the proposed project (see Appendix D.1). Aesthetic, emotional, and experiential values of the open canal could not be quantified due to insufficient data. A new section has been added to the NEE that analyzes the effect of piping the canal on property values. Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.
22.06	PUB	As a final comment, the length of time given to the public for comment on this project is entirely too short. The draft plan for this project has been worked on for more than two years and the public, many of which did not know this plan was being developed, were only given 30 days to read, understand, and attempt to research alternatives to a document that is 160 pages long. These 160 pages do not include	Public participation for the proposed project has occurred in accordance with applicable federal CEQ regulations for implementing NEPA (40 CFR 1500–1508), USDA's NEPA regulations (7 CFR Part 650), and NRCS' National Watershed Program Manual (NRCS 2015) and National Watershed Program Handbook (NRCS 2014).

		the multitude of sources that were sited and were not made readily available to the public for review. The review of these sources for methodology applicable to this situation, accurate and non-misleading representation of the findings in the draft plan and potential for finding other research that could invalidate or support the claims made by these sources in integral to a proper review and analysis of any plan such as this.	For details on public participation activities related to the scoping meeting, Draft Plan-EA public review, and public meeting see Sections 3.1 and 7.2 of the Plan-EA.
23.01	WILD	In general, the Plan EA does not adequately identify or explain adverse impacts. It glosses over what is being lost, in order to present the project in the best light. "Artificial" or not, the proposed project will remove 36 acres of wetlands and over 17 miles of riparian habitat along the canals. The Plan does not adequately explain how the lost wetland and riparian habitat will be offset by "enhancement of naturally functioning wetland and riparian habitat in the East Fork Hood River". Walk along the canals (as seen from the roadside) on any day of the year and you will see that the riparian areas are full of many species of birds. I have been a birder all my life, and I notice the arrival of migratory species, as well as the everyday residents. Neo-tropical migratory birds are imperiled worldwide. We should be making more habitat, not removing riparian habitat, which is so vital to many.	Further explanation of the effects of the proposed project to wetlands and riparian habitat was added in Section 6.9.2.3 in the Plan-EA.
23.02	ALT	I suggest that the Project should be altered to include 1) wetland enhancement projects (blackberry removal and native plantings) along streams, ditches and ponds on public and private property on the east side of the Valley to compensate for wetland loss. 2) There should be a mix of open canals and pipe in order to preserve some of the wetland habitat and scenic values.	Effects from the proposed project to wetlands and wildlife are discussed in Section 6.9.2 and 6.10.2 of the Plan-EA. Prior to construction, consultation with USACE would occur and measures would be taken as required to identify and mitigate for potential effects on jurisdictional wetlands. A "Mix of Open Canal and Pipe Alternative" was added to the Alternatives Considered During Formulation section in Appendix D.3 of the Plan-EA.
23.03	NON V	My last comment is harder to articulate, but I will try. I have lived in the Valley for over 30 years. Many people love this place and feel viscerally connected. The landscape is a big part of why we feel this way. There is a mix of open space and agriculture, of forest lands and houses. Subtle things contribute to a pastoral landscape. But if you look closely, you realize how much of the natural environment has been converted to orchards. The East Fork canals are a historic and beautiful feature of our treasured landscape, and in much of the Valley,	Thank you for your comment.

		they are a last refuge for birds, frogs and other species. People use the ditches too, as a place for quiet respite, and they have done so for generations. But as we put all of the open water into pipes, and do away with the sedimentation ponds, we are converting our pastoral landscape into an industrial agriculture landscape. There is nothing left for nature. While I do understand the water conservation benefits, piping all of the canals will be detrimental to the upland wildlife that use the riparian corridor and wetlands. It will cause people to lose landscapes that they love. A better option is to keep some open canals, and include wetland restoration on public and private lands in affected areas to compensate for the wetlands that will be destroyed.	
24.01	REC	There have been rumors of a pipeline for many years now, so it's with mixed feelings I make my comments. I walk the canal daily and have lived on Miller Rd. since 1978. I would disagree, with the claim on page 31 that "No trails occur in the project area." There is a good trail maintained and although I don't walk the whole length, one could walk it from the Pinemont Rd. area all the way to Hess Rd.	Section 3.4 and Section 6.6.2 in the Plan-EA has been updated to differentiate between public recreation trails and the maintenance roads/trails alongside the District's canals that are also used for recreation by local residents.
24.02	WILD	To take a key aspect explored in the proposal the canal "barrier" has pros and cons. Yes, it can be a place for human-wildlife conflicts. But it also acts as a barrier, keeping many animals on the east side of the canal only coming down for water. I'm concerned about the generations of wildlife that have habituated and come to rely on that drinking water. In my immediate area, across from my property and across the canal at Zemans, there are 2 dry, old creek beds. How long have they been dry? Many, many years ago perhaps that was a natural water source for the wildlife, but it is no more. From this angle, there could actually be an increase in human-wildlife conflict too, as a land bridge/mass would now "allow," or make easier, the passage of wildlife onto properties at any point along the pipeline length.	Please see Section 6.10.2 in the Plan-EA for information about the potential effects of the proposed project to wildlife.
24.03	WILD	I'm concerned more large animals will be killed on Hwy 35 as they make their way to the East Fork of the Hood River. This puts drivers in danger too.	Please see updated language in Section 6.10.2 in the Plan-EA about the effects of the proposed project on wildlife.
24.04	NON V	So far, I've concentrated on the logistical concerns raised by the proposal. But I want to return to the way this canal has functioned in our community as a source of pleasure, exercise, and neighborly interaction. Many of us use this trail and have for decades. Since many folks use the trail for walking, biking, horseback riding, etc. there is rather an unwritten rule that allows people to walk the canal even	Please see updated language in Section 6.2.2 in the Plan-EA about effects of the project on land use. Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.

		though it is, in most places, private property. There's even a legal term for this: prescriptive easement. Once that right-of-way has been established, reverting it out of that usage is legally a challenge. So even though the walk will not be the visual resource it now is, people & pets will continue to use this area.	
24.05	VEG	I see mention in the proposal of 'invasive species, implementation of BMPs and the spread of noxious weeds during construction would be avoided.' "The net gain in native vegetation would occur' (?), and 'weeds managed according to NRCS OR & WA Guide for Conservation Seedlings & Plantings.' So what are those guidelines? On page 110 of the PDF, 'herbicide applications'—-vegetation control activities' make me question the quote 'beneficial cumulative effects on all ecosystems.' Herbicides to me are not a benefit. I don't want to walk with my dog through vegetation treated with pesticides. Dogs get cancer, and my husband got leukemia/lymphoma from Roundup and is currently in a case against Monsanto. Currently there is an amazing, functioning, sustainable ecosystem in place up there. The wildflowers are in profusion—-lupine, aster, goldenrod, pearly everlasting, Indian paintbrush, bog rein orchids—-all are a very visual resource to many of us—-as is the water that reflects the colors of the seasons all year round.	Please see updated language in Section 6.5.2 related to a net gain in vegetation as an effect of the proposed project. A brief summary of NRCS Guidelines for Conservation Seedlings and Plantings (NRCS 2000) was added to Section 6.5.2 of the Plan-EA. Section 6.11.3 addresses the cumulative effect of the proposed project together with past and ongoing vegetation control activities by many parties in the project area and the Hood River basin.
24.06	WAT	This brings me to another factual error in the proposal: yes, there is water in the canal year round even after it is drained in the fall. It is more than puddles. The only time it is dry is when it's so cold the water freezes. So it is a great source of water year round for wildlife and flowers, flora and fauna. The salamander population is impressive, the babies emerging in the fall, unfortunately about the time construction would begin. Salamanders, basically amphibians in general, speak of the most healthy of ecosystems. The wild flowers are a great attractant for our pollinators. So when the report states "It is a 'beneficial cumulative effect on all ecosystems," I don't know. Even the writers of this report seem to have their doubts, as they mention that some mature trees might possibly die from lack of seepage water. Perhaps water isn't "lost" along the canal so much as reclaimed at every step by the natural system.	Please see response to Comment ID 16.02.
24.07	WAT	Even the writers of this report seem to have their doubts, as they mention that some mature trees might possibly die from lack of	The water losses in the District's conveyance system were estimated based on end spills. These spills represent water lost to the natural system of the East Fork Hood River and to

		seepage water. Perhaps water isn't "lost" along the canal so much as reclaimed at every step by the natural system.	irrigation water supply. Please see Sections 4.7.2 and 6.7.2 in the Plan-EA for information about water losses in District infrastructure and effects on water resources and natural waterbodies.
24.08	VEG	I'm curious about the 50' on either side of the canal. We own a forested 2 acre plot here and wonder if we will lose any trees during the construction, whether immediately if they are cut down for the project to proceed, or over time thru lack of seepage water. If any of our trees in close proximity are cut down, will home owners like us be reimbursed for the timber value, to say nothing of the aesthetic value?	Please see Section 6.5.2 in the Plan-EA for a discussion of the effects of the proposed project on vegetation, Section 8.3 for BMPs related to vegetation, and Section 6.6.2 for effects on visual resources. Landowners would not be reimbursed for lost timber or aesthetic value of trees removed within the District's easements.
24.09	WILD	I'd be remiss not to mention the mallard ducks in the spring, the great blue herons & kingfishers who make appearances in the fall/winter, and the great horned owls with their night-long vocalizations. Of particular concern are the paired ducks, their secretive nests producing annual fleets of tiny ducklings. Of course these bird species aren't endangered, but do rely on the canal for remote, secluded, and uncrowded spaces in the increasingly populated world. The thrill these species gives us nature lovers is immeasurable.	Thank you for your comment.
24.10	CONS	I suppose it's a moot point whose land the trees are on, but my next concern is the construction access points of which East Fork Irrigation & us share a common easement/driveway, at the north end of land owned by Kyle Gray. Smaller douglas trees with overhanging branches would either need trimming or cutting down. I'd hope we'd have input on options.	Site-specific evaluations would be completed prior to the construction of each phase of the project, based on the Plan-EA's tiered approach. The District would work with landowners to request their input concerning specific access and construction issues at each site prior to construction. See response to Comment ID 1.01 for information on tiering.
24.11	VEG	In my canal neighborhood several landowners are thinning/logging to remove underbrush & possibly fuel sources to inhibit forest fire spread, and most likely for timber revenue/money. I'm not forestry educated but much controversy exists on the science of forest and fire management. As trees are cut, their ability to sequester carbon is lost. From this source, Forterra, 'CUFR Calculator estimates a Douglas Fir sequesters 13.9 tons of CO_2 by its 100th birthday.' So saving as many trees during the construction seems important, in light of what is being removed. As far as visual aesthetics, the broadleaf maples turning golden in autumn provide us recreationists another layer of appreciation. In my vicinity those include maples lining the canal just	No unnecessary removal of trees would occur during the construction of the proposed project. Please see Section 8.3 for a revised description of BMPs related to vegetation.

		south of our property, (between Kyle Gray's orchard & the ditch), a landmark maple just north of Cunningham Rd, and of course the beauties just south at N. Hess Bridge. Their falling leaves provide mulch that improves soil quality & microbial interactions. I would hope there will not be indiscriminate removal of trees.	
24.12	NON V	These are my concerns for now. I feel fortunate to have enjoyed the canal most of my adult life. I may not be able to halt "progress." But I must speak for the living things, currently thriving in this balanced, beneficial, and beautiful landscape I cherish so much. My daughters Becky & Merrie Richardson are quite disheartened over the pipeline project too, equally compelled to share their concerns and sentiments. As for the memories, I guess we must give East Fork Irrigation some due credit and thanks!	Thank you for your comment.
25.01	VEG	Although unfortunately unable to attend any of the local meetings (family illness, out of state, personal injury), I have tried to stay up on news and to read the posted documents, including the Draft Plan-EA. I have just a brief comment of continuing concerns, which I hope will prove not to be issues of concern, or which are positively resolved as the project progresses. I continue to have concerns about the piping work affecting the spread of invasive plants. Among the growing number of invasives in our area is an increasing number of poison hemlock plants.	The District would follow BMPs to avoid the spread of weeds and invasive plants. Please see Section 8.3 for a description of these BMPs.
25.02	WAT	I also worry greatly about year-round water availability for wildlife, birds, and reptiles. It seems that some springs and small wetland areas have disappeared in recent years. In addition to general climate warming and drying, I've wondered if it was also due to lowering water tables and ground water from an increasing number of wells.	Please see Sections 6.7.2.5, 6.9.2, 6.10.2 of the Plan-EA for discussions of the effects of the proposed project on groundwater resources, wetlands, and wildlife, respectively.
25.03	WAT	I also hope that the hook-up process by small properties to the new system goes smoothly, and that storm run-off provisions work well. Thank you.	Thank you for your comment.
26.01	WILD	My job is to teach students how to conduct scholarly research and craft persuasive as well as ethical arguments. Every term, my students worry about seeming "biased." I remind them that we all have positions and preferences ¾ the important thing isn't to shed those but to acknowledge them. Going through this report on the proposal to "modernize" the East Fork irrigation system I was struck by how clearly the framers of this Assessment already have a position. I'm concerned about how much of this position was there from the	The level of detail included in the Plan-EA is in accordance with applicable federal guidance and regulations. Per CEQ (1981), "Since the EA is a concise document, it should not contain long descriptions or detailed data". Similarly, NRCS (2016) states, "The detail provided about a specific resource should be commensurate with the degree of potential impact to that resource" (NRCS 2016). Since the proposed project would have a minor impact to wildlife (see Section 6.10.2 of the Plan-EA),

		beginning, leading to confirmation bias across the research process. In short, I found myself concerned by how the District's position has colored not only to writing of this report, but the research behind it. There are strange gaps, uncertainties, and elisions in the draft. For example: A variety of birds, mammals, reptiles, and other wildlife have the potential to occur in the project area and its vicinity. "Have the potential to occur"? Was this research not done, or was this language purposefully obscured to ward off concerns about the in fact very present wildlife populations? In addition to fish, other aquatic, semi-aquatic, and amphibious species occur in waterbodies that are associated with District operations. These likely include water shrew, water vole, newt, and salamander species, and may also include Pacific tree frog and Cascades frog (C. Fiedler, Fish and Wildlife Biologist, U.S. Forest Service, personal communication, July 25, 2018). These species are native to Oregon and may be present in irrigation canals and adjacent banks in the project area at locations with suitable vegetation and hydrology. Again "likely include" and "may also include" and "may be present" strangely obscure the facts of these species' presence. I'm not a biologist, but by sister, Merrie Richardson, is both a biology teacher and a wildlife enthusiast. I'll leave the details of all this to her which species are in fact definitively living along the irrigation canal. For now, I want to restrict myself to the language of the report.	additional detail on wildlife is not required. The language choice and descriptions included in the Plan-EA reflect the tiered nature of the document. Please see the response to Comment ID 1.01 for information on tiering. Please see the response to Comment ID 22.04 for information regarding the Plan-EA's focus on population-level effects on wildlife, fish, and aquatic species. Reference: Council on Environmental Quality (CEQ). (1981). Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations. *Federal Register* 46(18026). March 23, 1981.
26.02	GEN	Another concern I had with the research and writing of the report is the troubling lack of knowledge about the local conditions of the irrigation canal. There's an irony in my pointing this out, as I live in California now and only get to spend a few months out of the year with my family in Hood River County. But even I could have told the writers of this Assessment that the canal does in fact always have water year round. I can tell you this because I have the lived experience of traversing the path along the canal for the past 36 years, and especially the few miles in either direction of the Miller Road intersection. With this lived experience, I can attest that this passage is frankly false: From November through February, the canals do not carry water except during large storms and are usually empty with occasional puddles or pools in low-lying areas and at locations where spring water enters the canals. These "occasional puddles or pools" are more like a consistent creek, not flowing but certainly not "empty" either. Except for the	Please see Section 4.6.2 in the Plan-EA for revised language describing the conditions in canals outside of the irrigation season.

		coldest days, when this water freezes, one would have to use waterproof boots to cross, or find one of the occasional sandbars or outcroppings of rocks to serve as steps.	
26.03	REC	As is probably already evident from my points above about walking along the canal, another blatant falsehood in the report is the following: No trails occur in the project area. Again, decades of lived experience contradicts this. My family has lived on Miller Road since the 70s, and my mother took me for outings along the canal since before I could walk. I came of age exploring the muddy banks for salamanders, tucking myself behind the gnarly old Douglas Fir that grows along the canal and that we dubbed the "hide and go seek tree," and hiking the old logging roads with friends and family.	Please see the response to Comment ID 24.01 and response to Comment ID 1.04 regarding the cultural value associated with the canal system.
26.04	NON V	This landscape inspired me to value the natural world and its systems and to write about it. This place inspired my sister to pursue degrees in biology and, later, to teach the subject and pass on her love of wildlife. While she and I have left the area for our jobs, we delight in returning regularly. I love visiting and joining my mother and stepfather in their daily walks along the canal. I love that we regularly encounter our neighbors around the community-decorated "holiday tree," which grows along the canal at the intersection with Hess Road. I love that we can watch the light play on the water through the trees as we have for decades. That we sometimes see the owls and deer and myriad species that cluster close to a source of water they have relied on for over 70 years. Much of our world is far from "natural." But at this point, the canal has become naturalized a feature of the landscape that wildlife as well as people have come to frame their lives around.	Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.
26.05	NON V	If my own positions and commitments what my students like to call "bias" are not clear yet, I'll state them even more clearly: the canal has become one of the valued characters in the neighborhood, the foreground more than the background of our lives. It is not only a "visual resource," as the Assessment so unpoetically puts it. It is also a "cultural service." As my family members have already written in their responses, the presence of the canal is something that people tout in official real estate ads as something that makes this place one where "people want to live." When I was given the assignment in college to write about something meaningful to me, I chose the canal (essay attached). In an increasingly crowded Hood River County, in a time when everyone seems to know our hidden gems via guidebooks like	Please see the response to Comment ID 1.04 regarding the cultural value associated with the canal system.

		The Curious Gorge, the canal was one secret we kept among our neighbors. All this leads me to the other troubling gap in this Assessment. Passages like the following are the result of either not doing much research, or obscuring the facts in favor of the project, or a combination of both: Overall, the Piping Alternative would have a minor, long-term effect on visual resources in the project area because there are relatively few public viewpoints of the canals and the vegetated project area would blend in with the natural landscape. There would be minor effects on the developed and rural visual character of the landscape in the project area, resulting in minor cumulative effects when combined with other past, present, and reasonably foreseeable future actions. These passages do not represent the actual views of those living near the canal at least not those of us in the stretch near Miller Road. There are in fact many viewpoints, and for those of us who have called this canal part of our backyard for decades, these are not "minor effects" in the landscape. To pipe the canal would amount to losing a favorite place. Perhaps in geological time this canal is a blip. But we think in human terms: the canal has been here for a human lifetime. Perhaps the framers of this project didn't bother talking to residents while assessing the so-called "visual resources." I fear they hardly bothered to visit our stretch of the canal at all, given that the draft includes the following note: "This visual analysis was based on evaluations of aerial and ground-based photographs of the proposed project sites and preliminary design information." How can one assess a "cultural resource" without speaking to the people or visiting the landscapes that form a culture? Perhaps all of this sounds like so much self-interest. But as even the Assessment admits, cultural and visual aspects need to be taken into consideration what role does this space play in our local culture? What are its particular beauties? And yet these are the least well-researched components of this draft. I suspect this has to do with the fact that industry and money are involved. We're always already primed to think in terms of dollars and cents, not wellbeing and pleasure. I hope I've made the case for why the canal, particularly the stretch running between Pine Mont Drive and Hess Road, deserves to be accounted a place of beauty and local significance. But I'd also like to close with an appeal to think of "dollars and cents" in different terms.	

26.06	WAT	While reading the draft, I was struck by how little consideration there was of the agricultural practices leading to so much draining of water in the first place. As the climate changes, some farmers are going to be forced to change their practices. The draft seems to be at pains to avoid this. Why? Why not shift our growing practices and even which crops are grown in the first place? I'll leave the technical questions about water flow and temperature and their effects on fish for my sister's letter. Here I want to question the underlying premise. The draft includes statements like the following, which seem intended to paint a bleak picture of "business as usual": Water supplies would continue to be unreliable, and agriculture producers may irrigate fewer acres of land or grow different crops in the future. Compounded with anticipated population growth and potential developmental pressures, agricultural lands could be increasingly vulnerable to transitioning to a different land use. Why should we delay this inevitable outcome? Why spend so much money and alter the landscape that generations of animals and plants and people have come to depend on for this Band-Aid solution? I would argue that, in fact, the "business as usual" scenario isn't so terrible: Perhaps the District should "continue to call on its patrons to curtail irrigation during drought years, and as the climate warms, the frequency of curtailment requests may increase."	Consistent with NRCS Statement of Vision and Mission (NRCS 2019) and an authorized agricultural water management purpose of PL 83-566 (NRCS 2015), the proposed project would support the economic viability of working agricultural lands with ensuring a healthy environment. Additionally, the project would provide net economic benefits as described in the NEE Analysis in Appendix D.1 of the Plan-EA. On-farm improvements, voluntary duty reduction, and conversion to dryland farming were considered as alternatives. See Section 5.2.2 of the Plan-EA for a discussion of on-farm efficiency upgrades as an alternative. See Appendix D.3 of the Plan-EA for a description of how potential alternatives were analyzed and why voluntary duty reduction and conversion to dryland farming were eliminated from further study. Reference: U.S. Department of Agriculture Natural Resources Conservation Service (NRCS). (2019). Vision and Mission Statement and Guiding Principles. Retrieved from: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=19117
26.07	NONV	I fear this entire project is likely to have unintended consequences. I'm reminded of two paradoxes. First, the Jevons paradox. This describes a phenomenon common to environmental economics: often, when an agency increases the efficiency around a natural resource's use, demand increases, thereby wiping out any gains. Typically, those working at the junction of economics and environmentalism propose counteracting such effects by increasing price. Second, there's an analogy here with recent counterintuitive studies of traffic congestion: you'd think that building more roads would help, but in fact, they just encourage more people to drive (see Gilles Duranton and Matthew A. Turner's "The Fundamental Law of Road Congestion: Evidence from US Cities" published in American Economic Review in 2011).	Under the proposed project, 75 percent of the conserved water would be permanently allocated instream and would not be available to serve any increased irrigation demand given the associated reduction in District water rights. Please see Section 6.7 in the Plan-EA for more information about the effects of the proposed project on water resources.
26.08	WAT	Perhaps the solution isn't to try to shore up a few more years of "business as usual" agriculture. Perhaps the District would do better to make our County "climate resilient" by encouraging us all to adopt more sustainable growing practices now rather than later.	Section 2 in the Plan-EA describes the purpose and need of the proposed project. While making Hood River County "climate resilient" is not the purpose of the project, the Hood River Basin Study (Reclamation 2015) has previously identified water

			conservation in District canals and laterals as a potential approach to mitigate for the effects of climate change on water supplies in the basin. Additionally, on-farm efficiency upgrades were considered as an alternative in the Plan-EA (see Section 5.2.1).
26.09	WAT	Perhaps we should reframe the entire situation: the water "lost" along the open canal is used and reclaimed by other natural processes, which have just as much a right to that water as the orchardists do.	The proposed project would allocate 75 percent of the conserved water created by the project instream under Oregon water law to support natural processes in the East Fork Hood River. The District diverts water from the East Fork Hood River under its existing water right for irrigation purposes. Correspondingly, the District operates its canals and laterals for the purposes of delivering irrigation water. If water that leaks out of the District's canals and laterals is used by natural processes, that use is incidental to its purpose of irrigation. Please see Section 6.5 in the Plan-EA for more information about the effects of the proposed project on vegetation; Section 6.7 in the Plan-EA for more information about the effects of the proposed project on water rights, surface water, and groundwater resources; and Section 6.9 in the Plan-EA for more information about the effects of the proposed project on wetlands.

Appendix B

Project Maps

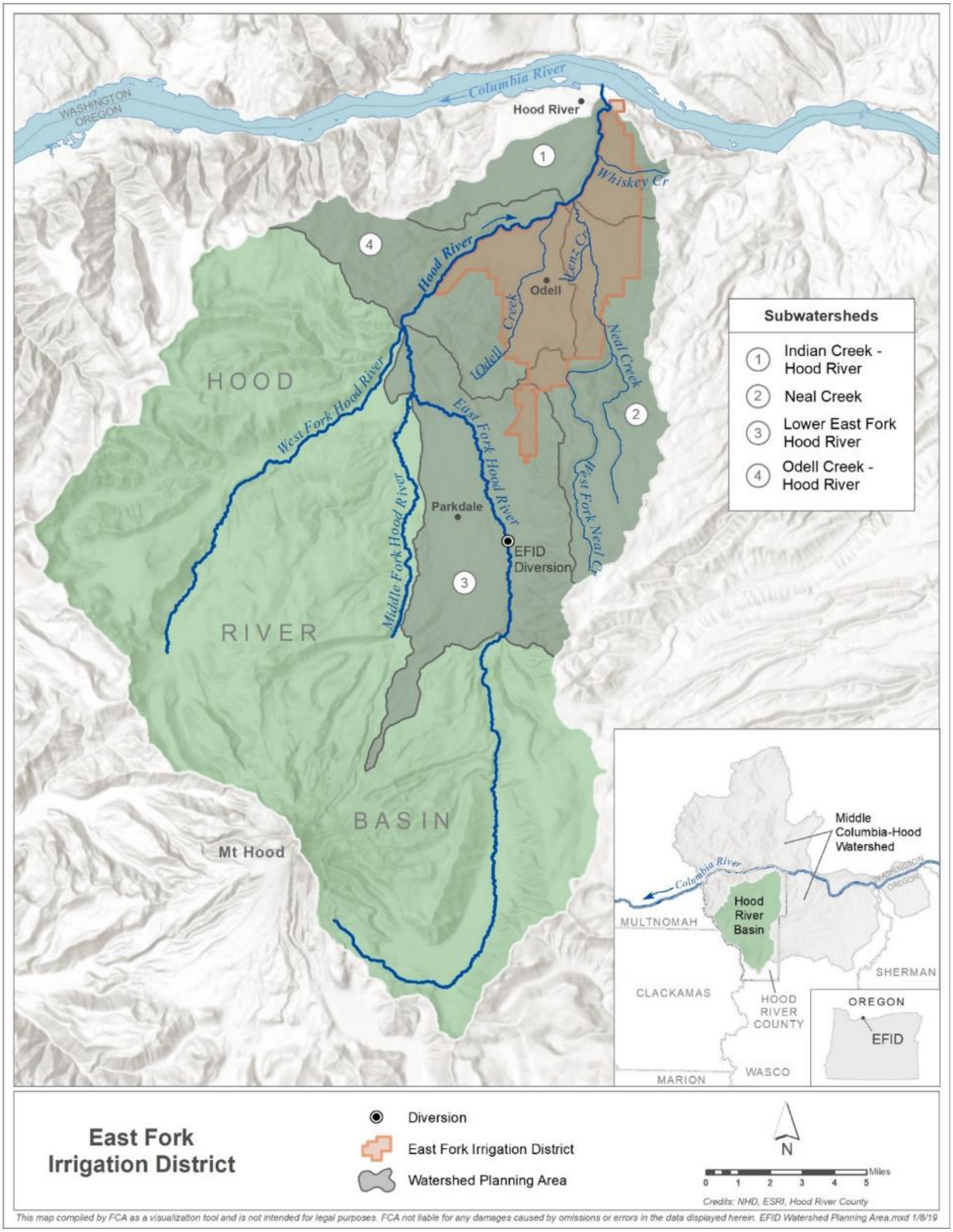


Figure B-1. The four watersheds within the East Fork Irrigation District watershed planning area.

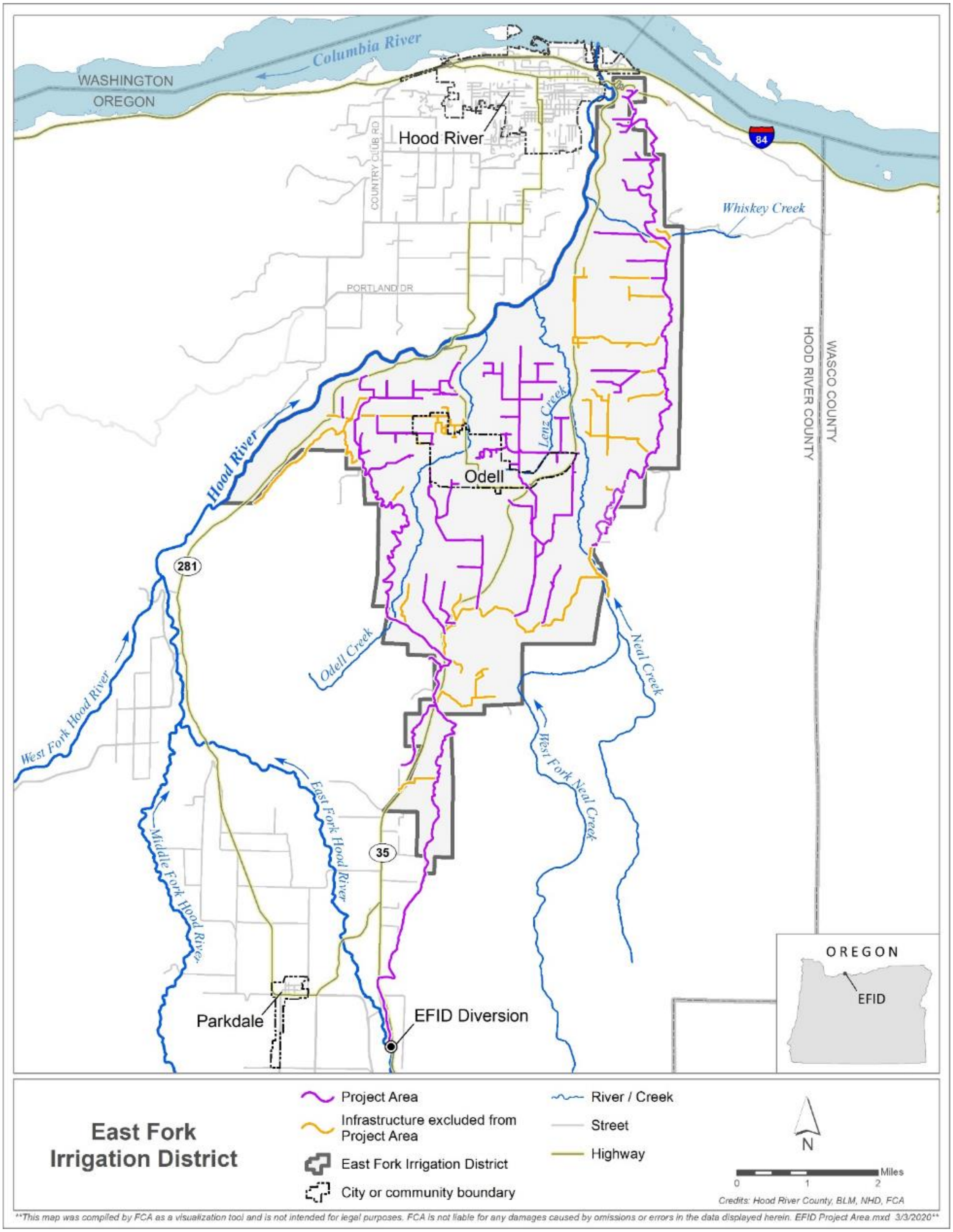


Figure B-2. Location of the East Fork Irrigation District Infrastructure Modernization Project area.

Appendix C

Supporting Maps

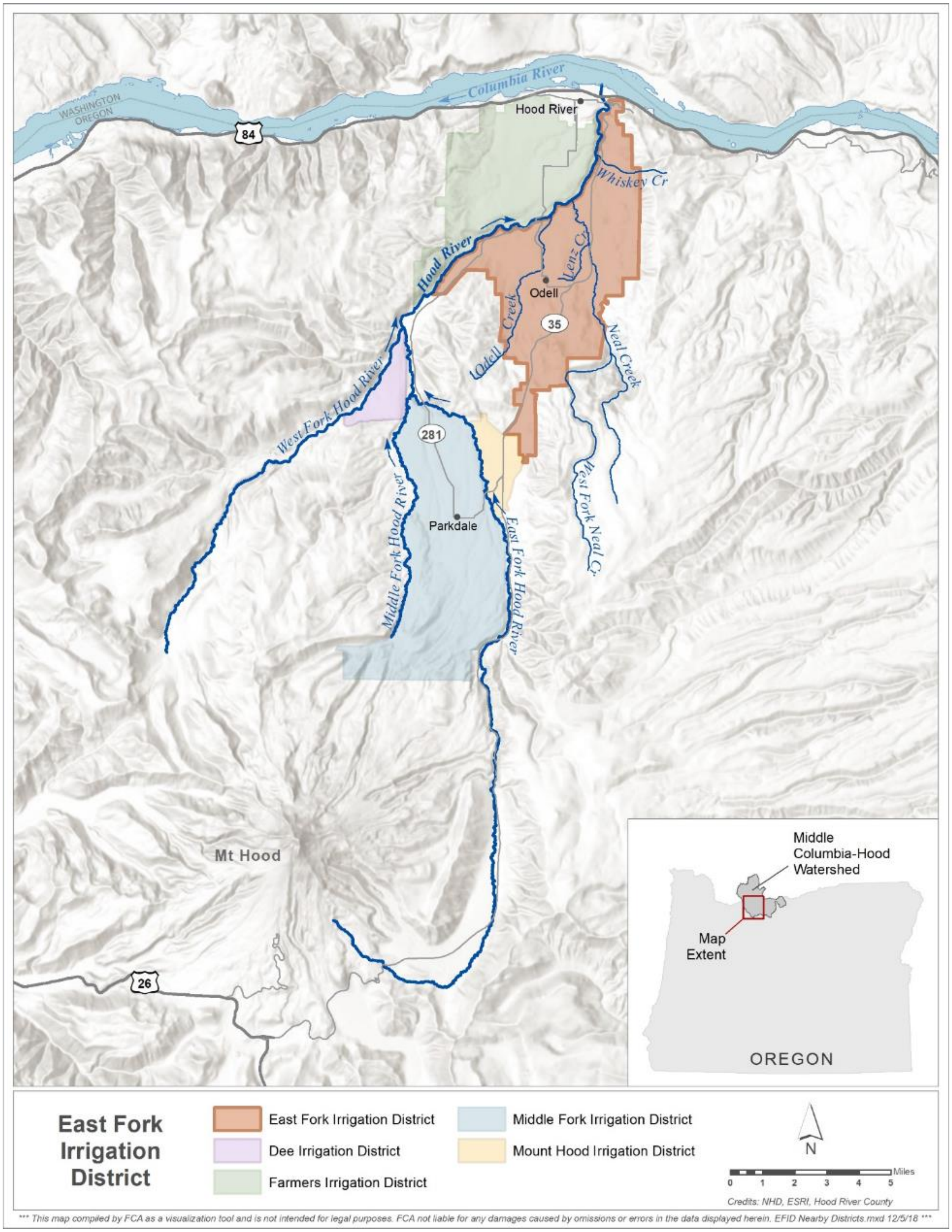
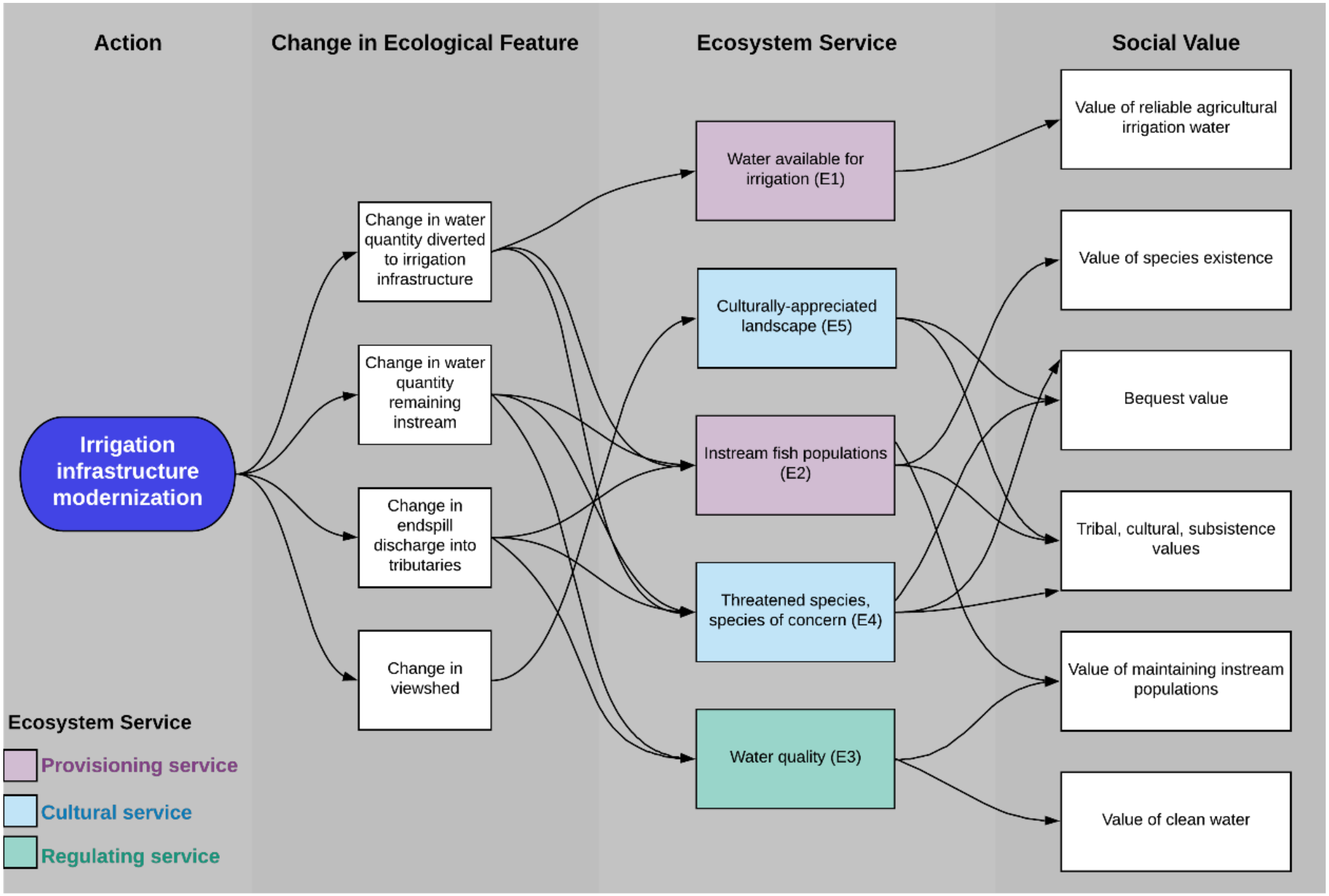


Figure C-1. Irrigation districts within the Hood River basin.



Note: E1 to E5 refer to ecosystem services 1 to 5. These services are referenced and explained in more detail throughout Sections 4 and 6 in the Plan-EA.

Figure C-2. Ecosystem services concept diagram for the East Fork Irrigation District Infrastructure Modernization Project.

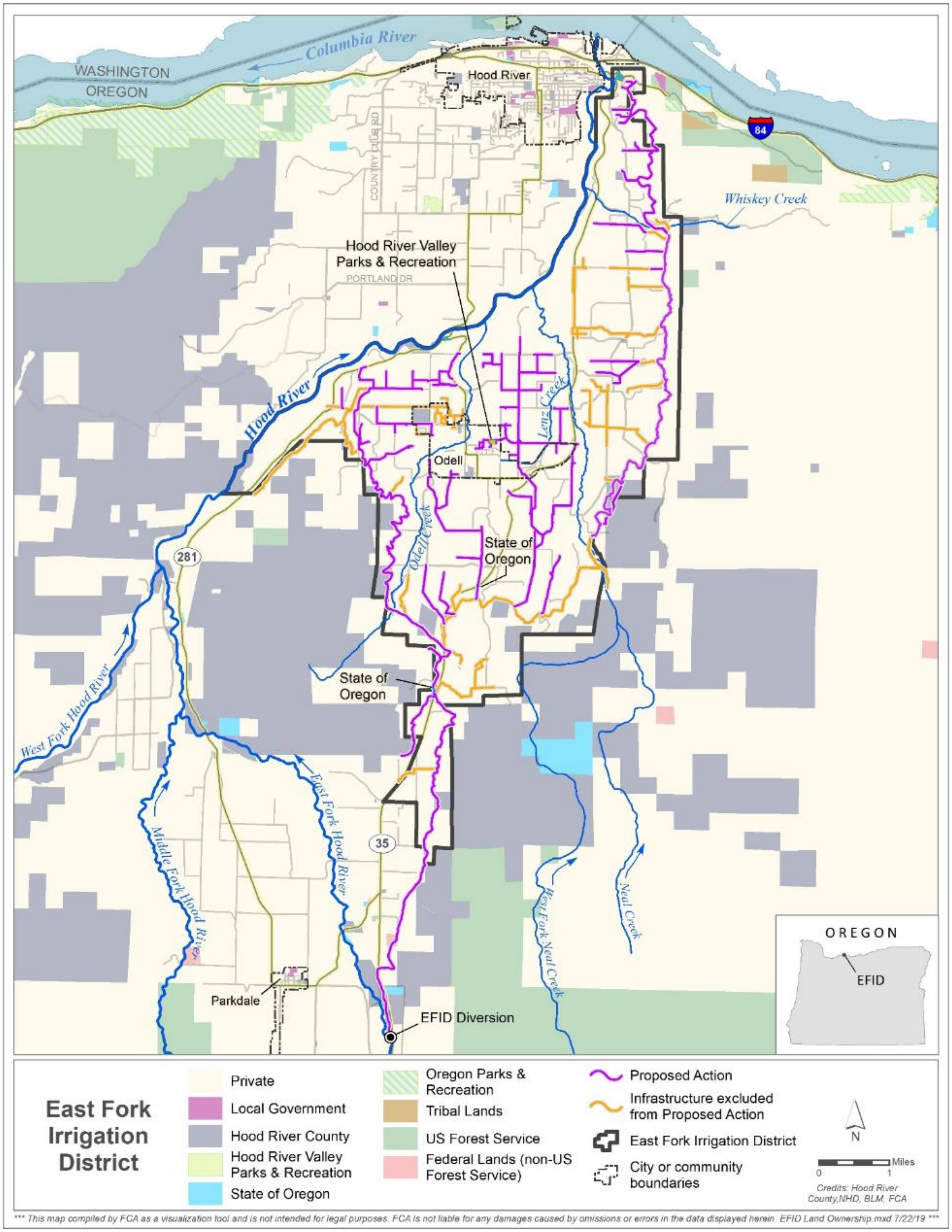


Figure C-3. Land ownership within and in the vicinity of East Fork Irrigation District.

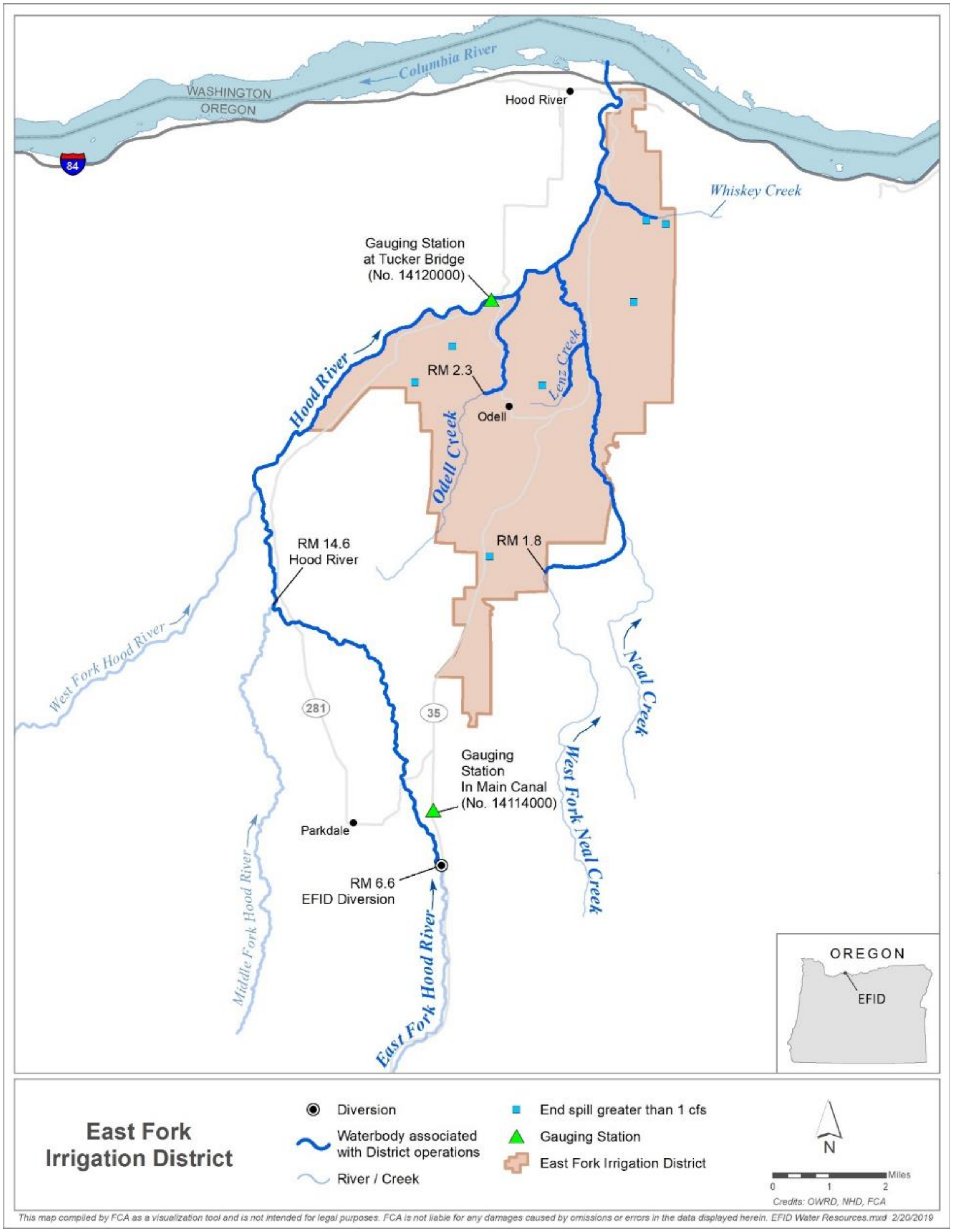


Figure C-4. Waterbodies associated with District operations and locations of streamflow gaging stations.

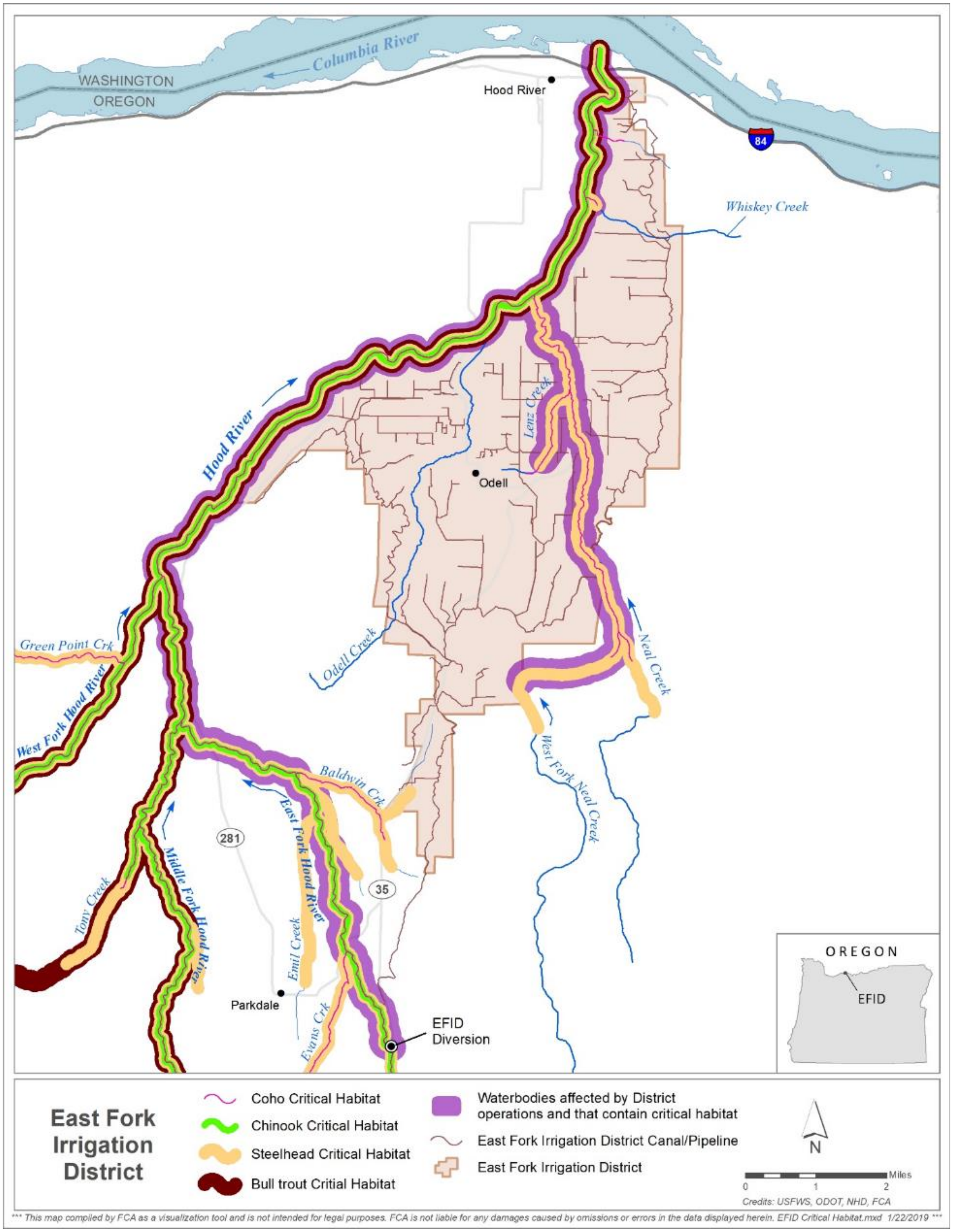


Figure C-5. Critical habitat designated for bull trout, coho, steelhead, and Chinook in the East Fork Irrigation District watershed planning area.

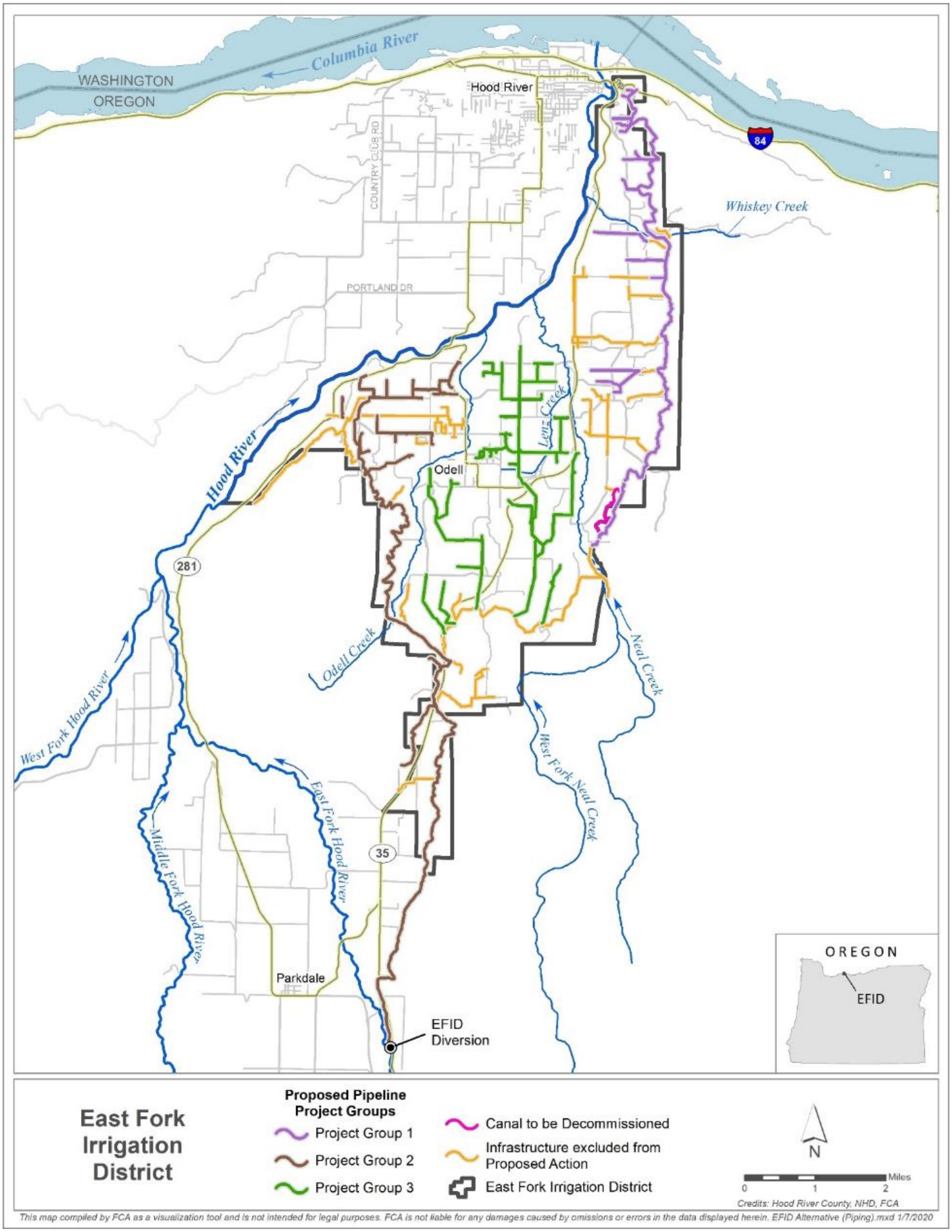


Figure C-6. The Piping Alternative project groups for the East Fork Irrigation District Infrastructure Modernization Project.

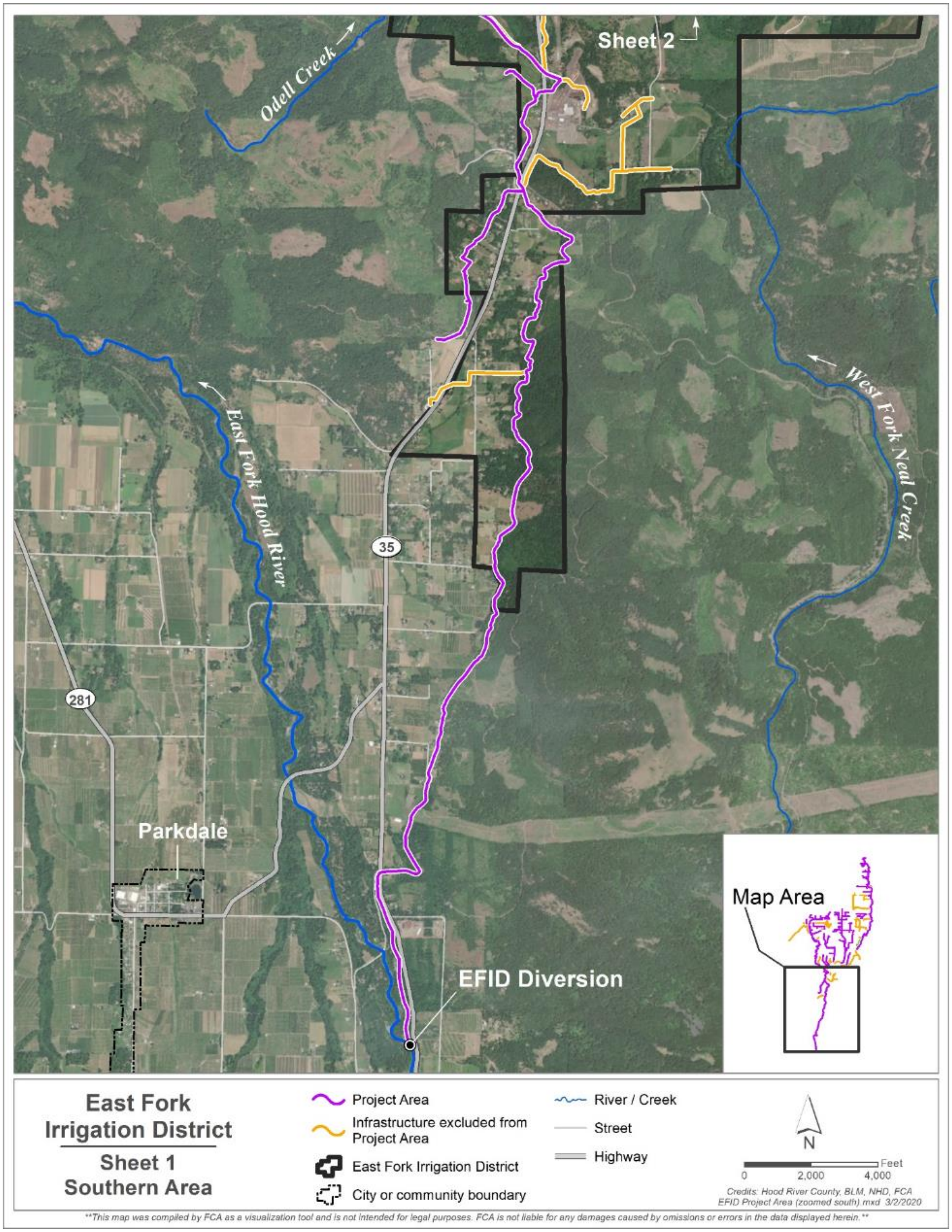


Figure C-7. The Piping Alternative Southern Area for the East Fork Irrigation District Infrastructure Modernization Project.

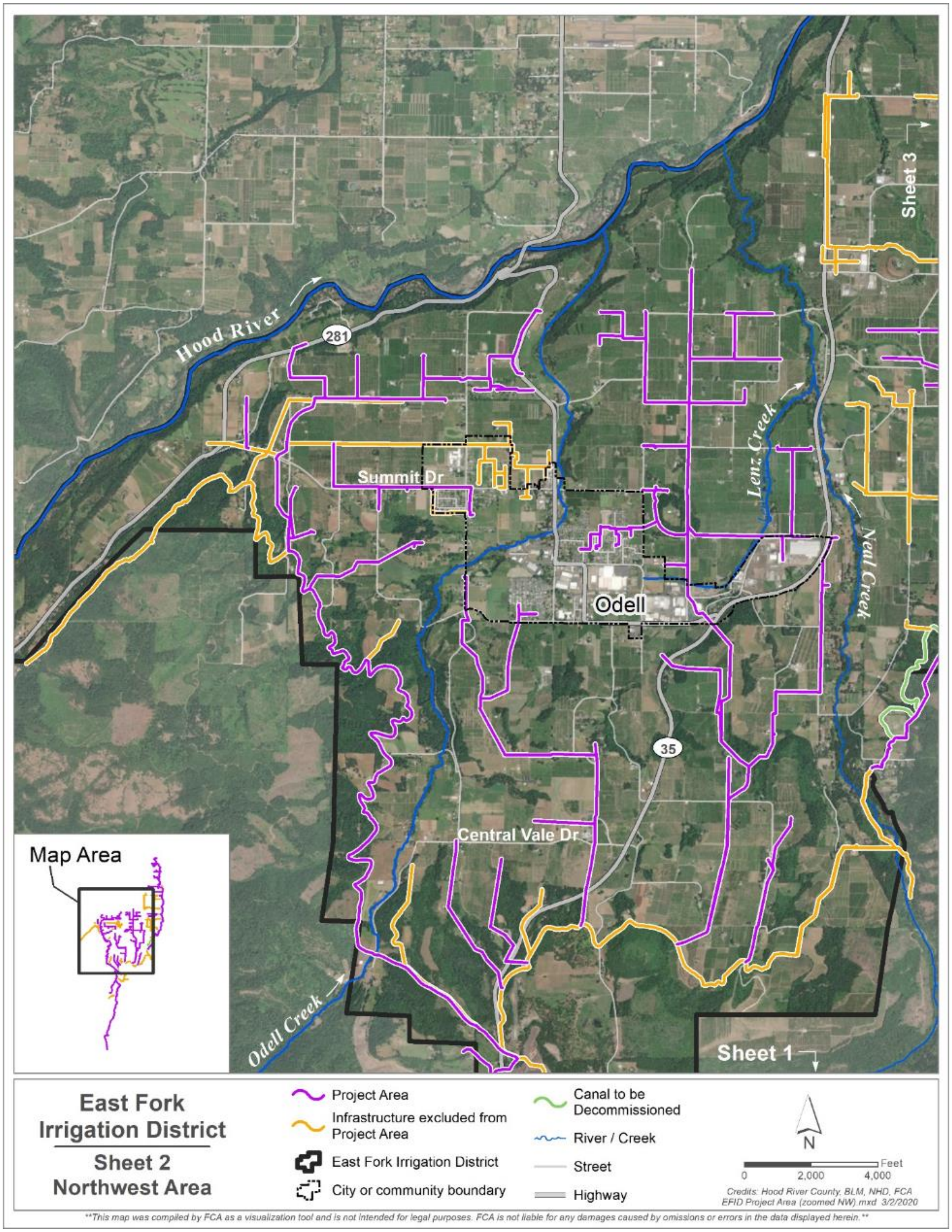


Figure C-8. The Piping Alternative Northwest Area for the East Fork Irrigation District Infrastructure Modernization Project.

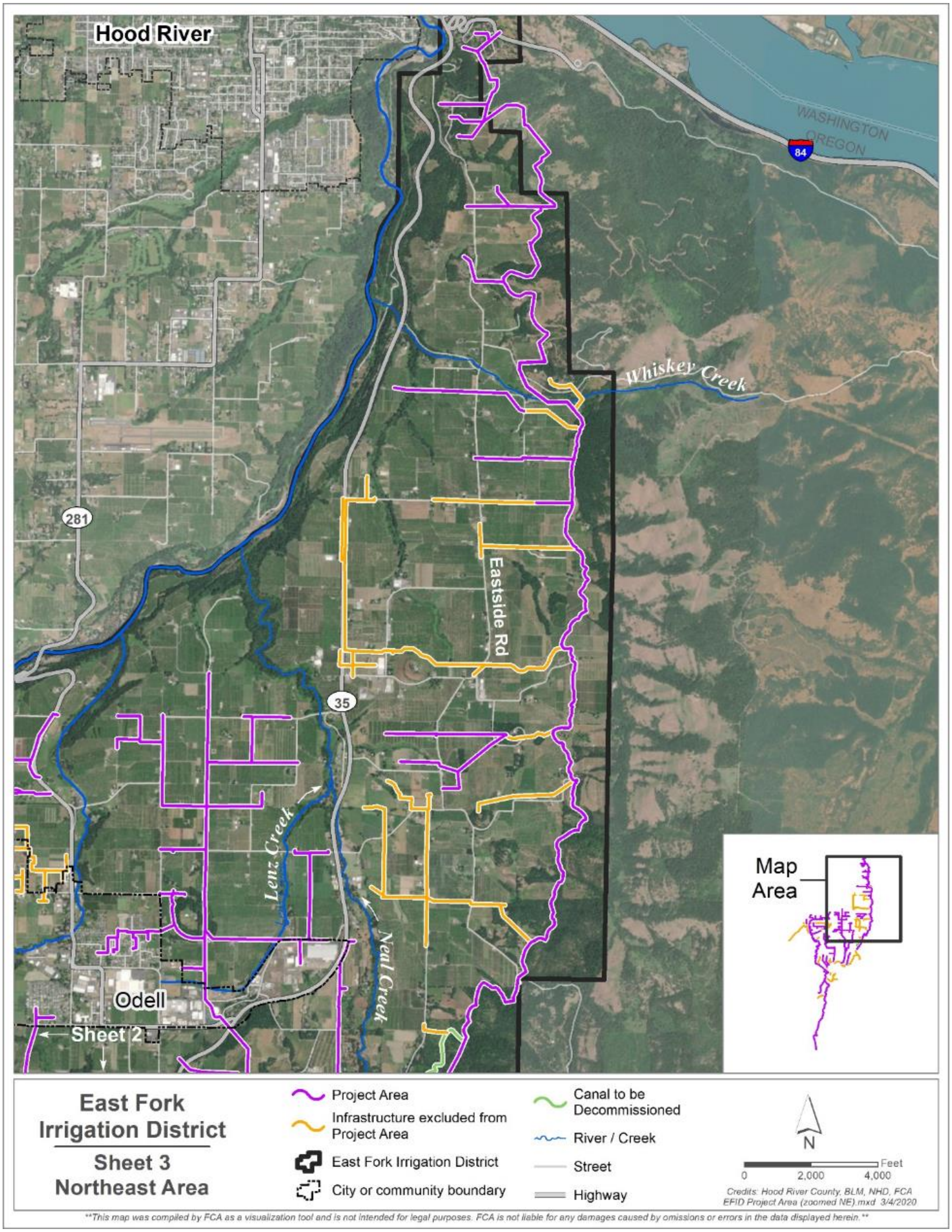


Figure C-9. The Piping Alternative Northeast Area for the East Fork Irrigation District Infrastructure Modernization Project.

Appendix D

Investigation and Analysis Report

Highland Economics LLC

National Economic Efficiency Analysis

Barbara Wyse and Winston Oakley
12/23/2019

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Acronyms, Abbreviations, and Short-Forms

AF	acre-foot
BOR	United States Bureau of Reclamation
cfs	cubic feet per second
EA	Environmental Assessment
EFID	East Fork Irrigation District
FCA	Farmers Conservation Alliance
gpm	gallon per minute
HDPE	high-density polyethylene
hp	horsepower
IWG	Interagency Working Group
kWh	kilowatt hour
Mt	metric ton
MWh	megawatt hour
NASS	National Agricultural Statistics Services
NEE	National Economic Efficiency
NRCS	Natural Resources Conservation Service
O&M	operation and maintenance
OMR	operate, maintain, and replace
OSU	Oregon State University
PPI	Producer Price Indices
project	East Fork Irrigation District Infrastructure Modernization Project
PR&G	Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies
PRV	pressure reducing valve
SCC	social cost of carbon
SIP	System Improvement Plan
U.S./US	United States
USDA	United States Department of Agriculture
WSU	Washington State University

D.1 Piping Alternative

D.1.1 Costs of the Piping Alternative

This section provides a National Economic Efficiency (NEE) analysis that evaluates the costs and benefits of the Piping Alternative over the No Action Alternative for the East Fork Irrigation District (EFID) Infrastructure Modernization Project (herein referred to as project). The analysis uses Natural Resources Conservation Service (NRCS) guidelines for evaluating NEE benefits as outlined in the NRCS Natural Resources Economics Handbook and the U.S. Department of Agriculture's (USDA) Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (DM 9500-013).

All economic benefits and costs are provided in 2019 dollars and have been discounted and amortized to average annualized value using the fiscal year 2019 federal water resources planning rate of 2.75 percent.

D.1.1.1 Analysis Parameters

This section describes the general parameters of the analysis, including funding sources and discount rates, the evaluation unit, the project implementation timeline, the period of analysis, and the project purpose.

Evaluation Unit

The proposed project is divided into three project groups. While some of the project groups depend on other project groups to produce water-saving benefits, as long as the project groups are implemented in the proposed order, each of the project groups could be completed as stand-alone projects and have a positive net-benefit. As such, each project group is defined as the evaluation unit. Note that for the incremental analysis, costs for constructing any given project group would not change if it were the only project group constructed.

Project Timeline

Construction is expected to begin in October 2020 and be completed in 10 years. For all Works of Improvement, the analysis assumes that full benefits would be realized the following year after construction is completed (e.g., for Project Group 1 construction begins in Year 0, is completed in Year 2, and full benefits are realized in Year 3). The analysis also assumes that project groups are completed in numeric order (i.e., Project Group 1 is completed first, followed by Project Group 2, and so on). A table showing the order of installation and timeframes can be found in Section 8.6.2 of the Watershed Plan-Environmental Assessment (Plan-EA).

Analysis Period

The analysis period for each individual project group is defined as 102 to 105 years since the installation period is 2 to 5 years for each project group, and 100 years is the expected project life of buried high-density polyethylene (HDPE) pipe. Across the three project groups, the installation period is anticipated to be 10 years and the overall analysis period is thus defined as 110 years (Year 0 to Year 109).

PROJECT PURPOSE

The piping infrastructure is multipurpose: it provides habitat benefits, agricultural production benefits, energy cost saving benefits, and operation and maintenance (O&M) cost savings. Because no project cost items serve a single purpose separately, this analysis does not allocate costs or benefits by purpose.

D.1.1.2 Proposed Project Costs

NWPM 506.11, Economic Table 1, NWPM 506.12, Economic Table 2, and NWPM 506.18, Economic Table 4 found in Section 8.8 of the Plan-EA summarize installation costs, distribution of costs, and total annual average costs for the Piping Alternative. (Note that Economic Table 3, Structural Data—Dams with planned storage capacity, is omitted as dams are not proposed). In addition to the installation costs, the Piping Alternative would entail costs to maintain and replace the sedimentation basin and costs to replace steel pipe. These costs are included as "Other Direct Costs." The subsections included in this report provide details on the derivation of the values in the tables found in the Plan-EA. Based on East Fork Irrigation District's (EFID or District) past experience of piping irrigation canals, the District expects cost savings, not cost increases for infrastructure maintenance, repair, and replacement of the Piping Alternative (Buckley, 2019c).

D.1.1.3 Project Installation Costs

According to the most recent estimates by engineering professionals at Watershed Professional Network LLC and Black Rock Consulting, the cost of piping and associated farm turnouts is roughly $60,232,000 (in 2018 dollars). We adjusted this price to 2019 dollars using the RSMeans construction cost index (an effective increase of 2 percent) (RSMeans, 2019). With the cost adjustment and the additional cost of the sedimentation basin ($767,000), the total construction cost is $62,189,000 in 2019 dollars. See Appendix D.3 for detailed cost derivation by pipe size, cost category, etc. All values in this analysis are presented in 2019-dollar values and rounded to the nearest $1,000 value. Of total estimated costs, Farmers Conservation Alliance (FCA) estimated that roughly 96 percent would go to construction and the remaining 4 percent would go to engineering.

Adding an additional 3 percent for in-kind project administration from EFID, 8 percent technical assistance from NRCS, and permitting costs of $1,866,000, the total cost for the Piping Alternative in 2019 dollars is estimated at $67,029,000. The average annual cost by project group is shown in Section 8 of the Plan-EA, in 2019 dollars, with an average annual cost of $1,763,000 for the Piping Alternative (assuming piping projects are completed in order).

D.1.1.4 Other Direct Costs

Other direct costs under the Piping Alternative consist of the costs to operate, maintain, and replace (OMR) the sedimentation basin, and the costs to replace steel pipe.

SEDIMENTATION BASIN OMR COSTS

Since the Piping Alternative would eliminate three existing in-canal settling basins, a new sedimentation basin would be installed immediately downstream of the sand trap. To continue to function properly, the sedimentation basin would require regular removal of sediment. The labor, logistic, and replacement costs of the basin would depend on its design, which has not yet been finalized. However, the EFID District Manager estimated the potential costs of maintaining the basin based on the historic costs of maintaining the District's existing sand trap (which requires similar maintenance). The District Manager estimated the annual costs of maintaining the basin, which due to its larger size, could be as much as three times the cost of maintaining the sand trap, which requires 6 labor hours every 2.5 weeks from March to October, which totals 67.2 hours per year (Buckley, 2019b). In years where sediment levels are extraordinarily high, the sand trap requires an excavator. We assume that the sedimentation basin would require an excavator for the same number of hours as normal labor (67.2 hours per year), which is likely an overestimate (Buckley, 2019b). Maintenance labor costs the District \$39.46 per hour, while excavator work costs \$84.46 per hour.[1] Allowing for excavator work, this brings the total maintenance cost estimate of the sand trap to roughly \$14,000 per year.

In addition to the O&M costs, the sedimentation basin would require replacement before the end of the 100-year project period. Because the final design has not been established, the costs to replace the sedimentation basin are uncertain. Therefore, in order to estimate the replacement costs, we used the full cost of constructing the basin (\$767,000, including contingency costs), which is likely to be an overestimate of the replacement costs. We assume the basin would have a useful life of 50 years, based on an estimate by an NRCS Engineer (Cronin, 2019). The sedimentation basin is expected to be completed in Year 5, with a replacement needed in Year 56. As such, annual costs begin in Year 6 and the replacement cost of the sedimentation basin is assumed to be incurred in Year 56, with annual costs then being incurred again after that. We apportion both the maintenance and replacement costs among the project groups using the proportion of irrigated acres in each project group, as shown in Table 1. When discounted and annualized, the cost of maintaining and replacing the sedimentation basin totals approximately \$18,000 per year.

Table 1. Costs of Maintaining and Replacing the Sedimentation Basin Under the Piping Alternative, Hood River Watershed, Oregon, 2019\$.[1]

Project Group	Irrigated Acres	Apportioned Cost of Replacement	Apportioned Annual Cost of Maintenance[2]	Total Annualized Costs
1	599	\$48,000	\$1,000	\$1,000
2	5,196	\$414,000	\$8,000	\$10,000
3	3,820	\$305,000	\$6,000	\$7,000
Total	**9,615**	**\$767,000**	**\$14,000**	**\$18,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.
[2] Total maintenance costs were estimated by the EFID District Manager (Buckley, 2019b).

STEEL PIPE REPLACEMENT

The Piping Alternative would require a relatively short section of steel piping. Unlike HDPE pipe, steel pipe has an expected life of 50 years, and would therefore need to be replaced during the period of this analysis (Crew, Black Rock Consulting, 2018a). Experts estimate that around 25 percent of the total steel pipe would need to be replaced in Year 50, and the remaining 75 percent would need to be replaced in Year 75 (Crew, Black Rock Consulting, 2018b). We assume that these costs would be incurred 50 and 75 years after the construction of each project group, and the cost to replace the steel pipe would be the same as the cost to install it in 2019. **Error! Reference source not found.** shows the costs of replacing steel pipe under the Piping Alternative. Because the replacement costs are relatively small and would occur in the distant future, the present value of the replacement cost is effectively zero when discounted and rounded to the nearest \$1,000 (as shown in the last column of the table).

[1] The District pays maintenance labor about \$26 per hour and incurs another \$13.46 per hour in benefits and other labor costs. An excavator costs \$71 per hour plus the same additional labor costs.

Table 2. Other Direct Costs of Steel Pipe Replacement Under the Piping Alternative, Deschutes Watershed, Oregon, 2019$.[1]

Works of Improvement	Feet of Steel Pipe Replaced	Total Replacement Cost in 2019	Annual Average NED Cost
Project Group 1	-	$0	$0
Project Group 2	38	$32,500	$0
Project Group 3	-	$0	$0
Total	**38**	**$32,500**	**$0**

Note: Totals may not sum due to rounding. Prepared June 2019
[1]Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

PROPERTY VALUE EFFECTS DUE TO THE LOSS OF OPEN CANALS

Numerous economic studies of residential property values have shown that people tend to value having views of or access to waterbodies such as rivers, streams, and lakes from their property (Nicholls & Crompton, 2017; Mooney & Eisgruber, 2001; Nelson, Hansz, & Cypher, 2005). This preference or value for proximity to waterbodies is reflected in higher property values for parcels that are proximate to water (assuming all other property characteristics are the same). While there are a few available studies of the positive effects of canals on property values, the known, available studies are of boat-able canals in urban settings, which are quite different from irrigation canals in a rural setting on which boating is not feasible (Nelson, Hansz, & Cypher, 2005; Conner, Gibbs, & Reynolds, 1973). Not only is the recreational value of the irrigation canal likely less, but the rural setting of the study area may also limit the impact of water features on a property's value. One review of the economic literature found that water features had less of an impact to rural properties values than urban ones (Nicholls & Crompton, 2017).

In EFID, there are 30-40 residential properties that are proximate to the irrigation canals. If current and prospective homeowners in the area generally positively value proximity to the irrigation canals, removal of the canals through the Piping Alternative may result in a potential cost to these property owners. According to one real estate agent in the area, individuals in the area may value the canals for both aesthetic reasons as well as for sentimental reasons (Josephson, 2020). On the other hand, not all residents or real estate buyers value the canals. According to two local real estate agents, some people view them as dangerous; others as unattractive (Nunamaker, 2020; Josephson, 2020). According to one real estate agent, property buyers from outside areas are less likely than current residents to value the canals (Josephson, 2020). The mixture of preferences on the proximity of irrigation canals suggests that the net effect on property values may be either positive or negative and is likely small.

While individual properties may experience positive or negative impacts depending on the owner or buyer, the effect on the average home is likely no net change (Nunamaker, 2020). Because the impact of irrigation canals on property values in the study area is uncertain and expected to be small, this analysis does not quantify the potential cost to property values of piping the canals.

D.1.2 Benefits of the Piping Alternative

The Plan-EA, Section 8.8 (NWPM 506.21, Economic Table 6), compares the project benefits (over baseline conditions) to the annual average project costs presented in NWPM 506.18, Economic Table 4. The remainder of this section provides detail on these project benefits.

The on-site benefits that would accrue to agriculture and the local rural community include increased agricultural production, reduced power costs, and reduced O&M costs. The off-site quantified benefits include the value of reduced carbon emissions and the value of instream flow for enhanced fish and wildlife habitat. Other benefits not included in the analysis that may result indirectly from the Piping Alternative include the potential for increased on-farm investment in irrigation efficiency (as patrons would have more funds available due to increased yields and reduced pumping costs) and potential recreation benefits.

D.1.2.1 Benefits Considered and Included in Analysis

Agricultural Damage Reduction Benefit

Of the 5,287 acre-feet (AF) projected to be conserved under the Piping Alternative, 75 percent would be dedicated to instream flow (approximately 3,965 AF per year) and the remaining 25 percent would be available for use within the District (approximately 1,322 AF per year). The conserved water going to the District would be used in dry water years (approximately 10 percent of the time) to enhance the reliability of water supply for existing irrigated lands. In this section, we model the benefits of this conserved water that would be available to District patrons to supplement existing irrigation waters supplies.

During previous dry periods, the EFID District Manager has requested voluntary irrigation cutbacks, which to-date have proven sufficient to avoid mandatory water curtailments within the District (Buckley, 2019b). In these voluntary curtailments, grass hay growers in particular have cut back their water use, often missing the last cutting of hay (Buckley, 2019c; Nakamura, 2019).

To date, this management response has minimized the adverse effect of dry years on orchards, which can be significantly affected by insufficient irrigation. Insufficient irrigation water to orchards can adversely affect yield and quality in the year of insufficient water and in future years. Young trees in the establishment period can be particularly affected, so growers typically prioritize water application to these young trees (Buckley, 2019b; Nakamura, 2019; Marsal, Girona, & Naor, 2012). However, as discussed in more detail below, a recent study from the U.S. Bureau of Reclamation (BOR) projects that future streamflow volumes and irrigation water supplies will be lower in the East Fork of the Hood River, resulting in greater shortages to EFID in dry water years (i.e., in 10 percent or more of years) (Bureau of Reclamation, 2014). The conserved water from piping, both by reducing District end-spill losses and increasing the amount of water available to irrigators by 1,322 AF per year, would reduce the adverse effects of these projected future dry year shortages and provide a crop damage reduction benefit. However, as the District is projected to have a shortfall only in approximately 10 percent of water years, the District would likely keep this 1,322 AF of conserved water instream for approximately 90 percent of water years (Buckley, 2019b).

According to the BOR study, by the year 2030, climate change is expected to cause water supply shortages in EFID of 10 to 12 percent from July to September in the 10th percentile water year (i.e., a dry water year will occur roughly 1 out of every 10 years) (Bureau of Reclamation, 2014), with even greater shortages in the 0 to 10th percentile water years.[2] EFID water rights total 117 cubic feet per second (cfs). The BOR report thus indicates that the District will face shortages of roughly 12.87 cfs (11 percent of 117 cfs) in at least 1 year every decade. The actual shortage is expected to be larger since the BOR study did not account for a recent agreement between EFID and the Confederated Tribes of the Warm Springs Reservation to maintain 15 cfs instream in the East Fork Hood River. The BOR study did account for a 2.1 cfs instream water right, so the currently agreed-upon instream flow is 12.9 cfs larger than was projected in the BOR study (Christensen, 2019). Adding together these effects (12.87 cfs and 12.9 cfs), and in absence of the Piping Alternative, the total EFID water supply shortage in 1 out of 10 years will be 25.77 cfs beginning in 2030. This would bring the District's total water supply down from 117 cfs to 91.2 cfs (a 22 percent reduction).

[2] There would also be shortages of a smaller magnitude in slightly wetter water years (i.e., water years in the 10th to 20th percentiles). We conservatively apply the 10th percentile shortages to just the driest 10 percent of water years.

As noted above, some EFID growers have voluntarily reduced their total water consumption by 20 to 25 percent in past water shortages, with low-value crops, such as hay and pasture, bearing a large share of the reductions (Buckley, 2019b). We conservatively assume that all growers of low-value crops will reduce their total water consumption by 30 percent, which the EFID District Manager agrees is plausible (Buckley, 2019b). We model the economic returns to low-value crops using grass hay a representative crop. The impact of losing 30 percent of their water would likely cause grass hay growers to forego their third and final cutting of the season, which has an average yield of roughly 1 ton per acre in EFID (Buckley, 2019b). We estimate the impact to growers' net returns using crop enterprise budgets developed by Oregon State University (OSU) and Washington State University (WSU), which we inflated to current dollars and slightly adapted to match EFID conditions (a process described in detail in Appendix D.2). Based on the crop enterprise budgets for grass hay (shown in Table 19 and Table 20), this loss is expected to reduce net returns by $105 on each acre of low-value crops. Since low-value crops are estimated to comprise 1,635 acres in the District,[3] the economic impact of these water shortages will be to reduce net returns of low-value crops by roughly $172,000 in the 10 percent of years this water shortage occurs.

With the low-value crop growers absorbing a 30 percent water curtailment, this would leave high-value crop growers with an overall water deficit of 20 percent.[4] We used pears to estimate the reduced net returns to high-value crops in the District. A compilation of studies has shown that, on average, decreasing the water available to producing pear trees by 1 percentage point results in a 1.3 percent decrease in gross revenue (Marsal, Girona, & Naor, 2012). Incorporating this relationship into the crop budget for pears (shown in Table 17) indicates that, in the absence of the Piping Alternative, the 20 percent water shortages facing high-value crop growers would result in a loss of just under $2,758 for each acre of high-value crops. As high-value crops comprise approximately 7,981 acres in the District, the loss of net returns to all high-value crops is projected to be $22,012,000 in the 10 percent of years this water shortage is expected to occur. When combined with the loss to low-value crops ($172,000), the total economic loss from climate change is expected to be $22.184 million in 10 percent of years starting in the year 2030 if the Piping Alternative is not implemented. The summary of this analysis is presented in Table 3 under the No Action Alternative. In this analysis, we assume that the projected decreased yield in EFID would not affect pear prices received by EFID farmers.[5]

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[3] Low-value crops occupy roughly 17 percent of the District's 9,615 total acres, as explained in the section above. (17 percent x 9,615 acres = 1,635 acres).

[4] A total shortage of 22 percent, subtracting a 30 percent cutback on 17 percent of acres, leaves a 20 percent cutback on the remaining 83 percent of acres. (0.22 - 0.17 x 0.3) / 0.83 = 0.2.

[5] There is no historic data from the area for the relationship between price and production levels, and interviews indicate that water reliability to-date has not reduced orchard yield. The pear market is an international market with significant U.S. fresh pear production exports and imports from other countries (imports of fresh pears comprise about 21 percent of U.S. production, while exports represent about 44 percent of national production). Considering just the national pear market, the projected change in yield for EFID under No Action as a percent of national pear production is under 5 percent, while the projected change in yield under the Piping Alternative represents approximately 2 percent of national production. Given that this is a relatively small change and that there is not a clear relationship between changes in national production and price over the last several years (it is a complex market with many factors affecting price), we assume no price change for pears due to this level of change in EFID production.

Table 3. Climate Change Impacts to EFID Agricultural Production.

	No Action Alternative		Piping Alternative	
EFID demand	117 cfs		100.4 cfs	
EFID supply	91.2 cfs		91.2 cfs	
EFID total water shortage	22%		9%	
	Low-value crops	High-value crops	Low-value crops	High-value crops
Acreage	1,635	7,981	1,635	7,981
Irrigation deficit by crop type	30%	20%	30%	5%
Loss of net returns per acre	$105	$2,758	$105	$657
Total loss in net returns by crop	$172,000	$22,012,000	$172,000	$5,244,000
EFID loss in net returns	$22,184,000		$5,416,000	
Avoided loss in net returns under piping in 10% of years[1]	$16,768,000			
Annual average net benefit under piping	$1,676,000			

[1] Full climate change impacts are projected to begin in the year 2030 (Marsal, Girona, & Naor, 2012), with benefits phasing in between 2020 and 2030.

The Piping Alternative would reduce the effect of future water shortages, reducing yield losses and providing economic benefits. Under the Piping Alternative, the District would face the same water supply that is available for diversion as under No Action: 91.2 cfs. However, under the Piping Alternative, the District's total water demands would experience a net decline of 16.6 cfs as a result of water conserved from piping (decreasing the total demand to 100.4 cfs).[6] This suggests that EFID would face a total supply shortage of approximately 9.2 cfs (100.4 cfs to 91.2 cfs), or 9 percent.[7] This compares to a 22 percent water supply shortage in the No Action Alternative.

As in the No Action Alternative, we assume that low-value crop growers would curtail their total water use by 30 percent in extremely dry years. With each of the 1,635 acres of low-value crops losing a little over $100 in net returns, the total economic loss to low-value crops is projected to be the same as in the No Action Alternative: $172,000 in 10 percent of years.

With the low-value crop growers curtailing their water use by 30 percent, high-value crop growers would face total water shortages of 5 percent.[8] Given the water deficit/gross revenue relationship of pears described above (1.3 percent reduction in gross revenue per 1 percent reduction in water), this shortage is expected to decrease pear yield revenues by 5 percent. Incorporating the change into the pear crop budget (shown in Table 18.), the water shortage will cause net returns to decline by $657 for each acre of high-value crop. As in the No Action Alternative, the District's total area of high-value crops is expected to be 7,981 acres. Accordingly, the total loss of net revenues to high-value crops is projected to be roughly $5.244 million.

[6] Because EFID uses all of its water rights in dry years, when piping conserves 16.6 cfs, the District would no longer need that water for conveyance (i.e., the water lots to seepage or end losses would no longer be required in order to supply District patrons).
[7] 9.2 cfs/100.4 cfs = 9 percent
[8] A total shortage of 9 percent, subtracting a 30 percent cutback on 17 percent of acres, leaves a 5 percent cutback on the remaining 83 percent of acres. (0.09 - 0.17 x 0.3) / 0.83 = 0.05

When combined with the impacts to low-value crops ($172,000), the total economic loss resulting from climate change under the Piping Alternative is around $5.416 million, which is expected to occur in 10 percent of years beginning in the year 2030.

Given that the total annual economic loss in a dry water year under No Action is projected to be $22.184 million, while the corresponding total economic loss under the Piping Alternative is projected to be reduced to $5.416 million, the total economic loss avoided by piping (i.e., the net benefit of piping) is approximately $16.768 million per dry water year. These net benefits are expected to be realized in the driest 10 percent of years. Therefore, the average annual net benefit of piping is expected to be $1.676 million beginning in the year 2030 (10 percent of $16.768 million). We assume that the impacts of climate change will gradually increase from 2020 to the 2030 predicted levels; as such we linearly increase the risk of climate change from the year 2020 to 2030 (i.e., 2021 has 10 percent of the damage projected in 2030, 2022 has 20 percent of the damage projected in 2030, etc.). When discounted and annualized, the avoided damage of climate change under the Piping Alternative is expected to bring average annual benefits of $1.37 million (as shown in Table 4 below).

Table 4. Annual Avoided Loss in Agricultural Production Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Total Future Acres by Project Group	Average Annual Avoided Climate Change Impacts in the year 2030	Average Annual NEE Benefit
Project Group 1	599	$104,000	$91,000
Project Group 2	5,196	$906,000	$760,000
Project Group 3	3,820	$666,000	$522,000
Total	**9,615**	**$1,676,000**	**$1,372,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1]Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

As noted above, when the District is not using its full 25 percent allocation of the water conserved by piping, it expects the water would be kept instream (Buckley, 2019b). Because we only model the District using its full allotment of conserved water rights in the 10 percent of years that EFID is expected to face a severe water shortage, we model the District's water going instream the remaining 90 percent of years. The value of this water is further described in the section below, titled the Value of Conserved Water.

OPERATION AND MAINTENANCE COST SAVINGS BENEFIT

The District currently incurs a number of costs associated with the O&M of open canals, which would be avoided under the Piping Alternative. These costs include the expense of manually adjusting water deliveries and end spills, inspecting and repairing canals, maintaining stormwater drains, dredging District-owned sediment ponds, and cleaning and excavating canals. Including consideration of the O&M costs of the piped canals, the EFID District Manager estimates that piping the canals would reduce total canal O&M expenses by roughly $282,000 each year (Buckley, 2019c), of which nearly all expenses are labor cost savings.

Should the Piping Alternative be implemented, the District does not plan to reduce staff or staff time in response to the avoided O&M costs. Instead, the District plans to assign staff to other activities that would benefit the District and its patrons. We assume that these activities will generate additional benefits that are at least equal to the cost of the staff's time, implying that the value of avoiding canal O&M will bring benefits at least equal to its current cost. In other words, if the District no longer has to pay $282,000 to maintain canals, it will be able to generate at least $282,000 in benefits by reallocating that labor to other valuable tasks. We apportioned the benefits among the project groups using the relative lengths of open canal that would be piped in each project group. As shown in Table 5, when discounted over the study period, these O&M savings are expected to average $250,000 annually.

Table 5. Annual Reduced Operation and Maintenance Costs to EFID Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Length of Open Canal Being Piped	Percent of Total Open Canal Being Piped	Undiscounted O&M Cost Savings Per Year	Discounted Annualized Benefit (OMR Cost Reduction)
Project Group 1	6.1	35%	$98,000	$93,000
Project Group 2	11.4	65%	$184,000	$157,000
Project Group 3	0	0%	$0	$0
Total	**17.5**	**100%**	**$282,000**	**$250,000**

Note: Totals may not sum due to rounding. Prepared April 2019

1/Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

District patrons also engage in O&M activities for the canals, primarily cleaning algae from screens. There are approximately 25 canal screens in the District that require regular maintenance by patrons, and each screen takes roughly 4 hours to clean every day from about June through the first week in September (Buckley, 2019b). In total, the effort requires an estimated 9,800 hours per year. We value this time at the average wage for farmworkers in Central Oregon: $15.89 per hour.[9] At this rate, the value of reduced patron O&M costs is roughly $156,000 per year. The Piping Alternative is expected to reduce the need for this maintenance by 50 percent (Buckley, 2019b). Accordingly, the potential savings from piping is approximately $78,000 per year. We apportion this total among the piping groups according to the length each group would be piped under the Piping Alternative (see Table 6 below). When discounted, the annualized value of O&M savings to EFID patrons is roughly $69,000.

[9] This is based on the mean hourly wage for the Farmworkers and Laborers, Crop, Nursery, and Greenhouse occupation (45-2092) in the Central OR non-metropolitan area in May 2017 ($12.84) (Bureau of Labor Statistics, 2017). This was the closest geography to Hood River County with available data. We adjusted the wage upward 20 percent to account for non-wage costs of labor and adjusted for inflation to 2019 dollars using the Consumer Price Index.

Table 6. Annual Reduced Operation and Maintenance Costs to EFID Patrons Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Length of Open Canal Being Piped	Percent of Total Open Canal Being Piped	Undiscounted O&M Cost Savings Per Year	Discounted Annualized Benefit (O&M Cost Reduction)
Project Group 1	6.1	35%	$27,000	$26,000
Project Group 2	11.4	65%	$51,000	$43,000
Project Group 3	0	0%	$0	$0
Total	**17.5**	**100%**	**$78,000**	**$69,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1]Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

Irrigation Pumping Cost Savings

Compared to the No Action Alternative, the system improvements associated with the Piping Alternative are estimated to reduce patron energy needs by 1,169,706 kilowatt hours (kWh) per year (due to patrons receiving pressurized water rather than pressurizing it themselves) (Farmers Conservation Alliance, 2018). The cost associated with this energy is estimated at $0.0830 per kWh, which is the marginal cost of electricity to irrigators using electricity from the Hood River Electric Cooperative (the power company with the greatest coverage in the District) (Hood River Electric Co-op, 2019). Table 7 presents the estimated savings to EFID patrons for each project group under the Piping Alternative. Once all project groups are complete, the average annual NEE savings to EFID patrons would be approximately $86,000 each year.

Table 7. Annual Increased Average Energy Cost Savings to EFID Patrons Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Annual Energy Savings Under Piping Alternative (kWh)	Undiscounted Annual Energy Cost Savings	Average Annual NEE Benefits (Avoided Energy Costs)
Project Group 1	614,911	$51,000	$48,000
Project Group 2	253,041	$21,000	$18,000
Project Group 3	301,754	$25,000	$20,000
Total	**1,169,706**	**$97,000**	**$86,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.
[2] As estimated by FCA (Farmers Conservation Alliance, 2018).

By providing a pressurized piping conveyance system, the Piping Alternative would allow some irrigators to eliminate the need for pumping altogether. This would reduce pump maintenance costs to irrigators. An analysis by FCA estimated that there are 457 total irrigation pumps within EFID; of those, 287 would be eliminated after pressurization. Table 8 shows the distribution of those pumps by project group.

To estimate the avoided maintenance costs of pumping, we add the average annual power company fixed service charge and the estimated annual repair costs. Hood River Electric Co-op charges $29 per horsepower (hp) of the irrigation pump. With an average irrigation pump size in EFID of 10 hp, the average annual charge is $290 (Hood River Electric Co-op, 2019; Walker C. , 2019). For annual repair costs, interviews with irrigation pump professionals indicated that surface irrigation pumps typically require maintenance every 3 to 5 years, which costs $300 to $800 per instance (Scarborough, 2019; Mark, 2019). From this, we assume the average irrigation pump receives maintenance once every 4 years, costing $550 (the midpoint of the cost range), resulting in an average annual cost of approximately $140 per year. Based on interviews with irrigation pump experts and published sources, we estimate replacement costs for a 10-hp irrigation pump at $3,000 (including installation), and assume replacement is required on average every 10 years (Haun, 2019; Fey, 2019). Amortizing this at the 2.75 annual rate, the annualized cost of replacing a 10-hp pump is about $350.

Combining the service charge, repair costs, and annualized replacement costs, we get an estimated total annual cost of approximately $780 per year per pump. We apply this cost to each eliminated pump to derive the annual benefit. Using this method, the 287 pumps eliminated would provide annual benefits of roughly $222,000, as shown in Table 8. When discounted, the avoided maintenance cost would provide annualized benefits of $193,000 over the No Action Alternative.

Table 8. Annual Increased Pump Maintenance Cost Savings to EFID Patrons Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Total Irrigation Pumps under Baseline Conditions [2]	Pumps Eliminated under the Piping Alternative [2]	Undiscounted Annual Maintenance and Replacement Costs Avoided	Discounted Annualized Maintenance and Replacement Costs Avoided
Project Group 1	131	118	$91,000	$86,000
Project Group 2	225	114	$88,000	$73,000
Project Group 3	101	55	$43,000	$34,000
Total	**457**	**287**	**$222,000**	**$193,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.
[2] As estimated by FCA (Farmers Conservation Alliance, 2018).

CARBON BENEFITS

Reduced energy use also reduces carbon dioxide emissions from power generation. Every megawatt hour (MWh) of reduced on-farm energy use is estimated to translate into an estimated reduction of 0.75251 metric ton (Mt) of carbon emissions.[10] Accordingly, on average, compared to Baseline conditions, the annual net energy savings of the Piping Alternative would reduce carbon dioxide emissions by approximately 880 Mt (approximately 1,169 MWh multiplied by 0.7525).

To value the reduced carbon emissions, this analysis uses an estimate of the social cost of carbon (SCC), which is the estimated total cost to society of emitting carbon related to the expected damages associated with

[10] This assumes that marginal changes in energy demand are met with fossil fuel-based production (renewable energy is typically used first and then fossil-fuel powered generation is used), such that 100 percent of energy use reduction and green energy production results in reduced fossil fuel-powered generation. Furthermore, this estimate assumes 0.75251 metric tons of carbon emitted from 1 MWh of fossil fuel-powered electricity generation based on 1) the current proportion of fuel source–oil, natural gas, and coal–for fossil fuel-powered electrical power generation in the West, and 2) the associated metric tons of carbon dioxide produced per MWh powered by each fossil fuel source, as reported by the Energy Information Administration.

future climate change. There are many estimates of the SCC, and the estimates vary based on what types of damages are included, the discount rate chosen, the geographic area under consideration (such as global damages versus U.S. domestic damages), and the projected level of global warming and associated damages. SCC damage values used by federal agencies have varied over the years. At first, federal agencies developed and applied their own estimates. Then, the Office of Management and Budget convened an Interagency Working Group (IWG) on the Social Costs of Greenhouse Gases, which developed a set of SCC estimates that could be used across federal agencies. In the year 2020 (the closest estimate available for the current year), the IWG estimate for SCC was estimated to be approximately $51.20 per Mt (2019 dollars) (Interagency Working Group on Social Cost of Greenhouse Gases, 2013).[11] However, in 2017, Executive Order 13783 disbanded the IWG, indicated that IWG estimates were not representative of government policy, and removed the requirement for a harmonized federal policy for SCC estimates in regulatory analysis. Since this time, the U.S. Environmental Protection Agency (USEPA) and other federal agencies have developed interim alternative estimates of the SCC, largely relying on the methodology used by the IWG, but using different discount rates and focusing on direct damages projected to occur within the borders of the United States. For example, the USEPA developed interim SCC values for the *Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units* published in June of 2019 (Environmental Protection Agency, 2019). As these interim USEPA SCC estimates are indicative of current federal agency policy on SCC applications for federal cost benefit analysis, they are employed in this analysis. This analysis uses the USEPA interim value of the SCC for 2020 based on a 3 percent discount rate, $7 per metric ton of carbon. At this value, the avoided carbon emissions from the Piping Alternative provide an estimated average annual benefit of approximately $5,000, as shown in Table 9.

Table 9. Annual Increased Average Carbon Cost Savings Under the Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Works of Improvement	Energy Savings Under Piping Alternative (kWh)	Average Annual Mt of Carbon Avoided from Reduced Pumping	Undiscounted Annual Benefit of Avoided Carbon	Discounted Average Annual NEE Benefit
Project Group 1	614,911	463	$3,000	$3,000
Project Group 2	253,041	190	$1,000	$1,000
Project Group 3	301,754	227	$2,000	$1,000
Total	**1,169,706**	**880**	**$6,000**	**$5,000**

Note: Totals may not sum due to rounding. Prepared April 2019
[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

VALUE OF CONSERVED WATER

The value of the conserved irrigation water can be looked at in two ways, depending on where the conserved water is used: the value of increased water instream, or the value of maintaining irrigated agricultural production. Of the 16.6 cfs conserved under the Piping Alternative, the District would receive 25 percent (1,322 AF per year) to augment District irrigation, while 75 percent (3,965 AF per year) would be used to augment instream flows. Additionally, in 90 percent of water years, the District's allotment of conserved water will enhance instream flow (or an annual average of 1,190 AF per year). This section explores the value of 5,155 AF per year of average enhanced instream flows.

[11] We adjusted the original cost of $42 in 2007 dollars to 2019 dollars using the Consumer Price Index.

This section provides several types of information on the value of instream flow. First, this analysis examines the value that environmental groups, federal agencies, and other funders of conservation have been willing to pay for water conservation projects that restore flow in the Hood River Basin. While these values are in fact costs rather than a measurement of benefit, the amounts paid in the past for water conservation projects to enhance instream flow represent the minimum value to the funding entities of conserved water projects (benefits as perceived by funding entities are expected to at least equal costs or funding would not be provided). Similarly, there are some limited water market data available for what environmental or governmental groups have paid to directly purchase water rights and dedicate the water to instream flow. These values also represent the cost of increasing instream flow, similar to the data on costs of water conservation projects, and may significantly underestimate the full value of instream flow augmentation. This analysis also presents market information on the value of water rights to irrigators in EFID, as this indicates the potential cost of purchasing water rights from these irrigators. While there have been relatively small amounts of water temporarily leased between EFID irrigators, the prices of these transactions (or other water transactions in the basin) were not available for this study (Nakamura, 2019). Prices of water rights are very basin-specific and often based on the value of water to agriculture (as agriculture is the most common seller of water rights for environmental or other water uses). We therefore rely on the agricultural value of water in the local basin as well as transaction prices for environmental water in other basins in the West to provide a basis for the economic value of instream flow augmentation.

Based on the following discussion, we assume that the economic benefit of instream flow augmentation would be at least $75 per AF per year, such that this enhanced instream flow is estimated to have a value of approximately $387,000 per year once all project groups are completed under the Piping Alternative (because of the timing, on an average annualized basis, the NEE benefit is roughly $337,000 as presented in Table 11). As most water right transactions for environmental purchases are to enhance fish habitat, this value is expected to be a conservative proxy for the value to the public of enhanced fish habitat and fish populations. (The full measure of the economic benefit of enhanced instream flow is the benefit to the public of enhanced fish and wildlife populations, water quality, ecosystem function, etc.).

Values published in the economic literature are often quite high for enhancements to salmon, trout, and other fish and wildlife populations (see Table 10), such as those that would benefit from the instream flows provided by the Piping Alternative. As quantitative information on how instream flows would improve fish and wildlife populations is not available, the analysis is not able to directly measure the economic benefit of enhanced instream flow. As such, the value of conserved water is estimated in this section using the prices of water from transactions in the Western United States. Table 11 shows the estimated average annual benefits of enhanced instream flow for the Piping Alternative.

Table 10. Studies and Values Used to Estimate the Value of Fish Enhancement.

Author(s)	Study Year	Original Value Per Household (Dollar Year)	Value Per Household Adjusted to 2019 dollars	Restoration Location	Fish Enhancement	Survey Respondents
Bell, Huppert, & Johnson	2003	$24 - $122 (2000$)	$36 - $179	Coastal WA and OR	Annual willingness to pay (WTP) per household to increase local Coho salmon populations by 100%	Households in Grays Harbor, WA; Willapa Bay, WA; Coos Bay, OR; Tillamook Bay, OR; Yaquina Bay, OR
Olsen, Richards, & Scott	1991	$43 (2006$)	$54	Columbia River Basin	Annual WTP per household to increase salmon and steelhead populations by 100%	Pacific Northwest households that never fish
Loomis	1996	$59 - $73 (1994$)	$101 - $125	Elwha River, Olympic Peninsula, WA	Annual WTP per household to restore a salmon and steelhead population in its historic habitat on the Elwha River	Households in Clallam County, WA; WA state; U.S.
Layton, Brown, & Plummer	1999	$119 - $250 (1998$)	$185 - $388	Eastern WA and Columbia River; Western WA and Puget Sound	Annual WTP per household to increase migratory fish populations by 50%	Households in WA state

Prepared April 2019

Sources: (Bell, Huppert, & Johnson, 2003); (Loomis, 1996); (Layton, Brown, & Plummer, 2001); (Olsen, Richards, & Scott, 1991) as cited in (Richardson & Loomis, 2009).

Table 11. Annual Estimated Instream Flow Value of Piping Alternative by Project Group, Hood River Watershed, Oregon, 2019$.[1]

Project Group	Water Conservation Going Instream (AF/year)	Undiscounted Annual Benefit to Instream Flow	Discounted Annualized Benefit to Instream Flow
Project Group 1	1,607	$121,000	$115,000
Project Group 2	2,605	$195,000	$166,000
Project Group 3	943	$71,000	$56,000
Total	**5,155**	**$387,000**	**$337,000**

Note: Totals may not sum due to rounding. Prepared April 2019

[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

This value of $75 per AF per year is based on the following information (see Table 12):

1. *Prices paid for water by environmental buyers throughout the Western United States*. In the period 2000 to 2009, the purchase price of environmental water varied from just over $0 to nearly $1,676 per AF per year, with an average permanent sale transaction price of $166 per AF per year. Among the 51 permanent water right purchases with the sales price and volume recorded in the database, the permanent sales price value in 27 transactions (53 percent) was above $75 per AF per year. As discussed in detail below, the values paid are expected to provide a low range estimate of instream flow value to society.
2. *Value of water to irrigators in EFID*. For low-value crop irrigators (likely the first to sell water for environmental purposes), this is estimated at approximately $60 to $100 per AF per year. This value is important as the value of water to local agriculture is a key factor determining water sales and lease prices to environmental buyers in the project area (i.e., the marginal value of water to agriculture determines the willingness of the agricultural sellers to accept a price for water), and because conserved water avoids potential future reductions in EFID deliveries.

Table 12. Value per AF per Year of Water (Market Prices and Value to Agriculture), Hood River Watershed, Oregon, 2019$.

Type of Value	Low Value	High Value	Median Value	Average Value
Permanent water right transaction in western U.S., 2000 to 2009 (*Converted to Annual Values*)	~$0	$1,676	~$75	$166
Value of water to EFID hay and pasture irrigators (*Income Capitalization Approach*)	$60	$100	~$80	

Past Costs Paid as a Proxy for Value

Past piping projects in the Hood River Basin highlight the willingness of funding entities to pay for instream flow augmentation. These values are evidence of the *minimum* benefit of the instream flows purchased, as perceived and experienced by these entities. Project costs paid are indicative of the *minimum* perceived benefit, as (barring very unusual circumstances) entities only pay for projects for which they believe benefits exceed costs. Furthermore, funding organizations do not necessarily represent all individuals who value instream flow benefits. Only if all people who value instream flow were to pay their maximum willingness to pay for instream flow restoration would the value paid equal the benefits received. Finally, it is important to recognize that these values fundamentally represent costs and not benefits; the values paid are based on the cost to conserve water or for agriculture to reduce their use of water (as evident through water rights transactions from agriculture to environmental flows).

There are five irrigation districts in the Hood River Basin: Dee, East Fork, Farmers, Middle Fork, and Mount Hood. These irrigation districts have implemented a variety of projects to enhance instream flow (and provide other benefits), including piping open canals and promoting on-farm irrigation efficiencies. Six basin piping projects, along with their associated costs and water savings, are shown in Table 13. The costs range from $754,000 to $6.15 million per cfs conserved, and an estimated $2,100 to $17,000 per AF conserved.

Table 13. Cost and Water Savings of Piping Projects in the Hood River Basin.

Project	Year Complete	Water Saved (cfs)	Total Cost (2019$)[1]	Cost per Amount of Water Conserved ($/cfs)	Cost per Amount of Water Conserved ($/AF)
DID Piping Project	2013	3.0	$2,528,000	$843,000	$2,300
EFID Central Lateral Piping	2008	2.1	$12,915,000	$6,150,000	$17,000
FID Green Point Pipeline Project	2016	1.5	$1,264,000	$843,000	$2,300
EFID Highline Canal Pipeline	2016	0.5	$826,000	$1,652,000	$4,600
FID Lower District Pressurization Project	2009	7.5	$5,656,000	$754,000	$2,100
MFID Glacier Ditch Pipeline Phase 3	2012	0.3	$595,000	$1,983,000	$5,500

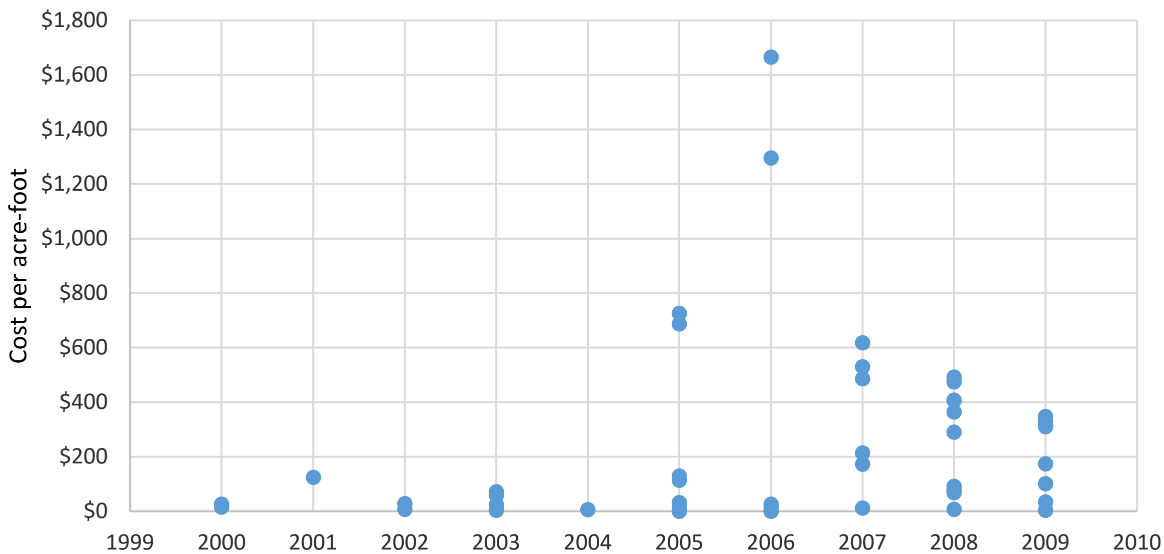
[1] Total costs were adjusted to 2019 dollars using the Consumer Price Index. Prepared April 2019
Sources: (Hood River Watershed Group, 2014; Hood River News, 2014; Christensen & Salminen, Hood River Basin Water Use Assessment, 2013; Farmers Irrigation District, 2019; Oregon Department of Agriculture, Hood River Local Advisory Committee, 2016; Oregon Water Resources Department, 2018; Craven Consulting Group, 2005).

Water rights can be purchased or leased in Oregon. It is important to note that the value paid per AF depends on many variables, including the value of water to the seller, funding available to the buyer, characteristics of the affected stream/river (including current flow levels, flow targets, and presence of threatened or endangered species), characteristics of the water right (seniority, time of use, point of diversion, etc.), and the size of the water right.

Water right leases and purchases for environmental purposes across the Western United States were analyzed in a 2003 paper (Loomis, Quattlebaum, Brown, & Alexander, 2003). During the period between 1995 and 1999, six transactions of water right purchases averaged $362 per AF in Oregon, while five water right leases averaged $115 per AF per year. The paper also shows lease and purchase price by environmental use, including for riparian areas, wetlands, recreation, and instream flow. For instream flows, the average purchase price across 18 transactions per AF was $1,121, while across 35 lease transactions the annual price was $68 per AF.

The Bren School of Environmental Science and Management at the University of California, Santa Barbara, maintains a database of water transfers in the Western United States, and distinguishes between the terms of the transaction (i.e., sale or lease) and the sector of the buyer and seller (e.g., agricultural or environmental)

(Bren School of Environmental Science & Management, University of California, Santa Barbara, 2017). The two graphs shown below in Figure D-1. and Figure D-2. show more recent (from 2000 to 2009) sales and leases of water rights by environmental buyers on a price per AF per year basis. The figures show how water right transaction values vary widely, but sale prices (amortized to an annual price) typically are less than $200 per year while 1-year leases typically fall below $800 per AF per year (with several transactions showing prices rising over a $1,000 per AF per year). Among the 51 permanent water right purchases with the sales price and volume recorded in the database, the sales price value in 27 transactions (53 percent) was above $75 per AF per year. However, it is also important to note that the amount paid per AF tends to decline with an increase in water volume traded; weighting the purchase price by the water volume sold decreases the average permanent sale transaction price to $20 per AF per year.



Note that dollar per AF purchase prices were amortized using a 2.75 percent interest rate and a 100-year period to derive dollar per AF per year values.

Figure D-1. Western water right purchases for environmental purposes, 2000 to 2009, price paid per acre-foot per year.

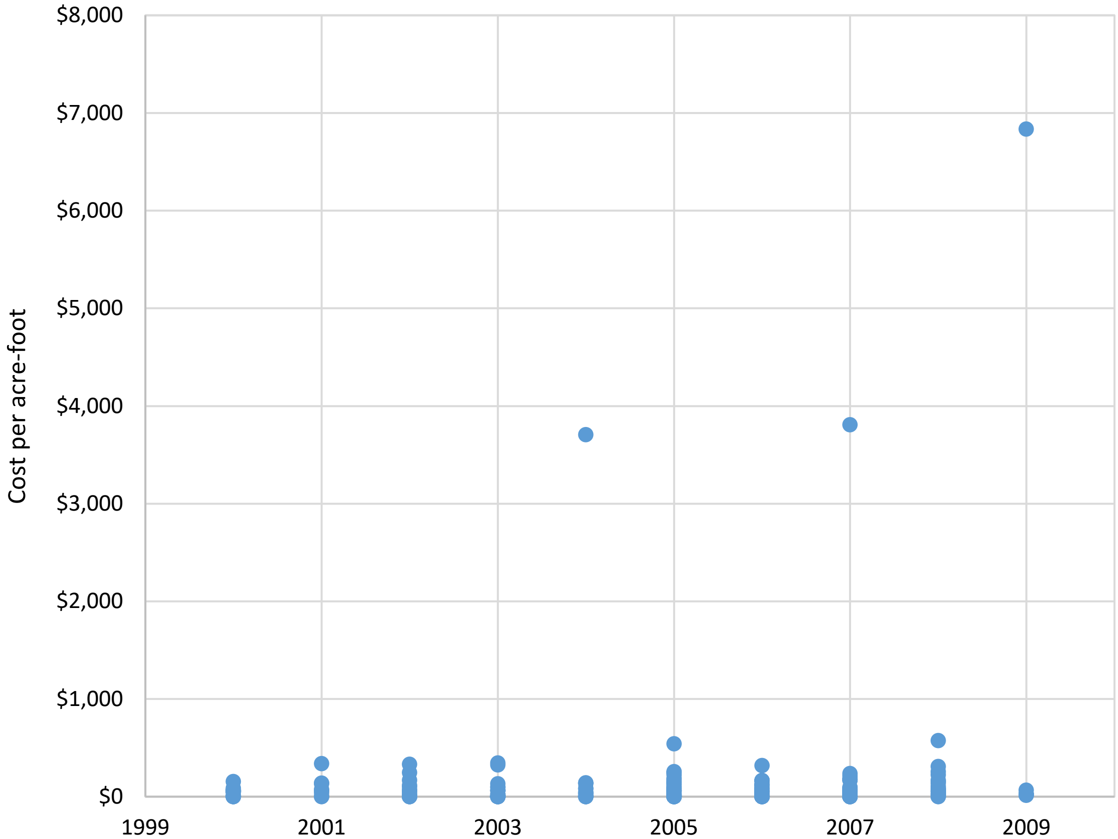


Figure D-2. 1-year water leases for environmental purposes, price paid per acre-foot in Western United States.

D.1.2.2 Benefits Considered but Not Included in Analysis

Public Safety Avoided Costs

Piping irrigation water removes the hazard of drownings in canals, and also eliminates the potential for canals to fail, causing potential damages to downstream property and lives. While EFID canal failure is very possible, the extent of damage varies dramatically depending on the timing and location of failure. Given the limited amount of available data on the cost of these canal failures, the public safety (and property damage reduction) benefit of piping is not analyzed in this analysis. However, past drownings in the District have demonstrated the danger inherent to open canals, which can have fast-moving water and present a threat to public safety. Between 1983 and 1985, two drownings occurred in District canals; one an adult male, the other a child (Buckley, 2019a). There have been no drownings since that time. This means that from 1983 to 2018, there was an average of 0.057 deaths per year in District canals. As the population in Hood River County continues to grow, the risks to public safety will increase.

The Piping Alternative would pipe the remaining open canals in the system. This section qualitatively discusses the potential magnitude of the public safety benefit of piping the remaining exposed canals in EFID. The analysis presents some information on the potential public safety hazard of the existing irrigation canals in EFID that are proposed for piping (based on the recent history of drownings and the mileage of exposed canals).

Level of Public Safety Hazard

This analysis estimates the public safety hazard of unlined canals in EFID based on past drownings in unlined canals in East Fork. The EFID System Improvement Plan (SIP) details how the District currently has approximately 17.9 miles of open canals, 17.5 miles of which would be piped under the Piping Alternative (6.1 miles in the Eastside Canal, 6.4 miles in the Main Canal, and 5.0 miles in the Dukes Valley Canal). In 2007, the 4.5-mile Central Canal was piped, meaning that from 1983 to 2007 there were 22.4 miles of open canals (Farmers Conservation Alliance, 2018). Accordingly, the length of open canals averaged 21 miles between 1983 and 2018. Given that two drowning deaths occurred during this time period (an average of 0.057 deaths per year, as described above), the annual drowning risk per mile of open canal was 0.0027. This may be an overestimate of risk if there were an abnormally high number of drownings in the last 25 years, but it may also be an underestimate of risk as the population of Hood River continues to grow.

Under the No Action Alternative, EFID would continue to have about 17.5 more miles of open canals than under the Piping Alternative. Assuming that the three drownings over the past 25 years are representative of the future drowning risk, and that the 0.0027 deaths per mile of exposed canal experienced during this period is an appropriate estimate of future risk, the unpiped canals in EFID carry a risk of 0.05 deaths per year.

D.1.3 Summary of Benefits

Table 8-6 (NWPM 506.20, Economic Table 5a) summarizes annual average NEE project benefits of the Piping Alternative that exceed the benefits under the No Action Alternative. In the table, the benefits from irrigating new acres (described in the Agricultural Damage Reduction Benefit section) and the benefits of having additional water for existing irrigated acres (described in the Agricultural Damage Reduction Benefit section) are grouped together under "Increased Agricultural Production" benefits. Avoided O&M costs to the District and to patrons (in the Operation and Maintenance Cost Savings Benefit section) are grouped under "Other - Reduced O&M" benefits. Avoided pump costs, including energy, maintenance, and replacement costs, are grouped under "Other - Pump Cost Savings."

D.1.4 Incremental Analysis

The Piping Alternative is also evaluated using an incremental analysis, which identifies how total costs and benefits change as project groups are added. In the incremental analysis, project group pipe sizes and costs remain the same for each project group assessed.

The engineering pipeline design (pipe diameters, pressure ratings, etc.) is independent of the number of project groups and the order that the project groups are installed. The District's SIP describes how the District designed modern pipelines to replace its open canals and laterals (Farmers Conservation Alliance, 2018). The District mapped and collected digital elevation data along its entire delivery system. The District is obligated to deliver water to patrons at 4.49 gallons per minute (gpm) but designed the system to be able to deliver 5.62 gpm.

As the pipeline is installed from the "top down" (from the diversion at higher elevations to the lowest elevations in the District), the design had to account for all the irrigation demand in the system. That is, the system had to be designed for the future full demand rather than the current project group demand.

For example, assume that two planned project groups would replace a leaky canal with a 2-mile pipeline. Project Group 1 construction is the upper 1 mile of pipeline starting at the diversion gate. Project Group 2 construction is the lower 1 mile. The irrigation demand (water right) for the Project Group 1 construction is 5 cfs. The irrigation demand for the Project Group 2 construction is 15 cfs. Total irrigation demand for the pipeline equals 20 cfs.

If the engineer designs a pipeline for 5 cfs for Project Group 1, this would be a relatively small pipeline. This small pipeline would then be connected to the larger Project Group 2 pipeline. The small Project Group 1 pipeline would have to convey 20 cfs of flow through a pipeline designed for 5 cfs. This would result in a pipeline that does not meet NRCS design standards and would likely not function or meet the project goals.

Pipelines typically decrease in size as the irrigation demand decreases with the number of acres served at lower elevations in the system. Project groups are not considered when determining when to reduce from a larger to a smaller pipe.

The District used the information and assumptions above to create a hydraulic model that determined pipe sizes for each pipeline (canal or lateral to be piped) in the system. The District designed each pipeline to deliver water under its existing water rights, and these pipelines are not designed to deliver water under any additional water rights.

While costs are the same for each project group in the incremental analysis (as shown in Table 14), the District aims to provide a piping pressure of at least 40 pounds per square inch wherever possible. Table 14 shows the incremental analysis of the project groups.

Table 14. Incremental Analysis of Annual NEE Costs and Benefits Under the Piping Alternative for East Fork Irrigation District, Hood River Watershed, Oregon, 2019$.[1]

Groups	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1	$396,000		$462,000		$66,000
1,2	$1,424,000	$1,028,000	$1,680,000	$1,218,000	$256,000
1,2,3	$1,763,000	$339,000	$2,313,000	$633,000	$550,000

Note: Totals may not sum due to rounding — Prepared April 2019

[1] Price Base: 2019 dollars amortized over 100 years at a discount rate of 2.75 percent.

D.1.5 References

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D.2 NEE Crop Enterprise Budgets

This section presents the crop enterprise budgets used in estimating agricultural NEE benefits under the Piping Alternative resulting from reduced damages associated with water shortages expected due to climate change. The agricultural production benefits are estimated using enterprise budgets that represent typical costs and returns of producing crops in the Hood River Watershed of Oregon. Enterprise budgets aim to reflect common practices and relevant costs for production in the region, but do not necessarily represent conditions of any particular farm.

We used crop budgets for pears and alfalfa hay developed, respectively, by OSU and WSU, and then adjusted values in these budgets to account for changes in prices through time and local conditions in EFID. An existing grass hay budget for Hood River County or the Columbia Basin was not available from OSU or WSU. In comparing grass hay to alfalfa hay budgets, the production costs tend to be higher for alfalfa hay per ton of production due to higher machinery, pest management, and establishment costs (Painter, 2015 Enterprise Budget: District 1 Alfalfa, 2015; Painter, 2015 Enterprise Budgets: District 1 Grass Hay, 2015; Turner & Mylen Bohle, 1995; McNeley, Williams, Carr, & Turner, 1995). As such, by using an alfalfa hay budget we expect that our estimated production costs for grass hay may be higher than typical in EFID, resulting in conservative estimates of net returns to grass hay production.

Due to the need to model years with different irrigation water availability, we developed five crop budgets. There are three budgets for pears to represent high-value crops: one for full production years under full irrigation, and two for full production years under different irrigation deficit scenarios. There are two budgets for grass hay to represent low-value crops: one for full production years under full irrigation and one for full production years under an irrigation deficit. We use the budgets of irrigation deficits to estimate the net benefits of piping to agricultural production under climate change (in the Agricultural Damage Reduction Benefit section). The following two sections outline the data and assumptions used in adjusting the Oregon State and Washington State pear and alfalfa hay budgets. Table 15 summarize the net returns to pears and grass hay modeled in the enterprise budgets.

Table 15. Per-Acre Net Returns to Crops Under Climate Change Scenarios.

Production Year	Pears	Grass Hay
Full Irrigation[1]	$3,795	$110
22% total water shortage at EFID	$1,267	$5
9% total water shortage at EFID	$3,368	$5

[1] These are the full production net returns with the amortized establishment costs subtracted out.

D.2.1 Pear Enterprise Budgets

The pear enterprise budgets (presented in full below) were primarily based on enterprise budgets for pears developed by OSU in 2016 to represent the costs and benefits of full production for pears in Hood River County (Halliday, Seavert, & Castagnoli, 2016a; Halliday, Seavert, & Castagnoli, 2016b). We updated the costs and revenues presented in the budgets to account for changing values over time and to reflect values specific to the District.

To model benefits of increased water supply reliability to existing orchards in the deficit irrigation budgets, we include establishment costs since we do not explicitly model the establishment years.[12]

D.2.1.1 Modeled Farm

The farm modeled in the original OSU budget is 70 acres total, which comprised 50 acres of pears, 5 acres of apples, 5 acres of cherries or wine grapes, and 10 acres are orchards under establishment. The budgets are based on 8 acres producing d'Anjou and fresh Bartlett pears, with 242 trees per acre.

D.2.1.2 Facilities and Equipment

Irrigation is delivered through a mix of solid set and handlines. Housing (sufficient for 10 people) is provided for summer labor and has a productive life of 30 years. Foreman housing is also provided. A 70-hp tractor is used for shredding brush, flailing, pulling the airblast sprayer, and harvesting. A 50-hp tractor is used to auger holes for new trees, spread fertilizer, pull an older air-blast sprayer, apply gopher bait, and assist during harvest. A 35-hp tractor is used to spray weeds, assist in harvest, and as a general utility tractor.

D.2.1.3 Input Costs

All costs are adjusted from the original values in the OSU budget. Wherever possible, we adopted area-specific values, which was the case for fuel prices and irrigation charges. EFID charges a flat rate of $175 for each tax lot supplied with District water and $59 per acre supplied (East Fork Irrigation District, 2018). As the average tax lot size in EFID is 10 acres, the flat rate is divided by 10 to derive the per-acre cost of the flat irrigation fee. For land costs, we use the average value of non-producing pear orchards in the area ($15,000 per acre) and multiplied it by the discount rate (2.75 percent), to generate the estimated annual cost of owning the land.

For costs that did not have area-specific values, we adjusted the value in the original budget using the national Producer Price Indices (PPIs) produced by the National Agricultural Statistics Services (NASS), which are published for a variety of farm expenses (NASS, 2018). For example, there are price indices for fertilizer, herbicides, supplies, tractors, custom work, as well as one for the farm sector in general. The PPI cost adjustments range from an 8 percent decrease in the price of fertilizer to a 10 percent increase in building materials. For the deficit irrigation budgets, the orchard establishment costs are amortized over the 25-year full production years assumed in the original OSU budget. We adjusted the establishment cost by using a discount rate of 2.75 percent (instead of the 5 percent from the original budget), and also adjusted the cost to 2019 dollars using the general Farm Sector PPI.

D.2.1.4 Labor Costs

For general farm labor, we used the average wage rate for farmworkers in the Central Oregon non-metropolitan area.[13] For equipment operator labor, we used the mean hourly wage rate for this occupation in Oregon.[14] In both cases, we adjusted the average wage rate up by 20 percent to account for non-wage

[12] In years requiring deficit irrigation, we also assume that water supply shortages would primarily affect only full-production orchards (growers prioritize watering young trees being established to protect their long-term productivity).
[13] This is the average wage for the Farmworkers and Laborers, Crop, Nursery, and Greenhouse occupation (45-2092) according the Bureau of Labor Statistics Occupational Employment Statistics data in May 2017 (Bureau of Labor Statistics, 2017). We adjust wage for inflation to 2019 dollars using the Consumer Price Index.
[14] This is the average wage for the Agricultural Equipment Operators (45-2091) according the Bureau of Labor Statistics Occupational Employment Statistics data in May 2017 (Bureau of Labor Statistics, 2017). We adjust wage for inflation to 2019 dollars using the Consumer Price Index.

employment costs, such as health care and insurance. This results in total labor costs of $15.89 and $18.13 per hour for laborers and equipment operators, respectively. The two pear budgets modeled under deficit irrigation (Table 17 and Table 18.) have their harvest labor costs adjusted downward in order to account for lower yields.

The original OSU pear budget did not include a cost for an orchard manager. To estimate the economic net benefits of the agricultural production, rather than the net returns to the time spent self-managing an orchard, we added the cost of managing the orchard to the budget. To estimate this cost, we used the wage rate for agricultural managers in Eastern Oregon (which is adjusted upward by 20 percent, similar to the other labor), resulting in a total cost of $39.77 per hour.[15] To estimate the amount of time spent per acre, we use a pear budget developed by the University of California, Davis, which models an orchard manager effectively running a 400-acre orchard (Ingles & Klonsky, 2012). Assuming this manager works 40-hour workweeks 48 weeks out of the year, each acre would require roughly 4.8 hours per week. At $39.77 per hour, we estimate that hiring an orchard manager would cost roughly $191 per acre.

D.2.1.5 Revenues

To estimate the gross revenues of pears under full irrigation, we used the full production year yield from the original OSU pear budget (50 bins of 1,050-lbs per acre) because it is specific to Hood River County and is specific to full production years. We used the average price per bin in the area as reported by an EFID board member and Quality Control Manager of Duckwall-Pooley Fruit Company, one of the largest fruit packing companies in the area: $250 per bin (Mallon, 2019). This price may be conservative given that, from 2013 to 2017, the average price in Oregon for Bartlett pears was the equivalent of $325 per bin and $353 per bin for other pears (Oregon Department of Agriculture, 2018; USDA and NASS, 2018). For the gross revenues under deficit irrigation, we adjusted the original yield downward using the yield/water relationship for pears described in the Agricultural Damage Reduction Benefit section.

D.2.1.6 Pear Enterprise Budget Tables

The tables below present the pear enterprise budgets used to estimate the net returns to high-value crops in the District under full water allocation (Table 16), under a 20 percent deficit irrigation (Table 17), and under a 5 percent deficit irrigation (Table 18.).

[15] This is the average wage for the Farmers, Ranchers, and Other Agricultural Managers (11-9013) according the Bureau of Labor Statistics Occupational Employment Statistics data in May 2017 (Bureau of Labor Statistics, 2017). We adjust wage for inflation to 2019 dollars using the Consumer Price Index.

Table 16. Pear Enterprise Budget Under Full Irrigation (Years 8–32).

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Pears	50	bins	$250	$12,500
VARIABLE COSTS				
Pruning and training labor	25.0	hrs	$15.89	$397.23
Thinning labor	18.0	hrs	$15.89	$286.01
Tree removal & replacement	1.0	ac	$17.20	$17.20
Raking and shredding bush labor	0.4	hrs	$18.13	$6.52
Fertilizer & lime	1.0	ac	$290.89	$290.89
Herbicide strip maintenance	1.0	ac	$53.35	$53.35
Insecticides & fungicides	1.0	ac	$820.80	$820.80
Pheromone disruption	1.0	ac	$112.86	$112.86
Bee rental	1.0	ac	$111.68	$111.68
Flailing/mowing orchard floor labor	2.9	hrs	$18.13	$52.13
Rodent control	1.0	ac	$43.01	$43.01
Frost protection labor	2.0	hrs	$15.89	$31.78
Irrigation water charge	1.0	ac	$59.00	$59.00
Ladders, pruning, & picking equipment	1.0	ac	$13.10	$13.10
Harvest labor	50.0	bins	$38.40	$1,920.04
Harvest - hauling fruit	50.0	bins	$3.55	$177.67
Pickup, truck & Gator	1.0	ac	$180.37	$180.37
Seasonal housing facilities	1.0	ac	$124.65	$124.65
Misc. and overhead	1.0	ac	$131.65	$131.65
Interest: operating capital	1.0	ac	$34.49	$34.49
Other general labor	7.3	hrs	$15.89	$115.99
Other tractor driver labor	8.7	hrs	$18.13	$157.16
Other machinery costs	1.0	ac	$411.88	$411.88
Total variable costs				$5,549.45
FIXED COSTS				
Irrigation service charge	1.0	ac	$17.50	$17.50
Property insurance	1.0	ac	$26.33	$26.33
Property taxes	1.0	ac	$63.19	$63.19
Management cost	1.0	ac	$190.91	$190.91
Machinery & equipment: depreciation and interest	1.0	ac	$610.53	$610.53
Pickup, truck & Gator: depreciation and interest	1.0	ac	$96.13	$96.13
Foreman housing	1.0	ac	$188.16	$188.16
Seasonal housing facilities	1.0	ac	$274.40	$274.40
Land cost	1.0	ac	$412.50	$412.50
Total fixed costs				$1,879.64
Total costs				$7,429.09
NET RETURNS PER ACRE				**$5,070.91**

Table 17. Pear Enterprise Budget Under 20-Percent Irrigation Deficiency.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Pears	36.7	bins	$250	$9,186
VARIABLE COSTS				
Pruning and training labor	25.0	hrs	$15.89	$397.23
Thinning labor	18.0	hrs	$15.89	$286.01
Tree removal & replacement	1.0	ac	$17.20	$17.20
Raking and shredding bush labor	0.4	hrs	$18.13	$6.52
Fertilizer & lime	1.0	ac	$290.89	$290.89
Herbicide strip maintenance	1.0	ac	$53.35	$53.35
Insecticides & fungicides	1.0	ac	$820.80	$820.80
Pheromone disruption	1.0	ac	$112.86	$112.86
Bee rental	1.0	ac	$111.68	$111.68
Flailing/mowing orchard floor labor	2.9	hrs	$18.13	$52.13
Rodent control	1.0	ac	$43.01	$43.01
Frost protection labor	2.0	hrs	$15.89	$31.78
Irrigation water charge	1.0	ac	$59.00	$59.00
Ladders, pruning, & picking equipment	1.0	ac	$13.10	$13.10
Harvest labor	36.7	bins	$38.40	$1,411.04
Harvest - hauling fruit	36.7	bins	$3.55	$130.57
Pickup, truck & Gator	1.0	ac	$180.37	$180.37
Seasonal housing facilities	1.0	ac	$124.65	$124.65
Misc. and overhead	1.0	ac	$131.65	$131.65
Interest: operating capital	1.0	ac	$34.49	$34.49
Other general labor	7.3	hrs	$15.89	$115.99
Other tractor driver labor	8.7	hrs	$18.13	$157.16
Other machinery costs	1.0	ac	$411.88	$411.88
Total variable costs				$4,993.35
FIXED COSTS				
Irrigation service charge	1.0	ac	$17.50	$17.50
Property insurance	1.0	ac	$26.33	$26.33
Property taxes	1.0	ac	$63.19	$63.19
Management cost	1.0	ac	$190.91	$190.91
Machinery & equipment: depreciation and interest	1.0	ac	$610.53	$610.53
Pickup, truck & Gator: depreciation and interest	1.0	ac	$96.13	$96.13
Foreman housing	1.0	ac	$188.16	$188.16
Seasonal housing facilities	1.0	ac	$274.40	$274.40
Land cost	1.0	ac	$412.50	$412.50
Amortized establishment costs	1.0	ac	$1,045.99	$1,045.99
Total fixed costs				$2,925.63
Total costs				$7,918.98
NET RETURNS PER ACRE				**$1,267.26**

Table 18. Pear Enterprise Budget Under 5-Percent Irrigation Deficiency.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Pears	46.8	bins	$250.00	$11,710
VARIABLE COSTS				
Pruning and training labor	25.0	hrs	$15.89	$397.23
Thinning labor	18.0	hrs	$15.89	$286.01
Tree removal & replacement	1.0	ac	$17.20	$17.20
Raking and shredding bush labor	0.4	hrs	$18.13	$6.52
Fertilizer & lime	1.0	ac	$290.89	$290.89
Herbicide strip maintenance	1.0	ac	$53.35	$53.35
Insecticides & fungicides	1.0	ac	$820.80	$820.80
Pheromone disruption	1.0	ac	$112.86	$112.86
Bee rental	1.0	ac	$111.68	$111.68
Flailing/mowing orchard floor labor	2.9	hrs	$18.13	$52.13
Rodent control	1.0	ac	$43.01	$43.01
Frost protection labor	2.0	hrs	$15.89	$31.78
Irrigation water charge	1.0	ac	$59.00	$59.00
Ladders, pruning, & picking equipment	1.0	ac	$13.10	$13.10
Harvest labor	46.8	bins	$38.40	$1,798.75
Harvest - hauling fruit	46.8	bins	$3.55	$166.44
Pickup, truck & Gator	1.0	ac	$180.37	$180.37
Seasonal housing facilities	1.0	ac	$124.65	$124.65
Misc. and overhead	1.0	ac	$131.65	$131.65
Interest: operating capital	1.0	ac	$34.49	$34.49
Other general labor	7.3	hrs	$15.89	$115.99
Other tractor driver labor	8.7	hrs	$18.13	$157.16
Other machinery costs	1.0	ac	$411.88	$411.88
Total variable costs				$5,416.93
FIXED COSTS				
Irrigation service charge	1.0	ac	$17.50	$17.50
Property insurance	1.0	ac	$26.33	$26.33
Property taxes	1.0	ac	$63.19	$63.19
Management cost	1.0	ac	$190.91	$190.91
Machinery & equipment: depreciation and interest	1.0	ac	$610.53	$610.53
Pickup, truck & Gator: depreciation and interest	1.0	ac	$96.13	$96.13
Foreman housing	1.0	ac	$188.16	$188.16
Seasonal housing facilities	1.0	ac	$274.40	$274.40
Land cost	1.0	ac	$412.50	$412.50
Amortized establishment costs	1.0	ac	$1,045.99	$1,045.99
Total fixed costs				$2,925.63
Total costs				$8,342.57
NET RETURNS PER ACRE				**$3,367.75**

D.2.2 Grass Hay Enterprise Budgets

The grass hay enterprise budgets were based on 2012 budgets developed by WSU for establishing and producing alfalfa hay in the Washington Columbia Basin (Norberg & Neibergs, 2012). These budgets include two budgets for the establishment year and one full production year budget. We selected these budgets as the basis for EFID crop production costs because they are the most recent crop budgets developed for agriculture in the Columbia Basin. As noted above, in comparing grass hay to alfalfa hay budgets, the production costs tend to be higher for alfalfa hay per ton of production due to higher machinery, pest management, and establishment costs (Painter, 2015 Enterprise Budget: District 1 Alfalfa, 2015; Painter, 2015 Enterprise Budgets: District 1 Grass Hay, 2015; Turner & Mylen Bohle, 1995; McNeley, Williams, Carr, & Turner, 1995). As such, by using an alfalfa hay budget we expect that our estimated production costs for grass hay may be higher than typical in EFID, resulting in conservative estimates of net returns for grass hay production.

As in the pear budgets, we updated the costs presented in the original budgets to account for changing values over time and to reflect conditions specific to EFID. Returns to grass hay were based on locally reported hay yields and Oregon State 5-year normalized average hay prices. We developed two hay budgets in total: one budget for hay under full production years and full irrigation (Table 19), and one budget where a 30 percent irrigation deficit causes the grower to forego the third and final hay cutting at a loss of 1 ton of hay per acre (Table 20). This results in a reduced net revenue of $105 per acre compared to a full water year.

D.2.2.1 Modeled Farm

The farm modeled in the original WSU budget was meant to represent typical per-acre costs of hay production in the years after establishment (second and third years). The modeled farm is 120 acres. The hay field is seeded in the fall following a grain crop, such as wheat or barley, and is harvested using one-ton bales beginning the following spring. Other than labor for irrigation, all labor is provided by hiring custom work (including harvest, fertilizer application, and herbicide application). Irrigation is delivered by a center pivot.

D.2.2.2 Input Costs

All costs are adjusted from the original values in the WSU budget. As with the pear budgets, we used area-specific values for fuel prices, irrigation charges, and land costs. Irrigation charges are the same as those presented in the pear budget. The original WSU budget did not include the costs of land, however, we added it to the budget used in this analysis. We adopted the land value used an enterprise budget for irrigated corn in the northcentral region of Oregon in 2014, adjusted it to 2019 dollars using the CPI, and then used an annual interest rate of 2.75 percent to derive the estimated land ownership costs (Seavert & Horneck, 2014).

For costs that did not have area-specific values, we adjusted the value in the original budget using the same PPIs as were used in the pear budgets. Establishment costs are amortized over 7 years, which is roughly the average productive life of hay stands in the area (Mallon, 2019). We adjusted this cost by the general Farm Sector PPI and used a 2.75 percent interest rate. For the hay budget under deficit irrigation (Table 20), we adjust some inputs to account for the reduction in costs associated with reductions in yield, including chemical treatments and fuel costs.

D.2.2.3 Labor Costs

Because most of the labor is provided by custom work, the only direct labor costs are for an agricultural equipment operator to move the center pivots. The per hour total labor costs for this equipment operator are the same as the per hour equipment operator costs presented in the pear budget ($18.13 per hour). We adjusted the cost of custom work using the Custom Work PPI. For the hay budget under deficit irrigation

(Table 20), we adjust the labor costs (including custom, management, and other labor) proportionally to the change in yield (e.g., if yield falls by 10 percent, the amount of labor also falls by 10 percent). To the extent that labor costs fall less than this, our results will under-estimate benefits (and vice versa).

D.2.2.4 Revenues

To estimate the gross revenues of grass hay, we use the average yield reported by an EFID board member: 4.5 tons per acre (Mallon, 2019). To estimate the gross revenues per ton, we use the normalized average price per ton for hay in Oregon reported by the Economic Research Service of the USDA in 2018 (Economic Research Service, 2018). For hay under deficit irrigation, we assume that the impact of losing 30 percent of their water would cause grass hay growers to forego their third and final cutting of the season, which has an average yield of roughly 1 ton per acre in EFID (Buckley, 2019b).

D.2.2.5 Grass Hay Enterprise Budget Tables

The tables below present the two grass hay enterprise budgets used to estimate the net returns to low-value crops in the District: one budget under full irrigation (Table 19), and one budget modeling returns under a 30 percent irrigation deficit (Table 20).

Table 19. Grass Hay Enterprise Budget Under Full Irrigation (Years 1 - 6).

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Grass Hay	4.5	ton	$209.63	$943.34
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.34	$0.00
Dry Phosphate	51.8	lb	$0.58	$29.94
Dry Potash	78.8	lb	$0.41	$32.40
Dry Sulfur	14.1	lb	$0.20	$2.75
Zinc	2.8	lb	$1.98	$5.58
Boron	1.1	lb	$4.47	$5.03
Custom Application	1.0	ac	$9.90	$9.90
Soil Test	1.0	ac	$0.33	$0.33
Herbicide	1.1	lb	$19.14	$21.53
Custom Application	1.0	ac	$9.90	$9.90
Custom - Swath	2.5	ac	$22.00	$55.00
Custom - Rake	2.5	ac	$11.00	$27.50
Custom - Bail	4.5	ton	$18.70	$84.15
Custom - Haul & Stack	4.5	ton	$9.90	$44.55
Custom - Tarping	4.5	ton	$5.50	$24.75
Irrigation - water charge	1.0	ac	$59.00	$59.00
Irrigation - service charge	1.0	ac	$17.50	$17.50
Irrigation - repairs	1.0	ac	$16.53	$16.53
Irrigation - labor	0.5	ac	$18.13	$9.06
Haystack insurance	4.5	ton	$2.20	$9.91
Gopher control	1.0	ac	$5.58	$5.58
Fuel	2.3	gal	$2.79	$6.37
Lubricants	1.0	ac	$0.89	$0.89
Machinery repairs	1.0	ac	$1.98	$1.98
Overhead	1.0	ac	$42.33	$42.33
Operating interest	1.0	ac	$13.74	$13.74
Total variable costs				$536.20
FIXED COSTS				
Machinery depreciation	1.0	ac	$6.31	$6.31
Machinery interest	1.0	ac	$3.68	$3.68
Machinery insurance, taxes, housing, license	1.0	ac	$2.62	$2.62
Management (5% of total cost)	1.0	ac	$36.98	$36.98
Establishment cost	1.0	Ac	$56.61	$56.61
Land cost	1.0	ac	$190.86	$190.86
Total fixed costs				$297.07
Total costs				$833.27
NET RETURNS PER ACRE				**$110.07**

Table 20. Grass Hay Enterprise Budget Under 30-Percent Irrigation Deficiency.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Grass Hay	3.5	ton	$209.63	$733.71
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.34	$0.00
Dry Phosphate	40.3	lb	$0.58	$23.29
Dry Potash	61.3	lb	$0.41	$25.20
Dry Sulfur	10.9	lb	$0.20	$2.14
Zinc	2.2	lb	$1.98	$4.34
Boron	0.9	lb	$4.47	$3.91
Custom Application	0.8	ac	$9.90	$7.70
Soil Test	1.0	ac	$0.33	$0.33
Herbicide	0.9	lb	$19.14	$16.75
Custom Application	0.8	ac	$9.90	$7.70
Custom - Swath	1.5	ac	$22.00	$33.00
Custom - Rake	1.5	ac	$11.00	$16.50
Custom - Bail	3.5	ton	$18.70	$65.45
Custom - Haul & Stack	3.5	ton	$9.90	$34.65
Custom - Tarping	3.5	ton	$5.50	$19.25
Irrigation - water charge	1.0	ac	$59.00	$59.00
Irrigation - service charge	1.0	ac	$17.50	$17.50
Irrigation - repairs	0.8	ac	$16.53	$12.85
Irrigation - labor	0.4	ac	$18.13	$7.05
Haystack insurance	3.5	ton	$2.20	$7.71
Gopher control	1.0	ac	$5.58	$5.58
Fuel	1.8	gal	$2.79	$4.95
Lubricants	1.0	ac	$0.89	$0.89
Machinery repairs	1.0	ac	$1.98	$1.98
Overhead	1.0	ac	$42.33	$42.33
Operating interest	1.0	ac	$13.74	$13.74
Total variable costs				$433.79
FIXED COSTS				
Machinery depreciation	1.0	ac	$6.31	$6.31
Machinery interest	1.0	ac	$3.68	$3.68
Machinery insurance, taxes, housing, license	1.0	ac	$2.62	$2.62
Management (5% of total cost)	1.0	ac	$34.69	$34.69
Establishment cost	1.0	ac	$56.61	$56.61
Land cost	1.0	ac	$190.86	$190.86
Total fixed costs				$294.78
Total costs				$728.57
NET RETURNS PER ACRE				**$5.14**

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D.3 Alternatives Considered During Formulation

This appendix section presents the alternatives considered in the formulation phase.

During the formulation phase, alternatives were evaluated based on meeting both National Environmental Policy Act and environmental review requirements specific to NRCS federal investments in water resources projects (Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies [PR&G]) (Table 21). According to the National Environmental Policy Act, "agencies shall rigorously explore and objectively evaluate all reasonable alternatives" (40 Code of Federal Regulations 1502.14). According to the PR&G, alternatives should reflect a range of scales and management measures and be evaluated against the Federal Objective and Guiding Principles; against the extent to which they address the problems and opportunities identified in the purpose and need; and against the criteria of completeness, effectiveness, efficiency, and acceptability:

1. Completeness is the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.
2. Effectiveness is the extent to which an alternative alleviates the specified problems and achieves the specified opportunities.
3. Efficiency is the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost.
4. Acceptability is the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency.

Alternatives eliminated during formulation are discussed below the table. Alternatives selected for further evaluation are discussed in the Plan-EA.

Table 21. Alternatives Considered During the Formulation Phase.

Alternative	Which criteria in the PR&G does the alternative achieve?				Selected for Further Evaluation
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
Pipeline Realignment	X	X			
Conversion to Dryland Farming			X		
Fallowing Farm Fields			X		
Market Based Approaches to include Voluntary Duty Reduction					
Partial Use of Groundwater					
Water Towers					

Alternative	Which criteria in the PR&G does the alternative achieve?				Selected for Further Evaluation
	Completeness	Effectiveness	Efficiency	Acceptability	
Rainwater					
Mix of Open Canal and Pipe	X			X	
Piping Alternative, with open Main Canal upstream of Hanel Mill	X			X	
On-Farm Efficiency Upgrades		X		X	X
Canal Lining	X	X		X	X
Piping District Infrastructure with Steel	X	X		X	X
Piping District Infrastructure with Polyvinyl Chloride (PVC)	X	X	X	X	X
No Action (Future without Project)			X		X
Piping Alternative	X	X	X	X	X

D.3.1 Pipeline Realignment

Pipeline realignment would convert the District's system to pipes. However, in some places, instead of following the same path as the existing canals and laterals, the pipes would be laid in a new alignment (or path across the landscape). New alignments would be selected to serve all patrons, but would take a more direct route to decrease the piping length needed where possible. Approximately 91 percent of land within the District is privately owned. Realignment would involve acquiring new easements across these private lands. Depending on the proposed alignment, a right-of-way across public land could potentially be necessary.

New easements would disrupt prime farmland and residential living areas, and the easements would be difficult to secure from enough landowners to be feasible. Pipeline realignment outside the existing easements would require EFID to pay market price for the easements and negotiate with many landowners, which would be a complex, expensive, and time-consuming process. Pipeline realignment was eliminated from further evaluation due to its lack of efficiency arising from high legal costs; its low acceptability, particularly with private landowners; and because it would not achieve the Federal Objective and Guiding Principles.

D.3.2 Conversion to Dryland Farming

Dryland farming is a non-structural alternative. This method of farming uses no irrigation and drought-resistant crops and practices to conserve moisture. Since fruit trees, which make up 75 percent of the irrigated acres in the District, can sustain long-term damage if they are not watered sufficiently each summer, dryland farming would not be effective in the District.

Conversion to dryland farming was eliminated from further evaluation because it would not meet the project purpose and need; its effectiveness would be uncertain since conversion to dryland farming would be voluntary and only successful for a limited number of irrigated acres in the District; it would not be acceptable because it is inconsistent with public policy supporting and maintaining existing agricultural land use; and because it would not achieve the Federal Objective and Guiding Principles.

D.3.3 Fallowing Farm Fields

Fallowing farm fields is a non-structural alternative that includes permanently transferring or temporarily leasing water rights from irrigated lands or otherwise not using water rights appurtenant to irrigated lands. Fallowing farm fields would use less irrigation water within the District and would therefore allow more water to be kept instream for fish, wildlife, and habitat. This water would be legally protected instream if the associated water rights were leased or transferred instream.

Fruit trees, which comprise 75 percent of the irrigated acres in EFID, can sustain long-term damage if they are not watered sufficiently. This precludes fallowing these crops during dry years. A portion of the remaining irrigated acres in the District, particularly annual crops like pasture, may be fallowed successfully.

Fallowing farm fields was eliminated from further evaluation because: it would not meet the project purpose and need; its effectiveness would be uncertain since fallowing fields would be voluntary and only successful for a limited number of irrigated acres in the District; it would not be acceptable because it is inconsistent with public policy supporting and maintaining existing agricultural land use; and because it would not achieve the Federal Objective and Guiding Principles.

D.3.4 Market-Based Approaches to include Voluntary Duty Reduction

Market-based approaches for the purpose of this analysis refer to patrons voluntarily accepting less than their full water delivery rate from the District, or patrons transferring water rights from the farm to the river temporarily or permanently. Although the District permanently dedicating water for instream use is part of the proposed action, it utilizes the District's established authorities and is not a part of the following discussion.

Market-based incentives as a stand-alone alternative do not address the underlying purpose and need of the project. Incorporating market-based solutions into the proposed action without corresponding regulatory and policy changes, which would be required to provide the District with the authority to carry out the transfer of patron water rights instream, is not ripe for consideration as an alternative at this time. Without a change in the framework of current lawful authorities on the part of the District, incorporating market-based incentives into the proposed action is not within the District's ability or capacity to undertake, nor is it logistically or technically feasible.

For example, a reduction in duty by a patron could mean the District diverts less water, which would leave more water instream. However, because the District is obligated to provide a certain amount of water to patrons to meet associated water rights, this alternative would be voluntary and at the discretion of individual landowners. For this reason, the District would not be able to provide certainty that water would be saved, and that streamflow would be restored. Furthermore, in addition to EFID lacking the statutory authority or responsibility to carry out, operate, and maintain voluntary duty reduction by its patrons, doing so could create a logistically complex situation for EFID to implement. Because the system has open canals, subject to certain operating inefficiencies, the District would still have to divert enough water, accounting for end spills and seepage, to ensure those deliveries. Therefore, carrying out this alternative would be both logistically complex and technically infeasible

Market-based incentives were eliminated from further evaluation because they would not meet the project purpose; effectiveness would be uncertain since reducing duty would be a voluntary and individual decision by each patron; the District lacks the ability to carry out patron duty reductions; it would not achieve the Federal Objective and Guiding Principles; and given the current water delivery technology it is technically infeasible by the District to accomplish.

D.3.5 Partial Use of Groundwater

The conversion from surface water sourced to groundwater sourced irrigation, for some of the District, was also initially considered as a possible alternative. The use of groundwater for irrigation would have logistical and legal constraints. The District would need the authority from each patron to convert surface rights to groundwater rights; there would be no guarantee of gaining this approval from patrons. Converting from surface water rights to groundwater rights would also affect the seniority and, therefore, the reliability of the District's water rights. The District currently has senior surface water rights that minimize the chance of being impacted during drought years; however, new groundwater rights would be junior (dated the year of the application and construction) and could be subject to curtailment.

The partial use of groundwater was eliminated from further evaluation because it would not meet the project purpose and need; its effectiveness would be uncertain since conversion to groundwater would be voluntary; there are inefficiencies associated with logistical and legal constraints obtaining groundwater rights; it would not be acceptable since converting to groundwater rights would result in junior water rights; and it would not achieve the Federal Objective and Guiding Principles.

D.3.6 Water Tower

A water tower alternative would include the installation of water towers throughout the District. For this alternative, the District's canals would remain open to transport water to the water towers. Therefore, this alternative would not meet the purpose and need of the project for the same reasons the No Action alternative does not meet the purpose and need of the project.

Since new land would be needed to locate the water towers and approximately 91 percent of land within the District is privately owned, installing water towers would require the District to acquire new easements across private lands. EFID would have to pay market price for the easements and negotiate with landowners, which would be a complex, expensive, and time-consuming process. Pressurization could be obtained from the water towers; however, the District would incur a significant O&M cost to pump water up to the towers. Due to the abundance of small sediment particle sizes and limited retention time in water towers, chemical treatment or additional pressure for filtration could be needed to effectively settle sediment.

A water tower alternative was eliminated from further evaluation because it would not meet the purpose and need of the project, would not be effective, would not be efficient arising from high legal costs, and would not achieve the Federal Objective and Guiding Principles.

D.3.7 Rainwater

For a rainwater alternative, the District would capture rainwater to supplement irrigation water diverted from the East Fork Hood River. The District could not capture rainwater for irrigation water supply under its existing water rights, which are limited to diversion from the East Fork Hood River. State law allows individual landowners to collect and use rainwater from impervious surfaces without obtaining a water right (Oregon Revised Statute 537.141). However, patrons collecting rainwater to supplement irrigation water would not be an effective alternative for the District because participation would be voluntary, and the District would need to maintain its open canal system. A rainwater alternative was eliminated from further evaluation because it would not meet the purpose and need of the project, would not be effective, would not be acceptable since the District cannot capture rainwater under its water right, and would not achieve the Federal Objective and Guiding Principles.

D.3.8 Mix of Open Canal and Pipe

Under this alternative, the District would pipe sections of its canals and laterals and leave sections of canal open throughout the District. Portions of the District's conveyance system would operate as an open channel system rather than a pressurized system under this alternative. The District would continue to divert and convey more water than its patrons apply in order to maintain water deliveries, end spills would continue to be required, and water would not be conserved. The project would not address instream flow, aquatic habitat, or water quality problems and opportunities.

The open canal and lateral sections would not provide pressurization benefits for patrons on those sections, and they would limit pressurization benefits for patrons elsewhere in the system. The District would continue to incur O&M costs associated with maintaining open canals and laterals. Lastly, public safety risks would remain along the sections of open canal. A mix of open canal and pipe was eliminated from further evaluation because it would not meet the purpose and need of the project, would not be effective, and would not achieve the Federal Objective and Guiding Principles.

D.3.9 Piping Alternative with Open Canal Upstream of Hanel Mill

This alternative would be the same as the Preferred Alternative except the entire 7 miles of the Main Canal, from the District's fish screen to Hanel Mill, would remain open.

Under this alternative, the District would continue to divert approximately 4.6 cfs more water than is directly used by patrons on the seven-mile Main Canal for irrigation. This would be necessary to ensure that these patrons receive the amount of water that they need when they need it.

When a piped and pressurized conveyance system starts at a diversion on a river, any water not taken by patrons never gets diverted into the system and remains in the river. When a piped and pressurized conveyance system starts along a canal, such as in the alternative described in this comment, any water not taken by patrons never gets diverted into the pipeline and remains in the canal. A decrease in water demand along such a pipeline would likely cause water to back up at the head of the pipe and into the canal. This water would be in addition to the 4.6 cfs of water described above.

To avoid flooding at the head of the piped and pressurized conveyance system at Hanel Mill, the District would need to either continue to spill excess water at the head of the piped system; build and maintain a regulating reservoir (including obtaining property to locate the reservoir) at head of the system; increase pipe sizes and spill excess water at the bottom of the piped system; and/or install other technology to regulate irrigation water flows.

Continuing to spill excess water at either the head or tail-end of the system would not contribute to addressing instream flow, aquatic habitat, and water quality problems and opportunities in the Hood River and its tributaries. Purchasing or condemning private land, which includes residential, agricultural, commercial, and industrial uses, to site a reservoir at this location may not be acceptable because it is inconsistent with public policy supporting and maintaining existing agricultural land use.

As compared to the Preferred Alternative, leaving the Main Canal open to Hanel Mill would result in less water conservation; a smaller decrease in District O&M costs associated with dredging the open canal and eliminating debris; no pressurization benefits for patrons along the Main Canal; and decreased pressurization benefits for patrons along the piped and pressurized system. The public safety risks and District liability would also remain high along the open Main Canal because there are many residences and orchards near the Main Canal. If a reservoir was installed, public safety risks would also increase adjacent to the reservoir due to the possibility of flooding.

Leaving the Main Canal to Hanel Mill open was eliminated from further evaluation because it would not be effective and/or would not be acceptable.

D.4 Capital Costs for the Preferred Alternative

This section presents capital costs for the Preferred Alternative, the Piping Alternative, as identified in the EFID SIP (2018$). Based on input from EFID, the total length of piping in Project Group 1 was decreased from the SIP and the costs for Project Group 1 were updated accordingly. Project costs in the Plan-EA were updated to 2019$.

Table 22. Capital Costs Summary for the Preferred Alternative, the Piping Alternative (2018$).[1]

Item	Construction Cost	ECMS[2]	CMGC[3]	Contingency	Total Cost
Project Group 1					
Pipe	$7,545,000	$602,000	$754,000	$1,780,000	$10,681,000
Turnout	$696,000	$1,000	$1,000	$2,000	$700,000
PRV Station	$805,000	$0	$0	$0	$805,000
Project Group 1 Subtotal:	*$9,046,000*	*$603,000*	*$755,000*	*$1,782,000*	*$12,186,000*
Project Group 2					
Pipe	$18,810,000	$1,882,000	$2,633,000	$6,996,000	$30,321,000
Turnout	$1,264,000	$127,000	$178,000	$470,000	$2,039,000
PRV Station	$1,420,000	$145,000	$201,000	$529,000	$2,295,000
Project Group 2 Subtotal:	*$21,494,000*	*$2,154,000*	*$3,012,000*	*$7,995,000*	*$34,655,000*
Project Group 3					
Pipe	$5,009,000	$500,000	$701,000	$1,863,000	$8,073,000
Turnout	$1,120,000	$111,000	$157,000	$417,000	$1,805,000
PRV Station	$2,175,000	$221,000	$307,000	$810,000	$3,513,000
Project Group 3 Subtotal:	*$8,304,000*	*$832,000*	*$1,165,000*	*$3,090,000*	*$13,391,000*
Total Piping:	$31,364,000	$2,984,000	$4,088,000	$10,639,000	$49,075,000
Total Turnouts:	$3,080,000	$239,000	$336,000	$889,000	$4,544,000
Total PRV Station:	$4,400,000	$366,000	$508,000	$1,339,000	$6,613,000
Total Overall Costs:	**$38,844,000**	**$3,589,000**	**$4,932,000**	**$12,867,000**	**$60,232,000**

Note: These costs are from the SIP (2018$).
[1] Total costs in the Plan-EA are higher than the table above due to being updated to 2019$, shortening the length of pipe in Project Group 1, and an additional $767,000 in Project Group 2 for installation of the sedimentation basin.
[2] Engineering, Construction Management, Survey
[3] Construction Management General Contractor

Table 23. Detailed Capital Costs for the Preferred Alternative, the Piping Alternative (2018$).[1]

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Project Group 1										
Eastside Canal	Pipe	18	21	302	feet	$19,205	$1,536	$1,921	$4,532	$27,194
Eastside Canal	Pipe	20	21	130	feet	$8,294	$663	$829	$1,957	$11,744
Eastside Canal	Pipe	20	26	452	feet	$23,438	$1,875	$2,344	$5,531	$33,188
Eastside Canal	Pipe	24	21	2,456	feet	$156,151	$12,492	$15,615	$36,852	$221,110
Eastside Canal	Pipe	26	21	784	feet	$49,846	$3,988	$4,985	$11,764	$70,582
Eastside Canal	Pipe	26	26	396	feet	$34,748	$2,780	$3,475	$8,201	$49,204
Eastside Canal	Pipe	28	26	3,274	feet	$333,104	$26,648	$33,310	$78,613	$471,675
Eastside Canal	Pipe	36	26	3,376	feet	$567,827	$45,426	$56,783	$134,007	$804,044
Eastside Canal	Pipe	42	26	20,922	feet	$4,787,066	$382,965	$478,707	$1,129,748	$6,778,486
Eastside Canal	Turnout	N/A	N/A	39	each	$312,000	$800	$1,120	$2,480	$316,400
Crag Rate Pipeline	Pipe	4	17	1,816	feet	$7,151	$572	$715	$1,688	$10,126
Crag Rate Pipeline	Pipe	4	21	1,823	feet	$115,909	$9,273	$11,591	$27,355	$164,127
Crag Rate Pipeline	Pipe	4	26	1,275	feet	$3,336	$267	$334	$787	$4,724
Crag Rate Pipeline	Pipe	4	32.5	54	feet	$113	$9	$11	$27	$161
Crag Rate Pipeline	Pipe	6	11	2,092	feet	$26,518	$2,121	$2,652	$6,258	$37,549

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Crag Rate Pipeline	Pipe	6	26	1,248	feet	$7,098	$568	$710	$1,675	$10,051
Crag Rate Pipeline	Pipe	8	21	7	feet	$416	$33	$42	$98	$590
Crag Rate Pipeline	Turnout	N/A	N/A	9	each	$72,000	$0	$0	$0	$72,000
Crag Rate Pipeline	PRV Station	4	N/A	2	each	$60,000	$0	$0	$0	$60,000
Crag Rate Pipeline	PRV Station	6	N/A	1	each	$30,000	$0	$0	$0	$30,000
Dethman/Swyers Line	PRV Station	10	N/A	1	each	$45,000	$0	$0	$0	$45,000
Whiskey Creek Pipeline	Pipe	4	21	1,284	feet	$81,644	$6,532	$8,164	$19,268	$115,608
Whiskey Creek Pipeline	Pipe	4	26	703	feet	$1,838	$147	$184	$434	$2,603
Whiskey Creek Pipeline	Pipe	4	32.5	14	feet	$30	$2	$3	$7	$42
Whiskey Creek Pipeline	Pipe	5.375	19	923	feet	$4,664	$373	$466	$1,101	$6,604
Whiskey Creek Pipeline	Pipe	6	11	1,144	feet	$14,506	$1,160	$1,451	$3,423	$20,540
Whiskey Creek Pipeline	Pipe	6	32.5	1,538	feet	$7,072	$566	$707	$1,669	$10,014
Whiskey Creek Pipeline	Pipe	8	21	3,359	feet	$213,530	$17,082	$21,353	$50,393	$302,358
Whiskey Creek Pipeline	Pipe	8	26	1,469	feet	$14,174	$1,134	$1,417	$3,345	$20,071
Whiskey Creek Pipeline	Pipe	8	32.5	2,025	feet	$15,742	$1,259	$1,574	$3,715	$22,290
Whiskey Creek Pipeline	Pipe	10	26	765	feet	$11,459	$917	$1,146	$2,704	$16,225
Whiskey Creek Pipeline	Pipe	10	32.5	77	feet	$927	$74	$93	$219	$1,313

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Whiskey Creek Pipeline	Pipe	12	13.5	771	feet	$30,087	$2,407	$3,009	$7,100	$42,603
Whiskey Creek Pipeline	Pipe	12	19	534	feet	$15,174	$1,214	$1,517	$3,581	$21,486
Whiskey Creek Pipeline	Pipe	12	21	1,384	feet	$87,964	$7,037	$8,796	$20,760	$124,557
Whiskey Creek Pipeline	Pipe	14	21	388	feet	$24,640	$1,971	$2,464	$5,815	$34,891
Whiskey Creek Pipeline	Pipe	16	15.5	4,202	feet	$227,353	$18,188	$22,735	$53,655	$321,932
Whiskey Creek Pipeline	Pipe	16	21	2,120	feet	$134,764	$10,781	$13,476	$31,804	$190,826
Whiskey Creek Pipeline	Pipe	20	13.5	286	feet	$27,420	$2,194	$2,742	$6,471	$38,826
Whiskey Creek Pipeline	Turnout	N/A	N/A	17	each	$136,000	$0	$0	$0	$136,000
Whiskey Creek Pipeline	PRV Station	4	N/A	2	each	$60,000	$0	$0	$0	$60,000
Whiskey Creek Pipeline	PRV Station	6	N/A	2	each	$60,000	$0	$0	$0	$60,000
Whiskey Creek Pipeline	PRV Station	12	N/A	1	each	$45,000	$0	$0	$0	$45,000
Whiskey Creek Pipeline	PRV Station	14	N/A	1	each	$40,000	$0	$0	$0	$40,000
Kelly Pipeline	Pipe	4	26	1,476	feet	$3,862	$309	$386	$911	$5,468
Kelly Pipeline	Pipe	4	32.5	1	feet	$3	$0	$0	$1	$4
Kelly Pipeline	Pipe	5.375	11	1,530	feet	$12,784	$1,023	$1,278	$3,017	$18,102
Kelly Pipeline	Turnout	N/A	N/A	1	each	$8,000	$0	$0	$0	$8,000
Kelly Pipeline	PRV Station	4	N/A	1	each	$30,000	$0	$0	$0	$30,000

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Loop Pipeline	PRV Station	10	N/A	1	each	$30,000	$0	$0	$0	$30,000
Loop Pipeline	PRV Station	16	N/A	1	each	$55,000	$0	$0	$0	$55,000
Lower Highline Pressure Pipeline	Pipe	4	15.5	0	feet	$0	$0	$0	$0	$0
Lower Highline Pressure Pipeline	Pipe	4	17	1,039	feet	$4,090	$327	$409	$965	$5,792
Lower Highline Pressure Pipeline	Pipe	4	21	2,334	feet	$148,361	$11,869	$14,836	$35,013	$210,080
Lower Highline Pressure Pipeline	Pipe	4	26	1,861	feet	$4,869	$390	$487	$1,149	$6,895
Lower Highline Pressure Pipeline	Pipe	4	32.5	2,105	feet	$4,438	$355	$444	$1,047	$6,284
Lower Highline Pressure Pipeline	Pipe	5.375	15.5	440	feet	$2,682	$215	$268	$633	$3,798
Lower Highline Pressure Pipeline	Pipe	6	21	33	feet	$2,068	$165	$207	$488	$2,928
Lower Highline Pressure Pipeline	Pipe	6	26	2,291	feet	$13,037	$1,043	$1,304	$3,077	$18,460
Lower Highline Pressure Pipeline	Pipe	6	32.5	2	feet	$8	$1	$1	$2	$11
Lower Highline Pressure Pipeline	Pipe	8	32.5	102	feet	$794	$63	$79	$187	$1,124
Lower Highline Pressure Pipeline	Turnout	N/A	N/A	16	each	$128,000	$0	$0	$0	$128,000
Lower Highline Pressure Pipeline	PRV Station	4	N/A	3	each	$90,000	$0	$0	$0	$90,000
Lower Highline Pressure Pipeline	PRV Station	6	N/A	2	each	$60,000	$0	$0	$0	$60,000
Lower Highline Pressure Pipeline	PRV Station	8	N/A	1	each	$40,000	$0	$0	$0	$40,000
Paasch Pipeline	Pipe	10	13.5	1,078	feet	$29,906	$2,392	$2,991	$7,058	$42,347

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Paasch Pipeline	PRV Station	10	N/A	1	each	$40,000	$0	$0	$0	$40,000
Rasmussen Pipeline	PRV Station	12	N/A	1	each	$45,000	$0	$0	$0	$45,000
Tallman Pipeline	PRV Station	4	N/A	1	each	$30,000	$0	$0	$0	$30,000
Thomsen Pipeline	Pipe	4	21	1,183	feet	$75,193	$6,015	$7,519	$17,746	$106,474
Thomsen Pipeline	Pipe	4	32.5	0	feet	$1	$0	$0	$0	$1
Thomsen Pipeline	Pipe	5.375	21	2,963	feet	$188,395	$15,072	$18,840	$44,461	$266,768
Thomsen Pipeline	Pipe	8	32.5	3	feet	$21	$2	$2	$5	$30
Thomsen Pipeline	Pipe	10	32.5	1	feet	$12	$1	$1	$3	$17
Thomsen Pipeline	Turnout	N/A	N/A	5	each	$40,000	$0	$0	$0	$40,000
Thomsen Pipeline	PRV Station	10	N/A	1	each	$45,000	$0	$0	$0	$45,000
Project Group 2										
Main Canal	Pipe	66	N/A	38	feet	$20,945	$2,094	$2,932	$7,791	$33,763
Main Canal	Pipe	54	26	4,074	feet	$1,541,366	$154,137	$215,791	$573,388	$2,484,683
Main Canal	Pipe	54	41	36,434	feet	$8,876,697	$887,670	$1,242,738	$3,302,131	$14,309,236
Main Canal	Pipe	48	26	1,257	feet	$375,658	$37,566	$52,592	$139,745	$605,560
Main Canal	Pipe	48	41	24,809	feet	$4,775,854	$477,585	$668,620	$1,776,618	$7,698,676
Main Canal	Turnout	N/A	N/A	49	each	$392,000	$39,200	$54,880	$145,824	$631,904

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Main Canal	PRV Station	66	N/A	1	each	$280,000	$28,000	$39,200	$104,160	$451,360
Arens Lateral Pipeline	Pipe	4	32.5	0	feet	$0	$0	$0	$0	$0
Arens Lateral Pipeline	Pipe	6	32.5	1,334	feet	$6,135	$613	$859	$2,282	$9,889
Arens Lateral Pipeline	Turnout	N/A	N/A	2	each	$16,000	$1,600	$2,240	$5,952	$25,792
Bowcut Pipeline	Pipe	4	26	1	feet	$2	$0	$0	$1	$4
Bowcut Pipeline	Pipe	4	32.5	337	feet	$711	$71	$99	$264	$1,146
Bowcut Pipeline	Pipe	6	26	1,553	feet	$8,834	$883	$1,237	$3,286	$14,240
Bowcut Pipeline	Pipe	6	32.5	4,524	feet	$20,800	$2,080	$2,912	$7,737	$33,529
Bowcut Pipeline	Turnout	N/A	N/A	16	each	$128,000	$12,800	$17,920	$47,616	$206,336
Christopher Pipeline	PRV Station	12	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Fisher Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Dukes Valley Canal	Pipe	30	21	2,480	feet	$157,651	$15,765	$22,071	$58,646	$254,134
Dukes Valley Canal	Pipe	32	21	13,166	feet	$837,030	$83,703	$117,184	$311,375	$1,349,293
Dukes Valley Canal	Pipe	32	26	1,327	feet	$176,368	$17,637	$24,692	$65,609	$284,306
Dukes Valley Canal	Pipe	32	32.5	1,499	feet	$160,740	$16,074	$22,504	$59,795	$259,113
Dukes Valley Canal	Pipe	34	17	1,637	feet	$367,025	$36,702	$51,383	$136,533	$591,644
Dukes Valley Canal	Pipe	34	21	6,430	feet	$408,813	$40,881	$57,234	$152,079	$659,007

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Dukes Valley Canal	Turnout	N/A	N/A	22	each	$176,000	$17,600	$24,640	$65,472	$283,712
Dukes Valley Canal	PRV Station	16	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Dukes Valley Canal	PRV Station	30	N/A	1	each	$140,000	$14,000	$19,600	$52,080	$225,680
Cameron Hill Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Cameron Hill Pipeline	PRV Station	6	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Cameron Hill Pipeline	PRV Station	10	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Marsh/Chamberlin Pipeline	Pipe	4	21	5,367	feet	$341,199	$34,120	$47,768	$126,926	$550,013
Marsh/Chamberlin Pipeline	Pipe	4	26	6,178	feet	$16,164	$1,616	$2,263	$6,013	$26,057
Marsh/Chamberlin Pipeline	Pipe	4	32.5	2,085	feet	$4,396	$440	$615	$1,635	$7,087
Marsh/Chamberlin Pipeline	Pipe	5.375	32.5	27	feet	$81	$8	$11	$30	$130
Marsh/Chamberlin Pipeline	Pipe	6	17	688	feet	$5,851	$585	$819	$2,177	$9,433
Marsh/Chamberlin Pipeline	Pipe	6	21	5	feet	$342	$34	$48	$127	$551
Marsh/Chamberlin Pipeline	Pipe	6	26	2,807	feet	$15,972	$1,597	$2,236	$5,942	$25,747
Marsh/Chamberlin Pipeline	Pipe	6	32.5	1,853	feet	$8,518	$852	$1,193	$3,169	$13,732
Marsh/Chamberlin Pipeline	Pipe	8	26	1,516	feet	$14,628	$1,463	$2,048	$5,442	$23,580
Marsh/Chamberlin Pipeline	Pipe	8	32.5	2,583	feet	$20,075	$2,007	$2,810	$7,468	$32,360
Marsh/Chamberlin Pipeline	Pipe	10	21	1,962	feet	$124,747	$12,475	$17,465	$46,406	$201,092

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Marsh/Chamberlin Pipeline	Pipe	10	32.5	58	feet	$706	$71	$99	$262	$1,137
Marsh/Chamberlin Pipeline	Pipe	12	26	628	feet	$13,233	$1,323	$1,853	$4,923	$21,331
Marsh/Chamberlin Pipeline	Pipe	12	32.5	626	feet	$10,645	$1,065	$1,490	$3,960	$17,160
Marsh/Chamberlin Pipeline	Pipe	14	32.5	39	feet	$790	$79	$111	$294	$1,274
Marsh/Chamberlin Pipeline	Pipe	16	21	894	feet	$56,866	$5,687	$7,961	$21,154	$91,669
Marsh/Chamberlin Pipeline	Pipe	16	32.5	1,300	feet	$34,816	$3,482	$4,874	$12,952	$56,124
Marsh/Chamberlin Pipeline	Pipe	18	21	2,121	feet	$134,864	$13,486	$18,881	$50,169	$217,400
Marsh/Chamberlin Pipeline	Pipe	24	21	498	feet	$31,639	$3,164	$4,430	$11,770	$51,003
Marsh/Chamberlin Pipeline	Pipe	24	26	849	feet	$63,418	$6,342	$8,878	$23,591	$102,229
Marsh/Chamberlin Pipeline	Pipe	24	32.5	392	feet	$23,646	$2,365	$3,311	$8,796	$38,118
Marsh/Chamberlin Pipeline	Pipe	26	21	1,828	feet	$116,198	$11,620	$16,268	$43,226	$187,312
Marsh/Chamberlin Pipeline	Turnout	N/A	N/A	63	each	$504,000	$50,400	$70,560	$187,488	$812,448
Marsh/Chamberlin Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Marsh/Chamberlin Pipeline	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Marsh/Chamberlin Pipeline	PRV Station	16	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Marsh/Chamberlin Pipeline	PRV Station	22	N/A	1	each	$100,000	$10,000	$14,000	$37,200	$161,200
Shute Road Pipeline	PRV Station	6	N/A	2	each	$150,000	$15,000	$21,000	$55,800	$241,800

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Sheirbon Hill Pipeline	Pipe	4	26	349	feet	$913	$91	$128	$340	$1,472
Sheirbon Hill Pipeline	Pipe	6	26	1,874	feet	$10,659	$1,066	$1,492	$3,965	$17,183
Sheirbon Hill Pipeline	Pipe	8	13.5	815	feet	$14,549	$1,455	$2,037	$5,412	$23,453
Sheirbon Hill Pipeline	Pipe	8	21	5	feet	$342	$34	$48	$127	$551
Sheirbon Hill Pipeline	Pipe	8	26	856	feet	$8,267	$827	$1,157	$3,075	$13,326
Sheirbon Hill Pipeline	Pipe	8	32.5	161	feet	$1,248	$125	$175	$464	$2,012
Sheirbon Hill Pipeline	Turnout	N/A	N/A	6	each	$48,000	$4,800	$6,720	$17,856	$77,376
Sheirbon Hill Pipeline	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Project Group 3										
Central Lateral Pipeline	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Central Lateral Pipeline	PRV Station	30	N/A	3	each	$420,000	$42,000	$58,800	$156,240	$677,040
Allison Pipeline	Pipe	4	26	127	feet	$331	$33	$46	$123	$534
Allison Pipeline	Pipe	6	26	1,575	feet	$8,962	$896	$1,255	$3,334	$14,446
Allison Pipeline	Pipe	6	32.5	5	feet	$23	$2	$3	$9	$37
Allison Pipeline	Pipe	8	32.5	340	feet	$2,641	$264	$370	$983	$4,258
Allison Pipeline	Pipe	10	21	2,460	feet	$156,369	$15,637	$21,892	$58,169	$252,068
Allison Pipeline	Pipe	10	32.5	465	feet	$5,637	$564	$789	$2,097	$9,086

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Allison Pipeline	Turnout	N/A	N/A	8	each	$64,000	$6,400	$8,960	$23,808	$103,168
Allison Pipeline	PRV Station	10	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Dethman Ridge Line	Pipe	4	21	5,242	feet	$333,270	$33,327	$46,658	$123,977	$537,232
Dethman Ridge Line	Pipe	4	26	3,756	feet	$9,827	$983	$1,376	$3,656	$15,841
Dethman Ridge Line	Pipe	4	32.5	2,065	feet	$4,352	$435	$609	$1,619	$7,016
Dethman Ridge Line	Pipe	5.375	26	261	feet	$980	$98	$137	$365	$1,580
Dethman Ridge Line	Pipe	6	19	1,659	feet	$12,725	$1,273	$1,782	$4,734	$20,513
Dethman Ridge Line	Pipe	6	21	5,038	feet	$320,324	$32,032	$44,845	$119,160	$516,362
Dethman Ridge Line	Pipe	6	26	1,571	feet	$8,941	$894	$1,252	$3,326	$14,413
Dethman Ridge Line	Pipe	6	32.5	3,815	feet	$17,540	$1,754	$2,456	$6,525	$28,275
Dethman Ridge Line	Pipe	8	19	2,966	feet	$38,578	$3,858	$5,401	$14,351	$62,188
Dethman Ridge Line	Pipe	8	21	1,527	feet	$97,049	$9,705	$13,587	$36,102	$156,443
Dethman Ridge Line	Pipe	8	26	148	feet	$1,432	$143	$201	$533	$2,309
Dethman Ridge Line	Pipe	8	32.5	548	feet	$4,259	$426	$596	$1,584	$6,866
Dethman Ridge Line	Pipe	10	21	723	feet	$45,989	$4,599	$6,438	$17,108	$74,134
Dethman Ridge Line	Pipe	10	26	70	feet	$1,045	$104	$146	$389	$1,684
Dethman Ridge Line	Pipe	10	32.5	2,701	feet	$32,724	$3,272	$4,581	$12,173	$52,751

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Dethman Ridge Line	Pipe	12	26	1,227	feet	$25,868	$2,587	$3,621	$9,623	$41,699
Dethman Ridge Line	Pipe	12	32.5	70	feet	$1,194	$119	$167	$444	$1,925
Dethman Ridge Line	Pipe	14	26	525	feet	$13,342	$1,334	$1,868	$4,963	$21,507
Dethman Ridge Line	Pipe	14	32.5	2,064	feet	$42,353	$4,235	$5,929	$15,755	$68,273
Dethman Ridge Line	Pipe	16	26	643	feet	$21,341	$2,134	$2,988	$7,939	$34,401
Dethman Ridge Line	Pipe	16	32.5	4	feet	$102	$10	$14	$38	$164
Dethman Ridge Line	Pipe	24	26	1,014	feet	$75,742	$7,574	$10,604	$28,176	$122,097
Dethman Ridge Line	Pipe	24	32.5	2,687	feet	$161,863	$16,186	$22,661	$60,213	$260,924
Dethman Ridge Line	Pipe	26	32.5	230	feet	$16,260	$1,626	$2,276	$6,049	$26,210
Dethman Ridge Line	Pipe	28	32.5	923	feet	$75,798	$7,580	$10,612	$28,197	$122,187
Dethman Ridge Line	Pipe	30	21	2,984	feet	$189,685	$18,968	$26,556	$70,563	$305,772
Dethman Ridge Line	Pipe	30	32.5	337	feet	$31,768	$3,177	$4,448	$11,818	$51,210
Dethman Ridge Line	Pipe	34	11	0	feet	$37	$4	$5	$14	$59
Dethman Ridge Line	Turnout	N/A	N/A	74	each	$592,000	$59,200	$82,880	$220,224	$954,304
Dethman Ridge Line	PRV Station	6	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Dethman Ridge Line	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Dethman Ridge Line	PRV Station	12	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Dethman Ridge Line	PRV Station	24	N/A	1	each	$100,000	$10,000	$14,000	$37,200	$161,200
Oanna Pipeline	Pipe	4	19	541	feet	$1,910	$191	$267	$711	$3,080
Oanna Pipeline	Pipe	4	21	2,643	feet	$168,000	$16,800	$23,520	$62,496	$270,816
Oanna Pipeline	Pipe	4	32.5	490	feet	$1,033	$103	$145	$384	$1,666
Oanna Pipeline	Pipe	5.375	21	537	feet	$34,149	$3,415	$4,781	$12,704	$55,049
Oanna Pipeline	Pipe	6	17	1,719	feet	$14,630	$1,463	$2,048	$5,442	$23,584
Oanna Pipeline	Pipe	6	21	2,646	feet	$168,212	$16,821	$23,550	$62,575	$271,157
Oanna Pipeline	Pipe	6	26	1,932	feet	$10,992	$1,099	$1,539	$4,089	$17,719
Oanna Pipeline	Pipe	6	32.5	626	feet	$2,878	$288	$403	$1,071	$4,640
Oanna Pipeline	Pipe	8	19	288	feet	$3,749	$375	$525	$1,395	$6,043
Oanna Pipeline	Pipe	8	21	382	feet	$24,275	$2,428	$3,399	$9,030	$39,132
Oanna Pipeline	Pipe	8	26	4,323	feet	$41,729	$4,173	$5,842	$15,523	$67,267
Oanna Pipeline	Pipe	8	32.5	1,006	feet	$7,822	$782	$1,095	$2,910	$12,610
Oanna Pipeline	Pipe	10	11	1,384	feet	$46,201	$4,620	$6,468	$17,187	$74,476
Oanna Pipeline	Pipe	10	26	5	feet	$68	$7	$9	$25	$109
Oanna Pipeline	Pipe	30	32.5	2	feet	$175	$18	$25	$65	$282
Oanna Pipeline	Pipe	32	13.5	2,661	feet	$653,911	$65,391	$91,548	$243,255	$1,054,105

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Oanna Pipeline	Pipe	32	21	1,139	feet	$72,403	$7,240	$10,136	$26,934	$116,714
Oanna Pipeline	Pipe	32	32.5	3,310	feet	$354,907	$35,491	$49,687	$132,025	$572,110
Oanna Pipeline	Pipe	34	26	1,967	feet	$295,028	$29,503	$41,304	$109,750	$475,585
Oanna Pipeline	Pipe	34	32.5	0	feet	$1	$0	$0	$0	$2
Oanna Pipeline	Pipe	36	21	1,008	feet	$64,086	$6,409	$8,972	$23,840	$103,307
Oanna Pipeline	Turnout	N/A	N/A	28	each	$224,000	$22,400	$31,360	$83,328	$361,088
Oanna Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Oanna Pipeline	PRV Station	6	N/A	3	each	$225,000	$22,500	$31,500	$83,700	$362,700
Oanna Pipeline	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Oanna Pipeline	PRV Station	30	N/A	1	each	$140,000	$14,000	$19,600	$52,080	$225,680
Oanna Pipeline	PRV Station	32	N/A	1	each	$140,000	$14,000	$19,600	$52,080	$225,680
Chipping Pipeline	Pipe	4	17	653	feet	$2,572	$257	$360	$957	$4,145
Chipping Pipeline	Pipe	4	21	1,820	feet	$115,721	$11,572	$16,201	$43,048	$186,543
Chipping Pipeline	Pipe	4	26	521	feet	$1,363	$136	$191	$507	$2,197
Chipping Pipeline	Pipe	4	32.5	1,009	feet	$2,128	$213	$298	$792	$3,431
Chipping Pipeline	Pipe	5.375	13.5	1,111	feet	$7,707	$771	$1,079	$2,867	$12,423
Chipping Pipeline	Pipe	6	21	902	feet	$57,365	$5,736	$8,031	$21,340	$92,472

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Chipping Pipeline	Pipe	6	26	472	feet	$2,684	$268	$376	$999	$4,327
Chipping Pipeline	Pipe	6	32.5	2,422	feet	$11,133	$1,113	$1,559	$4,141	$17,946
Chipping Pipeline	Pipe	8	32.5	1,052	feet	$8,176	$818	$1,145	$3,042	$13,180
Chipping Pipeline	Pipe	10	19	339	feet	$6,852	$685	$959	$2,549	$11,046
Chipping Pipeline	Pipe	10	32.5	333	feet	$4,033	$403	$565	$1,500	$6,501
Chipping Pipeline	Pipe	12	21	1,542	feet	$98,048	$9,805	$13,727	$36,474	$158,053
Chipping Pipeline	Pipe	14	21	1,366	feet	$86,862	$8,686	$12,161	$32,313	$140,022
Chipping Pipeline	Pipe	14	26	1,376	feet	$34,947	$3,495	$4,893	$13,000	$56,334
Chipping Pipeline	Pipe	18	26	1,156	feet	$48,585	$4,858	$6,802	$18,074	$78,319
Chipping Pipeline	Pipe	18	32.5	324	feet	$10,997	$1,100	$1,540	$4,091	$17,728
Chipping Pipeline	Pipe	20	26	596	feet	$30,904	$3,090	$4,327	$11,496	$49,817
Chipping Pipeline	Pipe	24	11	1,936	feet	$322,239	$32,224	$45,113	$119,873	$519,449
Chipping Pipeline	Pipe	24	15.5	1,148	feet	$139,707	$13,971	$19,559	$51,971	$225,207
Chipping Pipeline	Turnout	N/A	N/A	20	each	$160,000	$16,000	$22,400	$59,520	$257,920
Chipping Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Chipping Pipeline	PRV Station	10	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Chipping Pipeline	PRV Station	12	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Chipping Pipeline	PRV Station	18	N/A	1	each	$100,000	$10,000	$14,000	$37,200	$161,200
Gilkerson Pipeline	Pipe	4	11	1,307	feet	$7,633	$763	$1,069	$2,839	$12,304
Gilkerson Pipeline	Pipe	4	21	753	feet	$47,877	$4,788	$6,703	$17,810	$77,177
Gilkerson Pipeline	Pipe	6	21	2,089	feet	$132,821	$13,282	$18,595	$49,410	$214,108
Gilkerson Pipeline	Pipe	6	32.5	5	feet	$25	$2	$3	$9	$40
Gilkerson Pipeline	Turnout	N/A	N/A	5	each	$40,000	$4,000	$5,600	$14,880	$64,480
Gilkerson Pipeline	PRV Station	4	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Winklebleck Pipeline	Pipe	4	21	943	feet	$59,965	$5,997	$8,395	$22,307	$96,664
Winklebleck Pipeline	Pipe	4	32.5	246	feet	$518	$52	$72	$193	$834
Winklebleck Pipeline	Pipe	6	19	324	feet	$2,485	$248	$348	$924	$4,006
Winklebleck Pipeline	Pipe	6	26	473	feet	$2,690	$269	$377	$1,001	$4,337
Winklebleck Pipeline	Pipe	6	32.5	5	feet	$24	$2	$3	$9	$38
Winklebleck Pipeline	Pipe	8	13.5	1,380	feet	$24,646	$2,465	$3,450	$9,168	$39,730
Winklebleck Pipeline	Pipe	8	26	1,007	feet	$9,722	$972	$1,361	$3,617	$15,672
Winklebleck Pipeline	Pipe	8	32.5	594	feet	$4,617	$462	$646	$1,717	$7,442
Winklebleck Pipeline	Turnout	N/A	N/A	5	each	$40,000	$4,000	$5,600	$14,880	$64,480
Winklebleck Pipeline	PRV Station	6	N/A	2	each	$150,000	$15,000	$21,000	$55,800	$241,800

Pipeline Name	Item	Nominal Diameter (inches)	Pressure Rating	Quantity	Units	Construction Cost	Engineering, Construction Management, Survey	Construction Management General Contractor	Contingency Costs	Total Costs
Winklebleck Pipeline	PRV Station	8	N/A	1	each	$75,000	$7,500	$10,500	$27,900	$120,900
Total						**$38,844,000**	**$3,589,000**	**$4,932,000**	**$12,867,000**	**$60,232,000**

Notes: These costs are from the SIP (2018$). Totals are rounded to nearest $1000 and may not sum due to rounding. N/A = not applicable.
[1] Total costs in the Plan-EA are higher than the table above due to being updated to 2019$, shortening the length of pipe in Project Group 1, and an additional $767,000 in Project Group 2 for installation of the sedimentation basin.

D.5 Eliminated Alternatives

This appendix section presents dimensions and capital costs for the eliminated alternatives, which includes canal lining, steel piping, and polyvinyl-chloride (PVC) piping.

D.5.1 Canal Lining Alternative

The capital cost of the Canal Lining Alternative (Table 24) was estimated by calculating the length of geotextile membrane in existing open canals, assuming an anchor of membrane extending 7 feet on either side. The membrane would be covered by a 1-inch layer of shotcrete (fine-aggregate concrete sprayed in place). This estimate also includes fencing along both sides of the canal, and safety ladders every 750 feet in canals deeper than 2.5 feet. Costs related to earthwork and labor are estimated by a 1.5 construction cost multiplier. Turnouts were estimated at an average of $1,000 each. The cross-section length of the canals was estimated based on cross-section lengths found for an irrigation district in Central Oregon, which were calculated for each corresponding pipe diameter size using transects on a digital elevation model.

Table 24. Capital Costs for the Canal Lining Alternative.

	Cross section length (ft)	Canal Length (ft)	Turnout cost	Construction Cost	ECMS [1]	CMGC[2]	Contingency	Total
Project Group 1								
Canal	10.70	1,305		$156,478	$15,648	$21,907	$48,508	$242,541
Canal	12.74	807		$129,871	$12,987	$18,182	$40,260	$201,299
Canal	14.52	273		$48,578	$4,858	$6,801	$15,059	$75,295
Canal	22.17	525		$131,719	$13,172	$18,441	$40,833	$204,165
Canal	22.21	3,686		$925,767	$92,577	$129,607	$286,988	$1,434,938
Canal	23.61	4,318		$1,142,369	$114,237	$159,932	$354,134	$1,770,672
Canal	23.77	2,572		$684,325	$68,432	$95,805	$212,141	$1,060,703
Canal	25.33	18,606		$5,227,107	$522,711	$731,795	$1,620,403	$8,102,016
Turnout			$39,000	$58,500	$5,850	$8,190	$18,135	$90,675
Project Group 2								
Canal	25.34	26,539		$7,457,448	$745,745	$1,044,043	$2,311,809	$11,559,045
Canal	25.88	26,066		$7,458,507	$745,851	$1,044,191	$2,312,137	$11,560,686
Canal	34.39	7,285		$2,675,198	$267,520	$374,528	$829,311	$4,146,557
Turnout			$71,000	$106,500	$10,650	$14,910	$33,015	$165,075
Sedimentation Basin								$767,000
Total		**91,982**	**$110,000**	**$26,202,000**	**$2,620,000**	**$3,668,000**	**$8,123,000**	**$41,380,000**

Note: Totals are rounded to nearest $1000 and may not sum due to rounding.
[1] Engineering, Construction Management, Survey
[2] Construction Management General Contractor

D.5.2 Steel Piping Alternative

The lengths, diameters, and range of pressure ratings used to calculate the capital costs for the Steel Piping Alternative (Table 25) were estimated based on the engineering analysis completed in the District's SIP. Spiral-welded steel was selected that conforms to requirements of the American Water Works Association C200 standard. This pipe was selected because it is considered an industry consensus standard (Bambie and Keil 2013). Steel pipe typically has a design life of 50 years under irrigation water delivery applications. Unlike HDPE, steel pipe cannot be shaped to conform into canal alignments; therefore, elbows would be required. The number of elbow fittings was estimated by assuming one elbow every 100 feet of pipe. Similar to the Preferred Alternative, turnouts were costed at $8,000 and pressure-reducing-valve (PRV) stations ranged from $75,000 to $280,000 per station. These costs are based upon actual installed costs for turnouts and PRV stations in Central Oregon.

Table 25. Capital Costs for the Steel Piping Alternative.

	Length (ft)	Elbow Quantity	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Project Group 1							
Pipe							
Crag Rate Pipeline	8,315	83	$417,774	$33,422	$41,777	$98,595	$591,568
Eastside Canal	32,093	321	$10,837,020	$866,962	$1,083,702	$2,557,537	$15,345,220
Kelly Pipeline	3,007	30	$129,676	$10,374	$12,968	$30,604	$183,621
Lower Highline Pressure Pipeline	10,206	102	$484,802	$38,784	$48,480	$114,413	$686,479
Paasch Pipeline	1,078	11	$103,632	$8,291	$10,363	$24,457	$146,743
Thomsen Pipeline	4,150	42	$179,107	$14,329	$17,911	$42,269	$253,615
Whiskey Creek Pipeline	22,984	230	$2,259,834	$180,787	$225,983	$533,321	$3,199,924
Turnout							
Crag Rate Pipeline			$72,000				$72,000
Eastside Canal			$312,000				$312,000
Kelly Pipeline			$8,000				$8,000
Lower Highline Pressure Pipeline			$128,000				$128,000
Thomsen Pipeline			$40,000				$40,000
Whiskey Creek Pipeline			$136,000				$136,000
Valve							
Crag Rate Pipeline			$90,000				$90,000
Dethman/Swyers Line			$45,000				$45,000
Kelly Pipeline			$30,000				$30,000
Loop Pipeline			$85,000				$85,000
Lower Highline Pressure Pipeline			$190,000				$190,000
Paasch Pipeline			$40,000				$40,000
Rasmussen Pipeline			$45,000				$45,000

	Length (ft)	Elbow Quantity	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Tallman Pipeline			$30,000				$30,000
Thomsen Pipeline			$45,000				$45,000
Whiskey Creek Pipeline			$205,000				$205,000
Project Group 2							
Pipe							
Arens Lateral Pipeline	1,334	13	$81,112	$8,111	$11,356	$25,145	$125,724
Bowcut Pipeline	6,415	64	$383,958	$38,396	$53,754	$119,027	$595,136
Dukes Valley Canal	26,539	265	$7,806,323	$780,632	$1,092,885	$2,419,960	$12,099,801
Main Canal	66,611	666	$30,911,624	$3,091,162	$4,327,627	$9,582,603	$47,913,017
Marsh/Chamberlin Pipeline	34,304	343	$3,146,606	$314,661	$440,525	$975,448	$4,877,239
Sheirbon Hill Pipeline	4,060	41	$273,060	$27,306	$38,228	$84,649	$423,243
PRV Station							
Cameron Hill Pipeline			$225,000	$22,500	$31,500	$69,750	$348,750
Christopher Pipeline			$75,000	$7,500	$10,500	$23,250	$116,250
Dukes Valley Canal			$215,000	$21,500	$30,100	$66,650	$333,250
Fisher Pipeline			$75,000	$7,500	$10,500	$23,250	$116,250
Main Canal			$280,000	$28,000	$39,200	$86,800	$434,000
Marsh/Chamberlin Pipeline			$325,000	$32,500	$45,500	$100,750	$503,750
Sheirbon Hill Pipeline			$75,000	$7,500	$10,500	$23,250	$116,250
Shute Road Pipeline			$150,000	$15,000	$21,000	$46,500	$232,500
Turnout							
Arens Lateral Pipeline			$16,000	$1,600	$2,240	$4,960	$24,800
Bowcut Pipeline			$128,000	$12,800	$17,920	$39,680	$198,400
Dukes Valley Canal			$176,000	$17,600	$24,640	$54,560	$272,800
Main Canal			$392,000	$39,200	$54,880	$121,520	$607,600
Marsh/Chamberlin Pipeline			$504,000	$50,400	$70,560	$156,240	$781,200
Sheirbon Hill Pipeline			$48,000	$4,800	$6,720	$14,880	$74,400

	Length (ft)	Elbow Quantity	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Sedimentation Basin							$767,000
Project Group 3							
Pipe							
Allison Pipeline	4,971	50	$409,281	$40,928	$57,299	$126,877	$634,386
Chipping Pipeline	20,080	201	$2,168,875	$216,887	$303,642	$672,351	$3,361,756
Dethman Ridge Line	44,798	448	$4,540,914	$454,091	$635,728	$1,407,683	$7,038,417
Gilkerson Pipeline	4,154	42	$239,127	$23,913	$33,478	$74,129	$370,647
Oanna Pipeline	28,608	286	$4,200,799	$420,080	$588,112	$1,302,248	$6,511,238
Winklebleck Pipeline	4,972	50	$333,909	$33,391	$46,747	$103,512	$517,559
PRV Station							
Allison Pipeline			$75,000	$7,500	$10,500	$23,250	$116,250
Central Lateral Pipeline			$495,000	$49,500	$69,300	$153,450	$767,250
Chipping Pipeline			$325,000	$32,500	$45,500	$100,750	$503,750
Dethman Ridge Line			$325,000	$32,500	$45,500	$100,750	$503,750
Gilkerson Pipeline			$75,000	$7,500	$10,500	$23,250	$116,250
Oanna Pipeline			$655,000	$65,500	$91,700	$203,050	$1,015,250
Winklebleck Pipeline			$150,000	$15,000	$21,000	$46,500	$232,500
Turnout							
Allison Pipeline			$64,000	$6,400	$8,960	$19,840	$99,200
Chipping Pipeline			$160,000	$16,000	$22,400	$49,600	$248,000
Dethman Ridge Line			$592,000	$59,200	$82,880	$183,520	$917,600
Gilkerson Pipeline			$40,000	$4,000	$5,600	$12,400	$62,000
Oanna Pipeline			$224,000	$22,400	$31,360	$69,440	$347,200
Winklebleck Pipeline			$40,000	$4,000	$5,600	$12,400	$62,000
Total	**328,679**	**3,288**	**$76,312,000**	**$7,193,000**	**$9,897,000**	**$22,125,000**	**$116,294,000**

Note: Totals are rounded to nearest $1000 and may not sum due to rounding.
[1] Engineering, Construction Management, Survey
[2] Construction Management General Contractor

D.5.3 PVC Piping Alternative

The lengths, diameters, and range of pressure ratings used for this alternative were estimated based on the engineering analysis completed in the District's SIP. Under the PVC Piping Alternative, PVC would be used for diameters up to 54 inches and steel would be installed for larger diameter pipes, since PVC is not manufactured in larger diameters. In the current design, steel pipe would only be used for approximately 30 feet.

The lifespan of a piping system depends on many different factors. Proper installation and operation of the piping system are key to achieving a long service life. Assuming a piping system is ideally installed and operated, the main factor affecting the pipe's service life is the number and magnitude of surge/water hammer events the system experiences. Surge/water hammer events are caused by valve operations, changing irrigation demand in the system, pump startup and shutdown, quick hydropower turbine shutdowns due to power failures, and any other factors causing fast changes in the piping system flow rate (B. Cronin, personal communication, July 27, 2018).

USDA-NRCS's practice standard lifespan for irrigation pipeline is 20 years (NRCS n.d.). This lifespan is based on long-term experience with primarily PVC pipe irrigation system installations (B. Cronin, personal communication, July 27, 2018). The Plastics Pipe Institute's online software indicates that with the average number of surge/water hammer events expected in a pipeline network, the lifespan of a typical 24-inch, 125 pounds per square inch pressure rated PVC pipe would be 14 years with a safety factor of two (Plastics Pipe Institute 2015). PVC is also more prone to failure under freezing conditions. During these periods, the PVC pipe system would be more likely to freeze and potentially rupture and fail. PVC piping has been installed in irrigation districts in the Deschutes Basin and experienced premature failure, especially in Districts where stock water is delivered during the winter. Considering all the information above, a PVC design life of 33 years was assumed for purposes of this analysis. Steel pipe has a design life of 50 years.

Capital costs for the PVC Piping Alternative (Table 26) account for additional elbow fittings that would be necessary for PVC pipe. The cost of elbow fittings was determined by assuming an elbow every 100 feet at a cost of $100 per 1 inch of pipe diameter. To account for additional PVC costs, an additional 5 percent cost was added. Similar to the Preferred Alternative, turnouts were costed at $8,000 and PRV stations ranged from $75,000 to $280,000 per station. These costs are based upon actual installed costs for turnouts and PRV stations in Central Oregon.

Table 26. Capital Costs for the PVC Piping Alternative.

	Length (ft)	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Project Group 1						
Pipe						
Crag Rate Pipeline	8,315	$119,048	$9,524	$11,905	$28,095	$168,572
Eastside Canal	32,093	$10,292,368	$823,389	$1,029,237	$2,428,999	$14,573,994
Kelly Pipeline	3,007	$38,456	$3,077	$3,846	$9,076	$54,454
Lower Highline Pressure Pipeline	10,206	$135,703	$10,856	$13,570	$32,026	$192,155
Paasch Pipeline	1,078	$39,783	$3,183	$3,978	$9,389	$56,332
Thomsen Pipeline	4,150	$55,600	$4,448	$5,560	$13,122	$78,730
Whiskey Creek Pipeline	22,984	$928,538	$74,283	$92,854	$219,135	$1,314,810
Turnout						
Crag Rate Pipeline		$72,000				$72,000
Eastside Canal		$312,000				$312,000
Kelly Pipeline		$8,000				$8,000
Lower Highline Pressure Pipeline		$128,000				$128,000
Thomsen Pipeline		$40,000				$40,000
Whiskey Creek Pipeline		$136,000				$136,000
Valve						
Crag Rate Pipeline		$90,000				$90,000
Dethman/Swyers Line		$45,000				$45,000
Kelly Pipeline		$30,000				$30,000
Loop Pipeline		$85,000				$85,000
Lower Highline Pressure Pipeline		$190,000				$190,000
Paasch Pipeline		$40,000				$40,000
Rasmussen Pipeline		$45,000				$45,000
Tallman Pipeline		$30,000				$30,000
Thomsen Pipeline		$45,000				$45,000
Whiskey Creek Pipeline		$205,000				$205,000

	Length (ft)	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Project Group 2						
Pipe						
Arens Lateral Pipeline	1,334	$25,024	$2,502	$3,503	$7,757	$38,787
Bowcut Pipeline	6,415	$117,784	$11,778	$16,490	$36,513	$182,566
Dukes Valley Canal	26,539	$6,347,032	$634,703	$888,585	$1,967,580	$9,837,900
Main Canal	66,611	$42,317,893	$4,231,789	$5,924,505	$13,118,547	$65,592,733
Marsh/Chamberlin Pipeline	34,304	$1,460,344	$146,034	$204,448	$452,707	$2,263,533
Sheirbon Hill Pipeline	4,060	$88,970	$8,897	$12,456	$27,581	$137,903
PRV Station						
Cameron Hill Pipeline		$225,000	$22,500	$31,500	$69,750	$348,750
Christopher Pipeline		$75,000	$7,500	$10,500	$23,250	$116,250
Dukes Valley Canal		$215,000	$21,500	$30,100	$66,650	$333,250
Fisher Pipeline		$75,000	$7,500	$10,500	$23,250	$116,250
Main Canal		$280,000	$28,000	$39,200	$86,800	$434,000
Marsh/Chamberlin Pipeline		$325,000	$32,500	$45,500	$100,750	$503,750
Sheirbon Hill Pipeline		$75,000	$7,500	$10,500	$23,250	$116,250
Shute Road Pipeline		$150,000	$15,000	$21,000	$46,500	$232,500
Turnout						
Arens Lateral Pipeline		$16,000	$1,600	$2,240	$4,960	$24,800
Bowcut Pipeline		$128,000	$12,800	$17,920	$39,680	$198,400
Dukes Valley Canal		$176,000	$17,600	$24,640	$54,560	$272,800
Main Canal		$392,000	$39,200	$54,880	$121,520	$607,600
Marsh/Chamberlin Pipeline		$504,000	$50,400	$70,560	$156,240	$781,200
Sheirbon Hill Pipeline		$48,000	$4,800	$6,720	$14,880	$74,400
Sedimentation Basin						$767,000
Project Group 3						
Pipe						
Allison Pipeline	4,971	$148,208	$14,821	$20,749	$45,944	$229,722
Chipping Pipeline	20,080	$1,100,136	$110,014	$154,019	$341,042	$1,705,211

	Length (ft)	Construction Cost	ECMS[1]	CMGC[2]	Contingency	Total
Dethman Ridge Line	44,798	$2,378,440	$237,844	$332,982	$737,316	$3,686,582
Gilkerson Pipeline	4,154	$72,269	$7,227	$10,118	$22,404	$112,018
Oanna Pipeline	28,608	$2,862,932	$286,293	$400,810	$887,509	$4,437,544
Winklebleck Pipeline	4,972	$109,452	$10,945	$15,323	$33,930	$169,651
PRV Station						
Allison Pipeline		$75,000	$7,500	$10,500	$23,250	$116,250
Central Lateral Pipeline		$495,000	$49,500	$69,300	$153,450	$767,250
Chipping Pipeline		$325,000	$32,500	$45,500	$100,750	$503,750
Dethman Ridge Line		$325,000	$32,500	$45,500	$100,750	$503,750
Gilkerson Pipeline		$75,000	$7,500	$10,500	$23,250	$116,250
Oanna Pipeline		$655,000	$65,500	$91,700	$203,050	$1,015,250
Winklebleck Pipeline		$150,000	$15,000	$21,000	$46,500	$232,500
Turnout						
Allison Pipeline		$64,000	$6,400	$8,960	$19,840	$99,200
Chipping Pipeline		$160,000	$16,000	$22,400	$49,600	$248,000
Dethman Ridge Line		$592,000	$59,200	$82,880	$183,520	$917,600
Gilkerson Pipeline		$40,000	$4,000	$5,600	$12,400	$62,000
Oanna Pipeline		$224,000	$22,400	$31,360	$69,440	$347,200
Winklebleck Pipeline		$40,000	$4,000	$5,600	$12,400	$62,000
Total	**328,679**	**$76,043,000**	**$7,222,000**	**$9,971,000**	**$22,249,000**	**$116,253,000**

Note: Totals are rounded to nearest $1000 and may not sum due to rounding.
[1] Engineering, Construction Management, Survey
[2] Construction Management General Contractor

D.5.4 References

Bambie, J. and B. Keil. (2013). *Revision of AWWA C200 Steel Water Pipe Manufacturing Standard: Consensus-Based Changes Mark Significant Improvements*. Northwest Pipe Company. Vancouver, Washington.

Plastics Pipe Institute. (2015). Pipeline Analysis & Calculation Environment online tool. Retrieved from http://ppipace.com.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). (n.d.). National Conservation Practice Standards. Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1076947.pdf.

Watershed Protection and Flood Prevention Act of 1954, Pub. L. No. 83-566, 68 Stat. 666.

D.6 Net Present Value of Eliminated Alternatives

This section presents the calculations used to estimate the net present value of the eliminated alternatives.

Design Life: PVC piping (33 years), steel piping (50 years), canal lining (33 years)

Discount Rate: 2.75 percent

Period of Analysis: 100 years

Table 27. Net Present Value of the Eliminated Alternatives.

Project Group	Alternatives		
	PVC Piping	**Steel Piping**	**Canal Lining**
Capital Costs[1]			
1	$17,940,000	$21,908,000	$13,182,000
2	$82,981,000	$70,961,000	$28,198,000
3	$15,332,000	$23,425,000	N/A
Total:	**$116,253,000**	**$116,294,000**	**$41,380,000**
Net Present Value of Replacement Costs[2]			
1	$5,068,000	$4,144,000	$10,044,000
2	$28,563,000	$13,611,000	$21,121,000
3	$3,188,000	$3,743,000	N/A
Total:	**$36,819,000**	**$21,498,000**	**$31,165,000**
Annual Operation and Maintenance Costs			
1	$224,000	$224,000	$555,000
2	$381,000	$381,000	$908,000
3	$295,000	$295,000	N/A
Total:	**$900,000**	**$900,000**	**$1,463,000**
Total Percent Change in O&M:	-10%	-10%	46%
Total Net Present Value of O&M Costs			
1	$7,605,000	$7,605,000	$18,843,000
2	$12,935,000	$12,935,000	$30,828,000

Project Group	**Alternatives**		
	PVC Piping	**Steel Piping**	**Canal Lining**
3	$10,016,000	$10,016,000	N/A
Total:	**$30,556,000**	**$30,556,000**	**$49,671,000**
Total Net Present Value of Project			
1	$30,613,000	$33,657,000	$42,069,000
2	$124,479,000	$97,507,000	$80,147,000
3	$28,536,000	$37,184,000	$0
Total:	**$183,628,000**	**$168,348,000**	**$122,216,000**

Note: Totals may not align with totals in Table 23, Table 24, and Table 25 due to rounding. N/A = not applicable.
[1] The capital cost for Project Group 2 includes $767,000 for installation of the sedimentation basin.
[2] For PVC pipe, 33 percent of the pipe was replaced at 33 years and 67 percent replaced at 66 years. For steel pipe, 25 percent was replaced at 50 years, and 75 percent replaced at 75 years. For canal lining, 100 percent was replaced at both 33 years and 66 years. The sedimentation basin was replaced fully at 50 years.

Appendix E

Other Supporting Information

E.1 Intensity Threshold Table

This section presents the intensity threshold table used to quantify effects on resources of concern because of the proposed East Fork Irrigation District Infrastructure Modernization Project.

Table E-1. Intensity Threshold Table for the East Fork Irrigation District Infrastructure Modernization Project.

	Intensity Threshold			
Resource	**Negligible**	**Minor**	**Moderate**	**Major**
Cultural Resources	No above or underground cultural resources are adversely affected.	Affects a cultural resource that does not have local, regional or state significance. The historic context of the affected site(s) is local. Not affect the contributing element of a property eligible for the National Register of Historic Places. Causes a slight change to a natural or physical ethnographic resource, if measurable and localized.	Affects a cultural resource with modest potential of local, regional or state significance. Changes a contributing element but would not diminish resource integrity or jeopardize National Register eligibility. Localized and measurable change to a natural or physical ethnographic resource.	Affects a cultural resource with high potential of national context. Diminishes the integrity of the resource to the extent that affects cannot be mitigated, would permanently impact the historic register eligibility of the resource, prevent a resource from meeting criteria for listing in a historic register, or reduces the ability of a cultural resource to convey its historic significance. Permanent severe change or exceptional benefit to a natural or physical ethnographic resource.
Fish and Aquatic Species	No discernable short- or long-term impacts to fish populations or aquatic habitat.	Changes in watershed conditions that may cause non-measurable degradation to aquatic habitat. Direct or indirect habitat changes that result only in non-measurable, short-term change in risk to ESA-listed or other fish populations.	Changes in watershed conditions that cause measurable degradation to aquatic habitat. Direct or indirect habitat changes that cause measurable, short- or long-term change in risk to ESA-listed or other fish populations.	Changes in watershed conditions that cause high impairment to aquatic habitat that affects population viability. The proposed action would likely jeopardize a species' continued existence or destroy or adversely affect a species' critical habitat.

Resource	**Intensity Threshold**			
	Negligible	**Minor**	**Moderate**	**Major**
Land Use	Existing land uses or ownership would continue as before. A short-term change or interruption to land use or access to existing land uses.	Land use changes that are consistent with existing ownership, easements, or right-of-way.	Land use changes that are inconsistent with existing ownership, easements, or right-of-way but are compatible to adjacent.	A new unauthorized land use or access that is not compatible with adjacent land use.
Public Safety	No increase in risk to human health and safety.	Any risks to public health and safety created by the project would be eliminated through mitigation.	Any risks to public health and safety created by the project would be eliminated through mitigation, but would require a short-term behavioral change by the public or present a temporary inconvenience.	Create a permanent and known health and safety risk.
Socioeconomics	No reduction in the yield of agricultural products or timber. Non-measurable change to income and/or employment levels.	Measurable, but short term, reduction to yield of agricultural products or timber. Temporary reduction to income and/or local employment levels.	Long term reduction in the yield of agricultural products or timber on the scale of individual farms. Short term reduction to income and/or local employment levels.	Long term reduction in the yield of agricultural products or timber on a district wide scale. Long term reduction to income and/or regional employment levels.
Vegetation	Project activities would not affect vegetation or it is limited to small areas.	Most effects would be localized and/or temporary. While individual plants could be affected, there would be no effects on a population scale. Any permanent effects would not be widespread nor affect sensitive species or populations.	A large proportion of one or more populations are affected but relatively localized and could be mitigated. Any effects on sensitive species could be mitigated.	Considerable effects on plant populations over large areas. Extensive mitigation required offsetting adverse effects on sensitive species, but success not assured.
Visual Resources	Project features are visually negligible or not visible.	The majority of project features do not attract attention to the landscape.	A majority of project features attract attention to the landscape.	Project features create a disruptive change and dominate the landscape.

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
		Short-term visual changes during project construction.		
Water Resources	Project activities would not disturb or alter water quantity, water quality, or groundwater quantity.	*Surface Water Quantity:* Temporary change in quantity away from the natural or target hydrograph. *Water Quality:* Short-term or non-measurable changes to water quality in waterbodies that is unlikely to result in excursions to water quality standards on the Oregon's 303(d) list. *Groundwater:* Long-term less than 10 percent change in depth to groundwater Change in depth to groundwater that does not result in any affects to groundwater users or their water rights.	*Surface Water Quantity:* Permanent change in water quantity that is measurable and that is counter to the natural or target hydrograph that does not affect other water users or water rights. *Water Quality:* Permanent measurable changes to water quality in waterbodies that is unlikely to result in excursions to water quality standards on the Oregon's 303(d) list. *Groundwater:* Measurable changes in depth to groundwater that does not reduce the availability of water for water users.	*Surface Water Quantity:* Permanent change in water quantity that is measurable and that is counter to the natural or target hydrograph that affects other water users and water rights. *Water Quality:* Permanent measurable changes to water quality in waterbodies that results in excursions to water quality standards on the Oregon's 303(d) list. *Groundwater:* Measurable changes in depth to groundwater that reduces the availability of water for water users.
Wetland, Floodplains, Riparian Zones	Does not alter wetlands or riparian areas or change the hydraulic capacity of floodplains.	Degradation of non-jurisdictional wetlands. Project does not increase the potential for flooding and damage to personal property.	Mitigated degradation of jurisdictional wetlands. Increase to the potential for flooding and damage to personal property that can be permitted and mitigated.	Permanent, non-mitigated degradation of jurisdictional wetlands. Increase to the potential for flooding and damage to personal property that cannot be mitigated.

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
Wildlife	No degradation to wildlife habitats or populations.	Degradation and recovery of wildlife populations and/or their habitats would be short-term.	Degradation and recovery of wildlife populations and/or their habitats would be long-term but would not affect the viability of any population. Habitat availability would continue to be adequate.	Long-term degradation to wildlife populations or habitats that would affect the viability of a population. Inadequate habitat availability.
Ecosystem Services	No degradation to ecosystem services.	Any degradation to ecosystem services would be temporary.	Any degradation to ecosystem services could be mitigated.	Any degradation to ecosystem services could not be mitigated.

Duration of Effects	
Temporary	Transitory effects which only occur over a period of days or months.
Short-term	Effects lasting 1-5 years.
Long-term	Effects lasting greater than 5 years.

E.2 Supporting Information for Land Use

Table E-2. Project Area Length Crossing Land Use Classes.

Land Use	Percent of the Project Area Length	Project Area Length Crossing each Land Use Class (miles)
Agriculture	48%	27
Non-cultivated lands[1]	38%	21
Developed Use[2]	14%	8
Total	**100%**	**56**

Source: USGS 2011
[1] Shrub/scrub, barren land, evergreen forest, woody wetlands.
[2] High, medium, low intensity development, developed open space.

Table E-3. Water Users by Acres Served within East Fork Irrigation District.[1]

Acres Served	Total Irrigated Acreage in EFID (ac)	Total Irrigated Acreage in EFID (%)	Patrons (number)	Patrons (%)
0-5 acres	929	10%	724	74%
6-10 acres	477	5%	58	6%
11+ acres	8,000	85%	191	20%
Total	**9,397**[1]	**100%**	**973**[1]	**100%**

Source: S. Swyers, EFID Office Manager, personal communication, November 12, 2018
[1] The data varies slightly from the values presented in the Plan-EA (9,607 acres irrigated by 990 patrons).

Reference

U.S. Geological Survey (USGS). (2011). National Land Cover Database (2011 Edition). U.S. Geological Survey, Sioux Falls, SD. Retrieved from https://www.mrlc.gov/data

E.3 Supporting Information for Fish and Aquatic Resources

This appendix section presents supporting information associated with Primary Constituent Elements for critical habitat of federally listed species.

Table E-4. Primary Constituent Elements for Lower Columbia River Chinook, Coho, and Steelhead.

Primary Constituent Element Number	Habitat Description and Characteristics
PCE 1	Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.
PCE 2	Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
PCE 3	Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
PCE 4	Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
PCE 5	Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
PCE 6	Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Table E-5. Primary Constituent Elements for Bull Trout.

Primary Constituent Element Number	Habitat Description and Characteristics
PCE 1	Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
PCE 2	Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
PCE 3	An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
PCE 4	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.
PCE 5	Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
PCE 6	In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
PCE 7	A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
PCE 8	Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
PCE 9	Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

E.4 Supporting Information for Water Resources

This appendix section presents supporting data used to evaluate effects of the Preferred Alternative with respect to water resources.

Table E-6. ODFW Instream Water Rights for the East Fork Hood River, Hood River, and Neal Creek.

Source	From	To	Certificate	Priority Date	Instream Rates (cfs)											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Fork Hood River	Below EFID diversion (approx. RM 6.6)	Above Middle Fork Hood River confluence	68457	11/3/1983	100	100	100	150	150	150	100	100	100	150	150	150
East Fork Hood River	Below EFID diversion (approx. RM 6.6)	Above West Fork Hood River confluence	Pending IS-88322	12/1/2016	210	210	210	210	210	210	150	150	175	175	180	180
Hood River	RM 4.0	Mouth at Columbia River	59679	11/3/1983	170	270	270	270	170	170	130	100	100	100	100	170
Hood River	RM 4.0	Mouth at Columbia River	76155	10/8/1998	-	-	-	-	250	250	250	250	250	250	-	-
Neal Creek	Mouth at Hood River	Mouth at Hood River	59681	11/3/1983	13	13	13	20	20	20	13	13	5	20	20	13

E.5 Allocation of Conserved Water Program

This appendix section presents information on the State of Oregon's Allocation of Conserved Water Program. Oregon Revised Statutes 537.455-500 authorize this program, which is managed by the Oregon Water Resources Department. Per OWRD (2017),

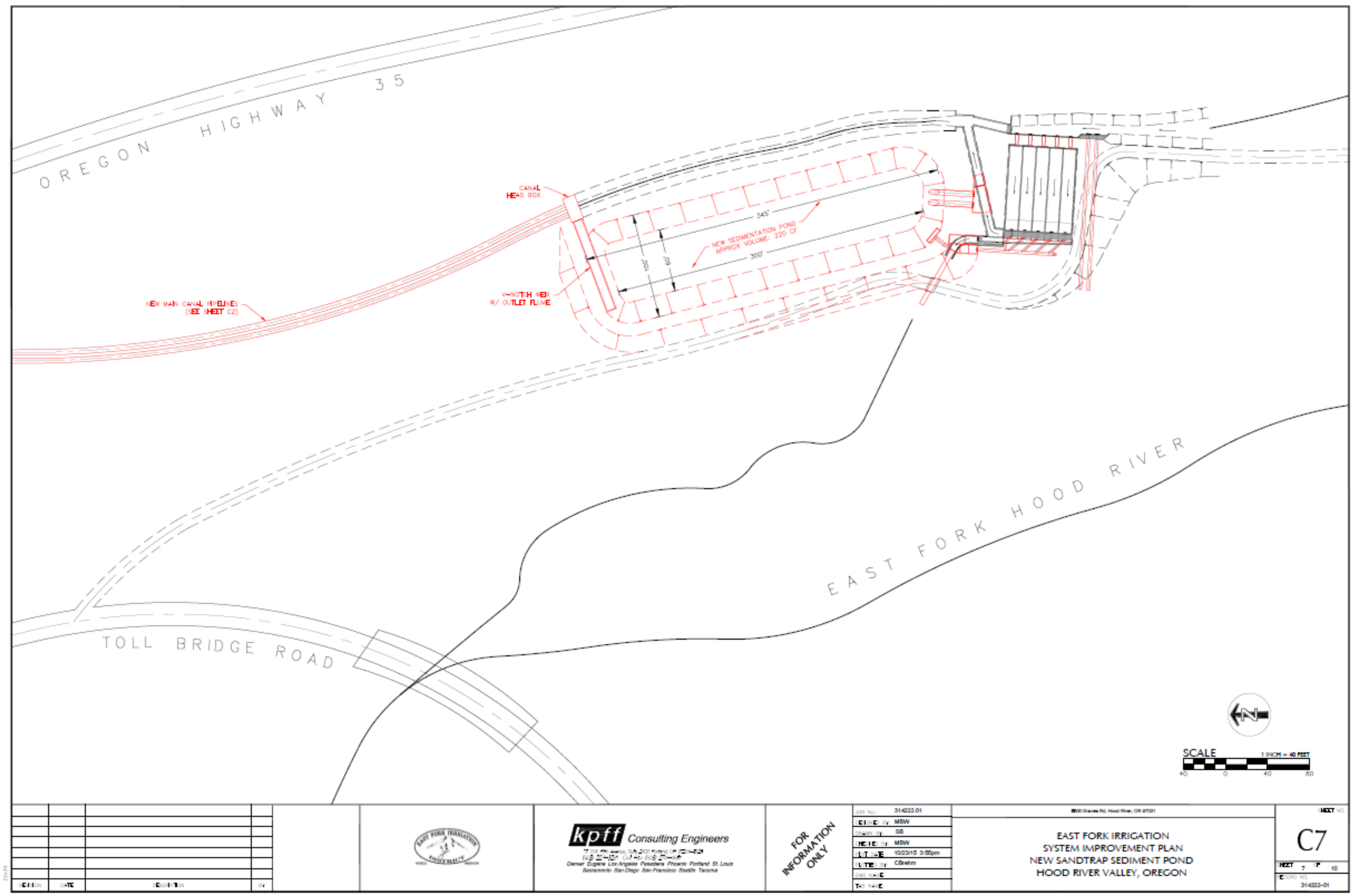
> The Allocation of Conserved Water Program allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. Use of this program is voluntary and provides benefits to both water right holders and instream values.
>
> The statutes authorizing the program were originally passed by the Legislative Assembly in 1987. The primary intent of the law is to promote the efficient use of water to satisfy current and future needs--both out-of-stream and instream. The statute defines conservation as "the reduction of the amount of water diverted to satisfy an existing beneficial use achieved either by improving the technology or method for diverting, transporting, applying or recovering the water or by implementing other approved conservation measures."
>
> In the absence of Department approval of an allocation of conserved water, water users who make the necessary investments to improve their water use efficiency are not allowed to use the conserved water to meet new needs; instead, any unused water remains in the stream where it is available for the next appropriator. In exchange for granting the user the right to "spread" a portion of the conserved water to new uses, the law requires allocation of a portion to the state for instream use.
>
> After mitigating the effects on any other water rights, the Water Resources Commission allocates 25 percent of the conserved water to the state (for an instream water right) and 75 percent to the applicant, unless more than 25 percent of the project costs come from federal or state non-reimbursable sources or the applicant proposes a higher allocation to the state. A new water right certificate is issued with the original priority date reflecting the reduced quantity of water being used with the improved technology. A certificate is issued for the state's instream water right, and, if requested, a certificate is issued for the applicant´s portion of the conserved water. The priority dates for the state's instream certificate and the applicant's portion of conserved water must be the same date and will be either the same date as the original water right or one-minute junior to the original right.

Section 2.3 of the Plan-EA describes the District's intention to allocate 75 percent of the water conserved through this project instream. Consistent with EFID's own Conserved Water Policy, adopted in 2007 and amended in 2014, the District has previously used the Allocation of Conserved Water Program (application nos. CW-86, CW-53, and CW-93) to restore a portion of the water conserved through three previous piping projects to the East Fork Hood River.

Reference

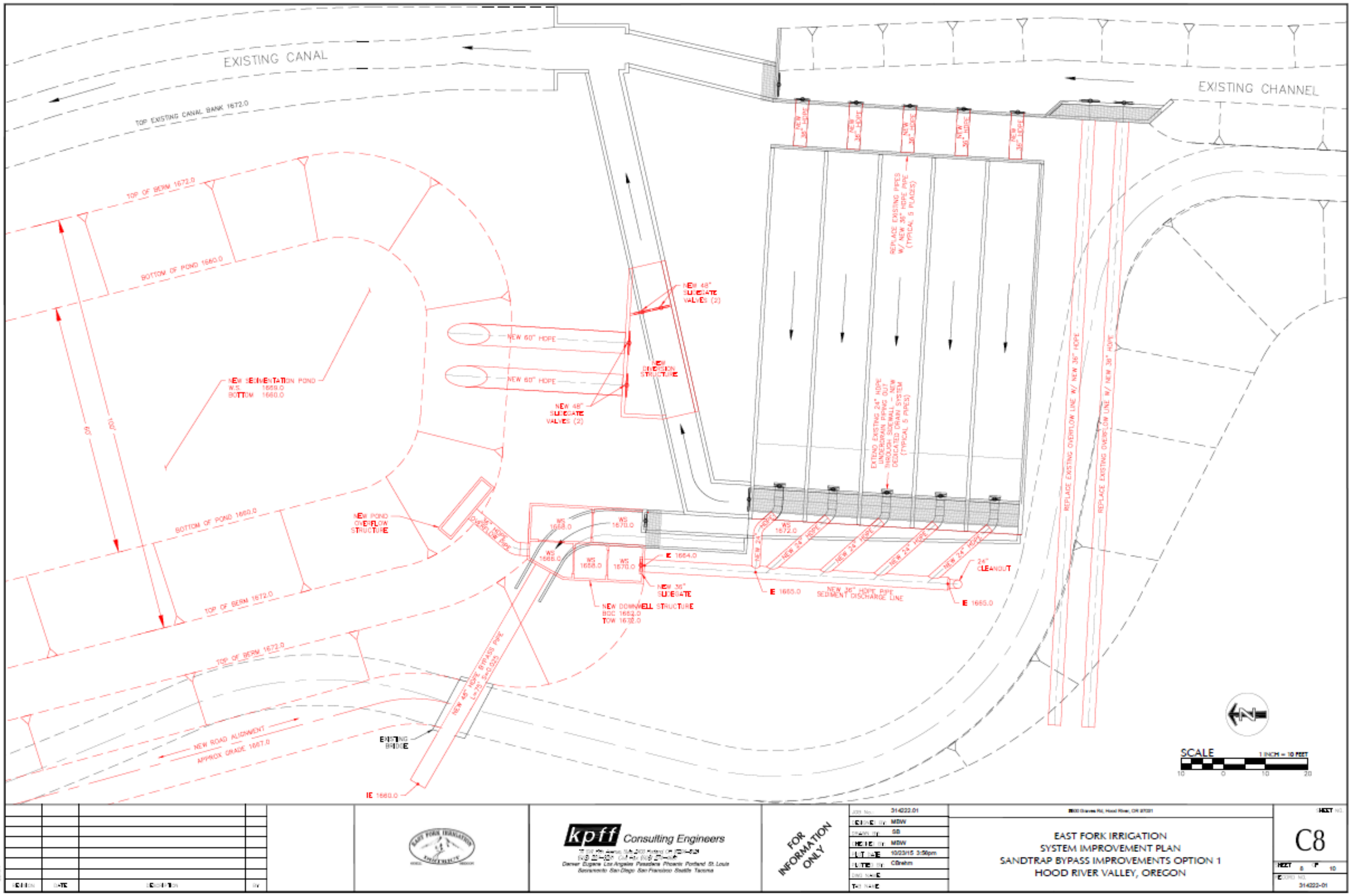
Oregon Water Resources Department (OWRD). (2017). Allocation of Conserved Water. Retrieved from http://www.oregon.gov/owrd/pages/mgmt_conserved_water.aspx

E.6 Proposed Sedimentation Basin



Source: Wharry 2016.

Figure E-1. Preliminary plan view of proposed sedimentation basin near East Fork Irrigation District's headworks.



Source: Wharry 2016.

Figure E-2. Preliminary drawing of proposed sedimentation basin.

E.7 Consultation Letters

Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

RECEIVED
DEC 13 2018
USDA/NRCS
Oregon State Office

Tom
Ron

December 11, 2018

In reply refer to: EC-4

Ronald Alvarado, State Conservationist
Natural Resources Conservation Service
1201 NE Lloyd Blvd
Portland, OR 97232

RE: Formal Request to be a Cooperating Agency on the Watershed Plan-Environmental Assessment for the East Fork Irrigation District, Irrigation Modernization Project

Dear Mr. Alvarado:

Thank you for your October 5, 2018, letter requesting the Bonneville Power Administration's (BPA) participation as a cooperating agency on the Watershed Plan-Environmental Assessment (Plan-EA) that the Natural Resources Conservation Service (NRCS) is preparing pursuant to the National Environmental Policy Act (NEPA) to analyze the effects of NRCS' proposed East Fork Irrigation District Irrigation Modernization Project. Although it is unknown at this time whether BPA will have any role or decisions in the East Fork Irrigation Modernization, BPA agrees to participate as a cooperating agency on this Plan-EA.

As a cooperating agency, BPA expects to have a minor role in reviewing draft EA documents and may be able to provide special expertise on request. As such, BPA does not believe that a formal MOU or further role definition are necessary.

I have assigned BPA's cooperating agency responsibilities to Israel Duran, 503-230-3967 or induran@bpa.gov. Please contact Israel if you have any questions or concerns.

Sincerely,

Scott G. Armentrout
Executive Vice President for Environment, Fish and Wildlife

ecc:
Ronald Alvarado, State Conservationist, NRCS, ronald.alvarado@or.usda.gov
Tom Makowski, ASTC-Watershed Resources and Planning, NRCS, tom.makowski@or.usda.gov
Blayne Einechener, Biologist, CTWS, beineichner@hrecn.net

USDA
United States Department of Agriculture
Natural Resources Conservation Service

2316 South Sixth Street, Suite C
Klamath Falls, OR 97601

Phone: (541) 887-3511
rachel.gebauer@or.usda.gov

Subject: East Fork Irrigation District Modernization Project, Hood River County

Date: January 7, 2019

To: SHPO Compliance

In compliance with the National Historic Preservation Act of 1966, Oregon State Revised Statutes (ORS 358.905-961 and ORS 97.740-760) and in accordance with our State PPA between Oregon SHPO and NRCS Oregon (Signed January 2018), the Natural Resources Conservation Service would like to initiate consultation with the Oregon State Historic Preservation Office for the following federally funded irrigation piping project. The NRCS proposes to provide technical and financial assistance to the East Fork Irrigation District through the Watershed Protection and Flood Prevention Program , Public Law 83-566 (PL566).

The East Fork Irrigation District (EFID) operates and maintains 17.9 miles of open canals and laterals and 64.8 miles of mostly unpressurized pipeline. EFID proposes to modernize its infrastructure by converting its open canals to buried, gravity-pressurized pipelines; replacing 43.5 miles of older pipelines with high-density polyethylene (HDPE) piping; and by adding a settling basin to manage glacial sand and silt in its water supply. The District plans to keep 21.3 miles of its existing pipeline, and to replace piping that is at least 10 years old or more. (Figures 1-5). The project will be divided into segments for the purpose of completing the work. The Eastside Canal is intended to be the first segment addressed by the District.
The EFID canals and laterals are located in Township 3N/ Range 11E/ Section 31; Township 2N/ Range 11E/ Sections 6, 7, 18; 19, 30, 31; Township 2N/ Range 10E/ Sections 12, 13, 21- 28, 33- 36; Township 1 N/ Range 10E/ Sections 1-4, 10,14, 15,22, 27,34; Township 1S/ Range 10E/ Sections 4,5.

In accordance with state and federal laws and under our State PPA between Oregon SHPO and NRCS Oregon (Signed January 2018), NRCS plans to identify the historic properties within the area of potential effect and to evaluate and assess any adverse effects. Recognizing that there may be segments of the canals and laterals that are determined to be historically significant cultural resources, we anticipate the potential need for avoidance or mitigation.

NRCS is consulting with the Confederated Tribes of the Warm Springs, Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Umatilla.

The following items are enclosed:

- EFID Index Map,
- EFID Sheets 1-5, detailed segments of EFID modernization project

Sincerely,

Rachel L S Gebauer

Rachel Smith Gebauer, M.A., RPA, Cultural Resources Specialist
rachel.gebauer@or.usda.gov

CC:
Tom Makowski, NRCS, ASTC Watershed Resources, Portland, OR
Carly Heron – NRCS, District Conservationist, Parkdale, OR
Kevin Conroy—NRCS, Basin Team Leader, Klamath Falls, OR
Kathy Ferge – NRCS Tribal Liaison, Portland, OR

Oregon

Kate Brown, Governor

Parks and Recreation Department
State Historic Preservation Office
725 Summer St NE Ste C
Salem, OR 97301-1266
Phone (503) 986-0690
Fax (503) 986-0793
www.oregonheritage.org

March 24, 2020

Ms. Rachel Gebauer
NRCS
2316 S 6th St
Suite C
Klamath Falls, OR 97601

RE: SHPO Case No. 19-0049
USDA-NRCS, East Fork Irrigation District Modernization Project
Irrigation upgrades
Multiple Legals, Hood River County

Dear Rachel:

This letter only addresses archaeological issues in regards to the above project. Additional consulation with our office in regards to the eligibility of the canal and any required mitigation needs to occur before projct approval.

With regardfs to the project's archaeological concerns, our office recently received a report of archaeological investigations for the project referenced above. The report has been assigned SHPO Report# 30944 and added to the SHPO Library. The newly identified hisotric archaeology site has been assigned Smithsonian trinomial 35HR171. Our office concurs with your agency's determination that this archaeological site is not eligible to ther National Regsiter. We have reviewed the report and concur that a good faith effort has been implemented and the project will likely have no effect on any <u>significant archaeological objects or sites.</u> Based on the information provided, additional archaeological research is not anticipated for this project. In the unlikely event an archaeological object or site (i.e., historic or prehistoric) is encountered during project implementation, all ground disturbance at the location should cease immediately until a professional archaeologist can be contacted to evaluate the discovery. Under federal and state law archaeological sites, objects and human remains are protected on both public and private land in Oregon. If you have not already done so, be sure to consult with all appropriate Indian tribes regarding your proposed project. If you have any questions regarding any future discovery or this letter, feel free to contact me at your convenience.

Sincerely,

Dennis Griffin

Dennis Griffin, Ph.D., RPA
State Archaeologist
(503) 986-0674
dennis.griffin@oregon.gov

cc: KC Fagen, Tillamook PUD

USDA

United States Department of Agriculture

Natural Resources Conservation Service

**1201 NE Lloyd Blvd.
Suite 900
Portland, OR 97232
503-414-3200**

October 5, 2018

Mr. Chris Brun, HRPP Supervisor
Confederated Tribes of Warm Springs
6030 Dee Highway
Parkdale, OR 97041

SUBJECT: Formal Request to be a Cooperating Tribe on the Watershed Plan – Environmental Assessment for the East Fork Irrigation District, Irrigation Modernization Project

Dear Mr. Brun,

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Section 1501.6, NRCS is formally requesting that your Tribe become a cooperating Tribe in the planning and development of the Watershed Plan - Environmental Assessment for the East Fork Irrigation District. This request is being made because your Tribe has been identified as having special expertise or jurisdiction by law related to this project. The Watershed Plan - Environmental Assessment (Plan-EA) is being prepared to fulfill NRCS's NEPA compliance responsibilities pertaining to our potential federal financial assistance through the Watershed Protection and Flood Prevention Program (Public Law 83-566) for this project. As your Tribe may also have NEPA compliance responsibilities concerning future projects that may be evaluated in this Plan-EA, preparation of this Plan-EA should also assist in fulfilling environmental review requirements for your Tribe or other Federal agencies and meet NEPA's intent of reducing duplication and delay between agencies.

If your Tribe is unable to participate as a cooperating Tribe, please return a brief, written explanation why your Tribe cannot participate. If we do not hear from you by November 2, 2018, we will assume you decline to be a cooperating Tribe on this project. Please note that a response declining to be a cooperating Tribe is required to also be submitted to the Council on Environmental Quality per 40 CFR Section 1501.6(c). Upon acceptance of this invitation, roles can be defined in an informal agreement or formal MOU can be established.

Thank you for your timely response and cooperation with this project. For further information contact Tom Makowski, Assistant State Conservationist for Watershed Resources and Planning, at 503-414-3202 or tom.makowski@usda.gov.

Sincerely,

Ronald Alvarado

RONALD ALVARADO
State Conservationist

ecc: Tom Makowski, ASTC – Watershed Resources and Planning, NRCS

USDA

United States Department of Agriculture

Natural Resources Conservation Service

**2316 S. 6th St., Suite. C
Klamath Falls, OR 97601**

January 7, 2019

Austin Green
Tribal Chairman
Confederated Tribes of Warm Springs
P.O. Box C
Warm Springs, OR 97761

Dear Mr. Green,

The purpose of this letter is to initiate consultation under the National Historic Preservation Act, within the homeland of the Confederated Tribes of the Warm Springs, for The NRCS proposes to provide technical and financial assistance to the East Fork Irrigation District through the Watershed Protection and Flood Prevention Program , Public Law 83-566 (PL566).

The East Fork Irrigation District (EFID) operates and maintains 17.9 miles of open canals and laterals and 64.8 miles of mostly unpressurized pipeline. EFID proposes to modernize its infrastructure by converting its open canals to buried, gravity-pressurized pipelines; replacing 43.5 miles of older pipelines with high-density polyethylene (HDPE) piping; and by adding a settling basin to manage glacial sand and silt in its water supply. The District plans to keep 21.3 miles of its existing pipeline, and to replace piping that is at least 10 years old or more. The project will be divided into segments for the purpose of completing the work. The Eastside Canal is intended to be the first segment addressed by the District.
The EFID canals and laterals are located in Township 3N/ Range 11E/ Section 31; Township 2N/ Range 11E/ Sections 6, 7, 18; 19, 30, 31; Township 2N/ Range 10E/ Sections 12, 13, 21- 28, 33- 36; Township 1 N/ Range 10E/ Sections 1-4, 10,14, 15,22, 27,34; Township 1S/ Range 10E/ Sections 4,5.

All of the project areas will be reviewed and surveyed for historic properties and reports will be submitted to the Oregon SHPO in compliance with the National Historic Preservation Act.

Attached are the proposed project area maps. Please understand this is a voluntary program; therefore, not all proposed projects are implemented. A copy of the completed reports will be made available to you for your review.

If there are any sites of religious or cultural significance to the CTWS in this vicinity, that you feel may be impacted by this project, please let us know so we can adequately address these concerns. Please let us know if you have any other questions or concerns.

Sincerely,

Rachel L.S. Gebauer
NRCS Basin Cultural Resources Specialist

CC:
Robert Brunoe, CTWS THPO, Warm Springs, OR
Brad Houslet, CTWS Manager, Natural Resource Planning, Warm Springs, OR
Mike McKay, CTWS Hydrologist, Warm Springs, OR
Christian Nauer, CTWS Cultural Resources, Warm Springs, OR
Tom Makowski, NRCS, ASTC Watershed Resources, Portland, OR
Carly Heron – NRCS, District Conservationist, Parkdale, OR
Kevin Conroy—NRCS, Basin Team Leader, Klamath Falls, OR
Kathy Ferge – NRCS Tribal Liaison, Portland, OR

USDA

United States Department of Agriculture

Natural Resources Conservation Service

2316 S. 6th St.
Suite C
Klamath Falls, OR 97601
541-887-3511

January 7, 2019

Ms. Carey L. Miller
Tribal Historic Preservation Officer/Archaeologist
Confederated Tribes of the Umatilla Indian Reservation
Cultural Resources Protection Program
46411 Timíne Way
Pendleton, OR 97801

Dear Ms. Miller,

The purpose of this letter is to initiate consultation under the National Historic Preservation Act, within the homeland of the Confederated Tribes of the Umatilla Indian Reservation, for The NRCS proposes to provide technical and financial assistance to the East Fork Irrigation District through the Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL566).

The East Fork Irrigation District (EFID) operates and maintains 17.9 miles of open canals and laterals and 64.8 miles of mostly unpressurized pipeline. EFID proposes to modernize its infrastructure by converting its open canals to buried, gravity-pressurized pipelines; replacing 43.5 miles of older pipelines with high-density polyethylene (HDPE) piping; and by adding a settling basin to manage glacial sand and silt in its water supply. The EFID plans to keep 21.3 miles of its existing pipeline, and to replace piping that is at least 10 years old or more. The project will be divided into segments for the purpose of completing the work. The Eastside Canal is intended to be the first segment addressed by the District.

The EFID canals and laterals are located in Township 3N/ Range 11E/ Section 31; Township 2N/ Range 11E/ Sections 6, 7, 18; 19, 30, 31; Township 2N/ Range 10E/ Sections 12, 13, 21- 28, 33- 36; Township 1 N/ Range 10E/ Sections 1-4, 10,14, 15,22, 27,34; Township 1S/ Range 10E/ Sections 4,5.

All of the project areas will be reviewed and surveyed for historic properties and reports will be submitted to the Oregon SHPO in compliance with the National Historic Preservation Act.

Attached are the proposed project area maps. Please understand this is a voluntary program; therefore, not all proposed projects are implemented. A copy of the completed reports will be made available to you for your review.

If there are any sites of religious or cultural significance to the CTUIR in this vicinity, that you feel may be impacted by this project, please let us know so we can adequately address these concerns. Please let us know if you have any other questions or concerns.

Sincerely,

Rachel LS Gebauer

Rachel L.S. Gebauer
NRCS Basin Cultural Resources Specialist

CC:
Tom Makowski, NRCS, ASTC Watershed Resources, Portland, OR
Carly Heron – NRCS, District Conservationist, Parkdale, OR
Kevin Conroy—NRCS, Basin Team Leader, Klamath Falls, OR
Kathy Ferge – NRCS Tribal Liaison, Portland, OR

USDA

United States Department of Agriculture

Natural Resources Conservation Service

**2316 S. 6th St.
Suite C
Klamath Falls, OR 97601
541-887-3511**

January 7, 2019

V. Kate Valdez. THPO
Confederated Tribes and Band of the Yakama Nation
P.O. Box 151, 401 Fort Road
Toppenish, WA 98948

Dear Ms. Valdez,

The purpose of this letter is to initiate consultation under the National Historic Preservation Act, within the homeland of the Yakama Nation. The NRCS proposes to provide technical and financial assistance to the East Fork Irrigation District through the Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL566).

The East Fork Irrigation District (EFID) operates and maintains 17.9 miles of open canals and laterals and 64.8 miles of mostly unpressurized pipeline. EFID proposes to modernize its infrastructure by converting its open canals to buried, gravity-pressurized pipelines; replacing 43.5 miles of older pipelines with high-density polyethylene (HDPE) piping; and by adding a settling basin to manage glacial sand and silt in its water supply. The EFID plans to keep 21.3 miles of its existing pipeline, and to replace piping that is at least 10 years old or more. The project will be divided into segments for the purpose of completing the work. The Eastside Canal is intended to be the first segment addressed by the District.
The EFID canals and laterals are located in Township 3N/ Range 11E/ Section 31; Township 2N/ Range 11E/ Sections 6, 7, 18; 19, 30, 31; Township 2N/ Range 10E/ Sections 12, 13, 21- 28, 33- 36; Township 1 N/ Range 10E/ Sections 1-4, 10,14, 15,22, 27,34; Township 1S/ Range 10E/ Sections 4,5.

All of the project areas will be reviewed and surveyed for historic properties and reports will be submitted to the Oregon SHPO in compliance with the National Historic Preservation Act.

Attached are the proposed project area maps. Please understand this is a voluntary program; therefore, not all proposed projects are implemented. A copy of the completed reports will be made available to you for your review.

If there are any sites of religious or cultural significance to the Yakama Nation in this vicinity, that you feel may be impacted by this project, please let us know so we can adequately address these concerns. Please let us know if you have any other questions or concerns.

Sincerely,

Rachel LS Gebauer

Rachel L.S. Gebauer
NRCS Basin Cultural Resources Specialist

CC:
Tom Makowski, NRCS, ASTC Watershed Resources, Portland, OR
Carly Heron – NRCS, District Conservationist, Parkdale, OR
Kevin Conroy—NRCS, Basin Team Leader, Klamath Falls, OR
Kathy Ferge – NRCS Tribal Liaison, Portland, OR

Garn
Ron ✓

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT
P.O. BOX 2946
PORTLAND, OR 97208-2946

RECEIVED
MAR 02 2020
USDA/NRCS
Oregon State Office

FEB 2 6 2020

Mr. Jay Gibbs
Acting State Conservationist
U.S. Department of Agriculture
Natural Resources Conservation Service
1201 NE Lloyd Blvd., Suite 900
Portland, OR 97232

Dear Mr. Gibbs:

We have received your January 6, 2020 letter requesting the U.S. Army Corps of Engineers (Corps) review the draft watershed plan-environmental assessment (Draft Plan-EA) for the East Fork Irrigation District Irrigation Modernization Project (Project), located in Hood River County, Oregon. You requested that we review this Project and provide comments.

The Draft Plan-EA describes the Project as multiple efforts to be completed over several years across a larger geographic area. Thus, it does not disclose the details of specific projects, but instead proposes to tier to site-specific project evaluations as they occur. As a result, we can only provide general comments on the Project in regards to Corps jurisdiction and authority.

We have reviewed the Draft Plan-EA pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 (RHA). Under Section 10 of the RHA, a Department of the Army (DA) permit is generally required to construct structures or perform work in or affecting navigable waters of the U.S. The Hood River and its tributaries are not regulated under Section 10 of the RHA. Therefore, based on the maps included in the Draft Plan-EA, it appears a Section 10 DA permit would not be required for the Project.

Under Section 404 of the CWA, a DA permit is generally required for the discharge of dredged or fill material (e.g., fill, excavation, or mechanized land clearing) into waters of the U.S., including wetlands. However, discharges of dredged or fill material that may result from certain activities can be exempt from regulation under Section 404.

The Corps' regulation, 33 CFR 323.4(a)(3), defines some activities not requiring a permit as the construction or maintenance of farm or stock pond or an irrigation ditch, or the maintenance (but not construction) of a drainage ditch.

Draft Plan-EA references Regulatory Guidance Letter No. 07-02, which provides additional information on the Corps' general application of this exemption. However, given the general nature of the Project description, the Corps is unable to determine if the exemption or the aforementioned Guidance Letter will apply to all the proposed activities. For example, the Draft Plan-EA states that enhancement of wetland and riparian habitat in the East Fork Hood River may be included in the project. Discharges associated with enhancement activities do not qualify for the exemption. Additionally, the exemption cited above does not apply to channelized streams which have been modified to serve as irrigation ditches or temporary discharges in waters of the U.S. that may be necessary to complete an exempt activity.

Section 14 of the Rivers and Harbors Act of 1899 and codified in 33 U.S.C. § 408 (referred to as "Section 408") authorizes the Secretary of the Army, on the recommendation of the Chief of Engineers, to grant permission for the alteration or occupation or use of a Corps federally authorized project if the Secretary determines that the activity will not be injurious to the public interest and will not impair the usefulness of the project. An alteration is defined as any action that builds upon, alters, improves, moves, occupies or otherwise affects the usefulness, or the structural or ecological integrity of a Corps federally authorized project. The Draft Plan-EA does not include sufficient information to determine if any project groups would require permission under Section 408.

The Corps Real Estate Division evaluates projects that may impact any real estate interest held by the Corps at a proposed Project location. The Draft Plan-EA does not include sufficient information to determine if any project groups would affect a real estate interest held by the Corps.

The Draft Plan-EA and your letter states that coordination and consultation with the Corps will occur prior to the implementation of each project group. I encourage this coordination with my staff regarding the applicability of the Corps jurisdiction and authority over nonexempt activities associated with your Project. If you have any questions, please contact Ms. Carrie Bond at the letterhead address, by telephone at (503) 808-4387, or e-mail: Carrie.L.Bond@usace.army.mil.

Sincerely,

Aaron L. Dorf
Colonel, Corps of Engineers
District Commander

cc:
U.S. Army Corps of Engineers, Section 408 (Sally Bird)
U.S. Army Corps of Engineers, Real Estate (Amanda Dethman)

USDA

United States Department of Agriculture

Natural
Resources
Conservation
Service

1201 NE Lloyd Blvd.
Suite 900
Portland, OR 97232
503-414-3200

October 5, 2018

Mr. Paul Henson, PhD
State Supervisor, Oregon Fish and Wildlife Office
US Fish and Wildlife Service
2600 SE 98th Avenue
Portland, OR 97266

SUBJECT: Watershed Protection and Flood Prevention Act of 1954 Section 12 Consultation Request for the Irrigation Infrastructure Improvement projects in the East Fork Irrigation District

Dear Mr. Henson,

Aging infrastructure, growing populations, shifting rural economies, and changing climate conditions have increased pressure on water resources across the western United States (U.S.). In parts of the Hood River basin, irrigated agriculture (the primary out-of-stream water use in the area) still relies on infrastructure that is over 100-years-old to deliver water to farms and other users. The Hood River Valley is one of Oregon's leading fruit growing regions and produces one third of the U.S. winter pear crop for fresh consumption (Stampfli et al. 2012).

Although pipelines currently serve most irrigation water deliveries within the East Fork Irrigation District, more than half of these pipelines are older and unpressurized. Additionally, three of the District's four major distribution canals and laterals still exist as open earthen ditches that are inefficient for water conveyance, pose a public safety risk, and require increased maintenance due to their age and other factors. Aging canals and inefficient water delivery systems contribute to water supply insecurity for out-of-stream users and limit streamflow, affecting aquatic habitat and water quality in the Hood River and its tributaries. To address these issues, East Fork Irrigation District (herein referred to as EFID or the District) must invest increasing amounts of funding in canal maintenance and infrastructure modernization.

EFID plans to apply for federal funding assistance for the proposed modernization project through the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (herein referred to as PL 83-566). Authorized by Congress in 1954, this program is managed by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) agency. Through this program, NRCS provides technical and financial assistance to eligible project sponsors to plan and implement authorized projects for watershed protection. A watershed plan will be developed that will help irrigators conserve water, reduce energy consumption, increase irrigation delivery efficiency, improve public safety, and benefit instream habitat for threatened and endangered aquatic species.

The purposes of this project are to:

- Improve water conservation within the Hood River basin by reducing water losses from end spills (operational overflows) and canal seepage
- Support and maintain existing agricultural uses through improved irrigation water management on 9,596 acres in the Hood River basin
- Enhance aquatic habitat by reducing diversion rates from the East Fork Hood River and creating permanent instream water rights with a portion of the conserved water through Oregon's Allocation of Conserved Water Program
- Reduce risks to public safety on 18 miles of open irrigation canal and laterals
- Conserve energy by reducing the need for on-farm irrigation pumping
- Increase water supply security and reliability for District patrons in the face of a changing climate
- Improve financial stability and control long-term operating costs for the District

Consistent with these purposes, the project would specifically address the following concerns:

- Water losses from end spill and seepage in the District's conveyance system
- Water delivery and operational inefficiencies
- Instream flow conditions for threatened fish species
- Drowning hazard along open canals

The Watershed Protection and Flood Prevention Act of 1954 (often referred to as P.L.83-566 or PL 566) authorizes the NRCS to assist States and local agencies in the development of water resources development projects in watersheds of 250,000 acres or less. NRCS provides technical, financial, and credit assistance to local sponsors in the development of projects for purposes including watershed protection, flood prevention, agricultural water management, ground water recharge, water quality management, and municipal and domestic water supply.

These projects are not covered by the consultation provisions of the Fish and Wildlife Coordination Act of 1934, as amended (FWCA). However, consultation is required under Section 12 of P.L. 83-566, which was added to P.L. 83-566 by the 1958 amendments to the FWCA. Section 12 was added in recognition of the need for evaluation of fish and wildlife resources impacts and opportunities at P.L. 83-566 projects in a manner similar to that required for other construction projects under the FWCA.

Section 12 provides that, in preparing project plans, the Department of Agriculture must consult with the FWS regarding the conservation and development of fish and wildlife resources and provide the FWS with the opportunity to participate in project planning. The FWS is to be afforded the opportunity to make surveys and investigations and prepare reports with recommendations on the conservation and development of fish and wildlife. The Department of Agriculture must consider the recommendations contained in FWS reports and include features that are determined to be feasible and that are acceptable to the Department and the local project sponsor. FWS reports are to be included in project reports prepared by the Department of Agriculture. No funds are provided by the Department of Agriculture for FWS involvement in P.L. 83-566 projects; funds for such work must come from those appropriated for FWS work in project planning.

This letter is being submitted to request consultation under the provisions of Section 12 of P.L. 83-566 which provides for consultation similar to that required under the FWCA.

Please provide recommendations on the conservation and development of fish and wildlife you feel are appropriate to the scope of the proposed action.

If you have any questions concerning the environmental compliance process on the draft Plan-EA, please contact Mr. Tom Makowski, Assistant State Conservationist for Watershed Resources and Planning, by phone at 503-621-7626 or by email at Tom.Makowski@usda.gov.

Sincerely,

RONALD ALVARADO
State Conservationist

Cc: Tom Makowski, ASTC – Watershed Resources and Planning, NRCS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
Phone: (503) 231-6179 FAX: (503) 231-6195

Reply To: 01EOFW00-19FY-F-0710
File Name: 2020.06.09 LOC NRCSirr.doc
TS Number: 20-399
TAILS: 01EOFW00-2020-I-0457
Doc Type: final

6-9-20

Ronald Alvarado
Natural Resources Conservation Service
1201 NE Lloyd Blvd. Suite 900
Portland, Oregon 97232-3200

Subject: Informal consultation on the East Fork Irrigation District's Infrastructure Modernization Project, Hood River Basin, Oregon

Dear Mr. Alvarado:

This letter responds to your May 8, 2020, request for informal consultation with the Fish and Wildlife Service (Service) on potential impacts to threatened bull trout (*Salvelinus confluentus*) and its designated critical habitat. The action is the proposed Natural Resources Conservation Service (NRCS) funding of improvements to the irrigation system at the East Fork Irrigation District (Project), as described in the biological assessment (BA). Our review and concurrence are provided pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended (ESA). The consultation timeline for the proposed action was initiated on May 12, 2020, upon our receipt of your letter of request.

The Project involves the multiple improvements to the existing irrigation system, which will eliminate unnecessary water loss, conserving up to 16.6 cfs. As proposed, 75% (12.45 cfs) of the conserved water would be allocated to instream flow. The BA determined the Project "may affect, not likely to adversely affect" bull trout, based upon minor, temporary disturbance to instream and riparian habitat that may occur when the Project crosses stream channels. Based on the Project and effects analysis described in the BA, the Service concurs with your effects determination for the following reasons:

- Few, if any, bull trout are anticipated to be in the Project area during the proposed in-water work. Adult migratory bull trout would be the only likely encountered life stage, and can easily move away from any disturbance. Other life stages would not be encountered.

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- The Project work includes some channel in-water work; however, multiple measures are proposed to avoid and minimize any impacts, as detailed in Section 5.1 of the BA.
- The Project provides long-term conservation of water, which will benefit aquatic habitat, including designated critical habitat, by increasing instream flow in the East Fork Hood River, its tributaries, and the mainstem Hood River during the summer months in reaches where reduced instream flows are considered a primary limiting factor for salmonid production.

This concludes the NRCS's consultation requirements under section 7(a)(2) and 7(c) of the ESA. If information reveals effects of the action may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; the action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this consultation; and/or, a new species is listed or critical habitat is proposed that may be affected by this action, the NRCS would need to re-initiate consultation. If you have any questions regarding this letter, please contact Ann Gray (ann_e_gray@fws.gov) or Chris Allen (chris_allen@fws.gov) of my staff at 503-231-6179.

Sincerely,

Christopher Allen for

Paul Henson, Ph.D.
State Supervisor

ecc: Diridoni- NRCS

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2020-1243

July 13, 2020

Mr. Ronald Alvarado
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
1201 NE Lloyd Blvd
Suite 900
Portland, OR 97232

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter [and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response] for the East Fork Irrigation District Irrigation Modernization Project Watershed Plan (HUC 170701506)

Dear Mr. Alvarado,

On May 13, 2020, NOAA's National Marine Fisheries Service (NMFS) received your request for a written concurrence that Natural Resources Conservation Service funding of the East Fork Irrigation District Modernization Project under the Watershed Protection and Flood Prevention Act and the Regional Conservation Partnership Program of the Food Security Act of 1985 is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency template for preparation of letters of concurrence.

NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), including conservation measures and any determination you made regarding the potential effects of the action. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency template for use of the ESA consultation process to complete EFH consultation. In this case, NMFS concluded the action would not adversely affect EFH. Thus, consultation under the MSA is not required for this action.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at Portland, Oregon.

Consultation History

NRCS provided NMFS with a draft project BA for review on February 11, 2020 and a final BA and consultation request on May 13, 2020.

Proposed Action and Action Area

The East Fork Irrigation District (EFID) proposes to replace 17.5 miles of open canals and up to 38.3 miles of existing pipelines with new high-density polyethylene (HDPE) pipe for pressurized water delivery to irrigation district patrons. EFID proposes to upgrade existing turnouts[1] and install pressure-reducing valves to alleviate high pressures within the system (Figure *1*). The EFID will also excavate an off-channel, 4.93 acre-foot sedimentation basin. The EFID will periodically remove sediment that accumulates in the basin and place it in an upland area. The construction sequence of the proposed action is; excavation with a track hoe or similar heavy equipment, laying pipe, bedding pipe, replacing existing turnout gates, installing pressure reducing valves along pipelines, and re-contouring and reseeding disturbed soils following pipeline installation. Construction would occur over the course of 10 years in three project groups. The only proposed in-water construction work is the replacement of two sublateral pipelines that cross Lenz Creek. If it is necessary to replace these pipelines, EFID will use nets to herd fish away from the work sites and block them from reentering work sites.

The action area consists of; Hood River from Middle Fork Hood River river mile 14.6 to its confluence with the Columbia River, EFHR from the EFID diversion at river mile 6.6 to its confluence with the Middle Fork Hood River, West Fork Neal Creek from river mile 1.8 to the confluence with Neal Creek, Neal Creek from the West Fork Neal Creek confluence to its confluence with Hood River, Odell Creek from river mile 2.3 to its confluence with Hood River, Whiskey Creek from river mile 1.3 to its confluence with Hood River and Lenz Creek from river mile 1.2 to its confluence with Neal Creek. The action area also includes the upland areas 50 feet on each side of the canals and pipelines and 50 feet around the sediment basin near the EFID diversion.

[1] The point at which the control of the water changes from the irrigation district to the customer

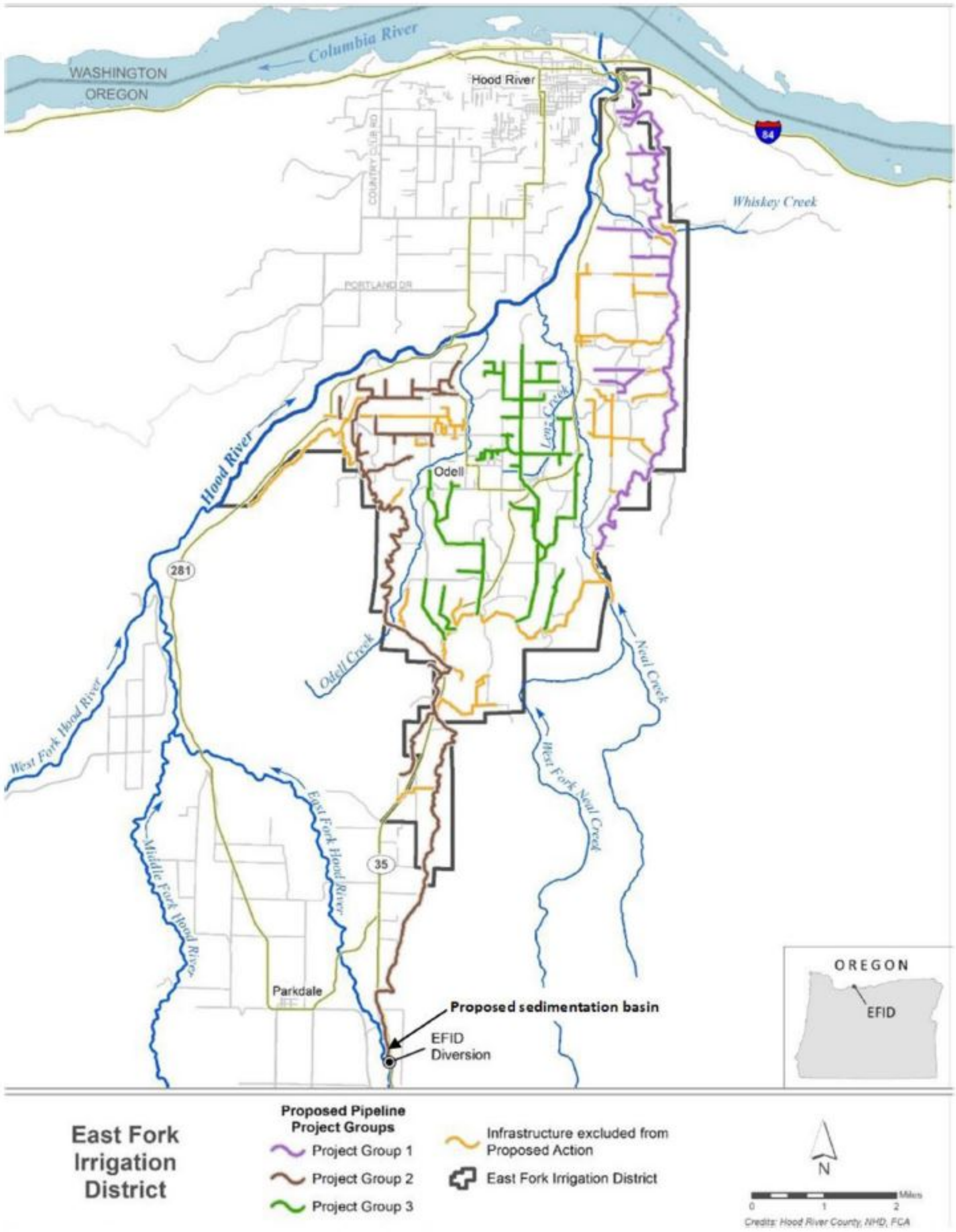

Figure 1. East Fork Irrigation District Modernization Project with phasing by project group.

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WCRO-2020-1234 (USDA-NRCS)

We considered whether or not the proposed action would cause any other activities and determined that it would not.

Background and Action Agency's Effects Determination

The EFID diverts up to 117.36 cubic feet per second (approximately 75 percent) of the available late summer flow of the EFHR. The reach between the EFID diversion at river mile 6.6 and the point where a portion of the diverted water returns from the EFID fish screen facility at river mile 6.1 is a fish passage concern. Since the existing irrigation system is unpressurized, the EFID maintains end spills at approximately 25 locations in five EFHR tributaries. Maintaining end spill flows requires the EFID to divert an average of 16.6 cubic feet per second more flow than it uses for irrigation. End spills also transfer glacial silt and heat (Stampfli et al., 2012), insecticides, fungicides, herbicides, fertilizer, and other contaminants present in canal water to these tributaries and ultimately to the EFHR and Hood River. Pressurizing the system eliminates end spills. The EFID will leave 12.45 cubic feet per second of the no longer need 16.6 cubic feet per second in the East Fork Hood River. EFID must remove glacial silt from EFHR irrigation water to protect irrigation equipment. In the existing system, glacial silt settles in small settling basins incorporated into the irrigation canals and recovers the capacity of these basins by periodically flushing accumulated sediment into the EFHR. After pressurized pipelines replace canals, the EFID will remove glacial silt from irrigation water in the new 4.93 acre-foot settling basin. The EFID will excavate sediment that accumulates in the basin and place it in upland locations thereby reducing the mass of sediment delivered to the EFHR.

The NRCS determined that the effects of the proposed action on Hood River Chinook, coho and steelhead and their critical habitat are: 1) an increase in EFHR flow from late July through September; 2) the elimination of sediment flushing into the EFHR; 3) blocking fish movement in Lenz Creek if sublateral pipelines crossing the creek are replaced.

1) The NRCS concluded that the increase in EFHR streamflow is beneficial because streamflow is a limiting factor to Hood River Chinook, coho and steelhead passage.
2) The NRCS concluded that the elimination of sediment flushing into East Fork Hood River is beneficial because suspended sediment is detrimental to fish health and spawning redds.
3) The NRCS concluded that the temporary disruption of fish movement in Lenz Creek is insignificant because the construction will not be done during adult or smolt migration periods, rearing juveniles will be blocked from the work site with nets and work site isolation does not require fish salvage.

Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

The effects of the proposed action include: 1) Increased EFHR streamflow. 2) Elimination of sediment flushing into EFHR. 3) Temporarily blocked fish movement in Lenz Creek.

1. NMFS concurs with the NRCS that returning 12 cubic feet per second of flow savings to EFHR is beneficial to Hood River Chinook, coho and steelhead and their critical habitat. Increased streamflow improve critical habitat physical and biological features including water quantity and quality and fish passage.

2. NMFS concurs with the NRCS that eliminating in canal sediment flushing into EFHR tributaries is beneficial to Hood River Chinook, coho and steelhead and their critical habitat. Suspended sediment can be physically injurious to salmon and steelhead and once incorporated into bedload can degrade the quality of substrate salmonids use to construct redds.

3. NMFS concurs with the NRCS that the temporary disruption of fish passage in Lenz Creek while crossing pipelines are replaces is insignificant. Lenz creek is likely to occupied by rearing coho and steelhead (Streamnet) but in-water work windows do not overlap periods of coho or steelhead smolt outmigration. If EFID replaces these pipes, they will use nets to herd fish away from, and keep fish from reentering the work sites.

Conclusion

Based on this analysis, NMFS concurs with the NRCS that the proposed action is not likely to adversely affect the subject listed species and designated critical habitats.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by NRCS or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA portion of this consultation.

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. The NRCS also has the same responsibilities, and informal consultation offers action agencies an opportunity to address their conservation responsibilities under section 7(a)(1).

Please direct questions regarding this letter to Tom Hausmann, at Tom.Hausmann@noaa.gov, or by calling 503-231-2315.

Sincerely,

Scott A. Hecht, Ph.D.
Branch Chief,
Washington Coast Lower Columbia River Branch
Oregon Washington Coastal Area Office

Cc: Gary Diridoni, NRCS

References

Stampfli, S., Saunders, M., Eineichner, B., and Pilz, D. (2012). EFID Central Canal Pipeline Project -Stream Flow, Water Quality, and Fish Passage Final Report (Odell, Oregon: East Fork Irrigation District).