Appendix A

Comments and Responses

Table A-1. Topics and Associated Codes.

Topic	Topic Code	Topic	Topic Code
Alternative Analysis	ALT	Property Value	PROP
Construction Process	CONS	Public Process	PUB
Fish and Aquatic Species	FISH	Water	WAT
General	GEN	Wildlife	WILD
Project Benefits	BENF		

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

Comment ID	Topic Code	Comment	Response
1.01	WAT	I would like to know the justification for the public's having to pay for private patrons' water and access rights—many of whom waste it regularly just so they can maintain those 100 year old and obsolete water rights? For that reason, I oppose the pipeline and the meager water savings projected. The patrons can pay for their own water until such time as they pay for mine. Email referenced the following quote: "The proposed project would improve water conservation in District-owned infrastructure and improve water supply management and delivery reliability to District patrons …"	There are a variety of benefits that make a project eligible to receive funding from the NRCS PL-566 Watershed Program. Project benefits under PL-566 can include agricultural and environmental benefits. The quantified benefits of this project include "agricultural damage reduction benefits" in the form of water for NUID patrons to meet supply shortfalls and increase agricultural production. Other quantified benefits in the Plan-EA include instream water, energy cost savings from reduced patron pumping, reduced operations and maintenance costs, and reduced carbon emissions from reduced pumping. In addition to quantifiable benefits, other public benefits and ecosystem services that are not quantifiable are described in Appendix D.1.2, including public safety, and in the Plan-EA in Sections 4 and 6. Per the requirements of the Updated Principles, Requirements, and Guidelines for Water and Land

			Related Resources Implementation Studies, the Plan-EA is required to describe the ecosystem services associated with each resource (PR&G; Council on Environmental Quality 2014). Some of the project's effects on ecosystem services may be beneficial. Please see Section 4 of the Plan-EA for an explanation of what ecosystem services are and how they are analyzed in the Plan-EA. References: Council on Environmental Quality. (2014). Updated principles, requirements, and guidelines for water and land related resources implementation studies. The White House President Barack Obama. https://obamawhitehouse.archives.gov/administration/eop/ceq/initiatives/PandG
2.01	WAT	A publicly funded project such as this should result in a significant increase in flow of the Upper Deschutes River in the winter or in the Middle Deschutes River in the summer. I missed where this benefit is outlined in the Draft Plan-EA, and I apologize if it is there and I didn't see it. Such a significant benefit to the Deschutes River should be a requirement for public funding to be used on this project.	Following public input received during the public comment period (held July 6, 2022 - August 10, 2022), the Plan-EA and associated analyses have been updated to clarify that the District would provide 25% of the water saved from the project (up to approximately 1,522 acre-feet) for instream use in the Deschutes River downstream from Wickiup Reservoir during the non-irrigation season. Please see updated language in Section 6.8.2 of the Plan-EA for additional discussion of the potential effects on water resources.
3.01	GEN	My husband and I live in Deschutes River Woods and support the canal being piped! It should have been done years ago!	Thank you for your comment.
4.01	PUB	The public scoping meetings FCA holds are inadequately informative. First in addressing the sections of the EA from one district and project to the next the findings are boilerplate, not suitable to all projects and deny controversy when it clearly exists. Then there seems to be an assumption on the part of the presenters that one has not read the draft plan-EA. It is irritating to ask a question, be given a non-answer, and then referred to a portion of the plan that one has already read that in no way answers the question or addresses a concern.	For public comment periods and public participation, the Council of Environmental Quality (CEQ) regulations for implementing NEPA, require the lead federal agency (in this case the NRCS of the USDA) to involve the public to the extent practicable. However, each agency has its own guidelines about how to involve the public for Environmental Assessments. The public comment

		I'm surprised anyone bothers to show up for these meetings. I doubt I will continue to waste my time doing so.	meeting was conducted in a manner that aligns with both the CEQ regulations and guidance in the NRCS National Watershed Program Handbook (NRCS 2016, Sections 601.24 and 602.2). The Plan-EA has been prepared to meet NEPA requirements as well as program and environmental review requirements specific to NRCS federal investments in water resources projects. Please see Section 1.4 and 7.1 of the Plan-EA for more information. Reference: U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). (2016) National Watershed Program Handbook. Retrieved from https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=35135.
5.01	WAT	I believe public funding for this project should be denied as it does not increase flows in the Deschutes River. Public funding should not be used for purely private benefit. These same public funds could be used to pipe other canals with the benefits of increasing water security and reliability to NUID, increasing flows in the Upper Deschutes for public benefit, and further helping to meet the requirements of the DBHCP.	Please see the responses to Comment ID 1.01 about project benefits and Comment ID 2.01 about water rights transferred to instream use in the Deschutes River.
6.01	WAT	I commend the NUID for making their system even more efficient. I am very upset that taxpayer money is being used without any water savings going back in stream. It's not only the irrigation who are facing issues related to climate change. Our rivers are over appropriated and this is an opportunity to make a modest improvement to help correct that. The canal seepage goes into the groundwater which ends up in the river. This recharge will be reduced due to the canal lining. This is only one reason the river should benefit from this project. Other projects like this have put 25-50% of the conserved water back instream. Please rethink your rationale for not following that precedent.	Please see the response to Comment ID 2.01 about water rights transferred to instream use in the Deschutes River. Please see Section 6.8.2.4 in the Plan-EA for more information regarding effects on groundwater.

7.01	WAT	To who it concerns, I read an article about your piping project in north unit and I think piping the canals is a great thing. Save every bit of water we can. Thanks.	Thank you for your comment.
8.01	WAT	Yes, I am IN FAVOR of piping this canal. Much water can be saved by doing this.	Thank you for your comment.
9.01	PUB	To North Unit irrigation district and Farmers Conservation Alliance. The League of Women Voters of Deschutes County intends to comment regarding north units request for Pl83-566 monies to pipe and pressurize their laterals and other actions. Due to summer holidays the approval needed from the State of Oregon LWV and LWV of the United States may be delayed for several days. I hope you can grant us until Friday to submit our comments. Thank you. [NAME], League of Women Voters of Deschutes County Water Chair.	Thank you for your comment.
10.01	WAT	Vehemently opposed -Review the information on water loss through evaporation provided by the water co. They are using a model that doesn't match this system. This system has ample tree shade coverage and vegetative growth along its side, preventing most of the evaporation they claim reduces their output. Their model to measure evaporation loss has no coverage	Water loss numbers in the Plan-EA include water loss as a result of both seepage and evaporation. Please see Section 2.2.1 of the Plan-EA for an overview of water losses in the system, and please see updated language in Section E.5.1 of the Appendix for a description of how water loss numbers were developed.
10.02	PROP	-This project will greatly reduce home values along the canal. Is the water project going to compensate the home owners?	Additional information about property value along the canals that are proposed to be piped was added to the Plan-EA. Please see Section 4.4.4 and 6.4.2.3 in the Plan-EA. Water saved from the project would be used to benefit District patrons and instream flows. Please

			see Section 6.8 of the Plan-EA for more information regarding the use of saved water.
10.03	ALT	-Estimates to line the canal are a cheaper option	Canal and lateral lining were considered as alternatives during the planning process, and the long-term costs of canal and lateral lining are greater than the long-term costs of piping. Please see Appendix D.6 of the Plan-EA for additional analysis of the net present value of the Canal Lining Alternative and the Preferred Alternative.
10.04	WILD	-Wildlife has become dependent on this canal, and to such a degree it has become a riparian corridor	Please see Section 4.11 of the Plan-EA for a discussion of wildlife in the project area and Section 6.11 of the Plan-EA for a discussion of the potential effects on wildlife.
10.05	CONS	-Home owners lives will be GREATLY DISTURBED due to the reconstruction Please reconsider the option to line the canal and meet the community living here with a COMPROMISE that can be more pleasant to BOTH sides	Please see Section 8.2 of the Plan-EA for a discussion of construction timelines. The project is planned to be completed over 6 years beginning in 2023 and ending in 2029. Construction would occur during the non-irrigation season. The District will work with adjacent landowners to notify them about construction timing and minimize effects from construction. Please see Section 8.3 of the Plan-EA for a discussion of minimization, avoidance, and mitigation measures.

11.01	WAT	The Sunriver Anglers (SRA) consist of 180 members who primarily reside near or on the Deschutes River above Benham Falls. Anglers and other residents of the Upper Deschutes are impacted by NUID Irrigation Infrastructure projects when those projects do or do not provide conserved water to enhance instream flows, mainly inadequate instream Winter flows out of Wickiup Reservoir. To ensure that public funds actually result in instream flow and other environmental benefits, SRA has been an active, charter member of both the Upper Deschutes Basin Study as well as the Deschutes Basin Water Collaborative. In addition to shared fishing experiences, community education, and recruiting the next generation of anglers and river stewards, conservation is a key component of our mission. In keeping with that mission, Sunriver Anglers oppose accepting NUID's draft EA. We believe that the Natural Resource Conservation Service (NRCS) must reject this draft EA and require a second, revised draft EA that addresses concerns raised by Sunriver Anglers and other stakeholders. A new public comment period on the revised draft EA must also be required. 1. The NUID Draft EA must describe the standard for public benefits required by Public Law 83-566, and it must also show that this project meets that standard. PL-566 funding requires a description of the environmental value of the project. The proposed project will include constructing four ponds to capture tailwater returns and perhaps incrementally improve downstream water quality. The Draft EA neither includes a description of those water quality issues, nor does it provide data on how and to what degree this project will resolve them. Assuming that there is public environmental benefit in construction of the retention ponds, that could be completed at a much lower cost than piping the district.	Please see the response to Comment ID 1.01 related to project benefits. Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see Section 4.8.3 of the Plan-EA for a description of current surface water quality issues and Section 6.8.2.3 of the Plan-EA for the proposed project's effects on water quality. Construction of the retention ponds would reduce the District's operational discharge into nearby waterbodies including the Crooked River and an unnamed ephemeral creek that feeds into Willow Creek For additional discussion, please see sections 6.8.2.3.6 and 6.8.2.3.7 of the Plan-EA. Section 6.8.2.4 and footnote 49 in the Plan-EA summarize the amount of water that would be eliminated from discharge into the surface water of nearby waterbodies (up to 2,000 acre-feet/ year). Language has been clarified in the Plan-EA that, due to instream water levels, any beneficial effect in nearby waterbodies as a result of eliminating operational spills at the four locations identified in Section 6.8.2.4 of the Plan-EA would be below the level of detection. This planning process has complied with applicable federal requirements and guidelines. Please see Section 1.4 of the Plan-EA for a list of these requirements and guidelines. These federal guidelines and requirements do not typically require the issuance of a revised Draft Plan-EA and an associated public comment period. If NRCS issues a Finding of No Significant Impact (FONSI) for the project, the FONSI and Final Plan-EA will be available for a 30-day public review.

11.02	BENF	2. The draft EA doesn't describe any significant public benefits from approving the project funding request: no instream flow increases; no improved aquatic species habitat; no recreational enhancements; no contribution to meeting ID obligations under the Habitat Conservation Plan (HCP) and ESA listings in the Upper Basin. Sections 6.3 and 6.4 of the draft EA describe modest public benefits re safety and socioeconomic issues, but those are not public environmental benefits and do not provide an environmental return proportionate to the required public investment. 3. There have been other PL-566 funded projects that provide instream flow and habitat benefits. To date, all other PL-566 piping projects in the Upper Deschutes Basin have included dedicating conserved water to increasing flows. For previous funding by the Oregon Watershed Enhancement Board (OWEB), public environmental benefit analysis was a key part of the grant process. Under previous PL-566 funded projects completed in COID, Tumalo, and Swalley IDs, 75-100% of conserved water has been returned to the river as protected, instream flows. The Lone Pine ID project which has been approved, and the pending approval of Arnold ID's watershed plan, both provide for conserved water being protected and returned instream. All of those projects provide tangible, significant, public environmental benefits. As described, this NUID plan does not. There is no analysis in the draft as to why this project should not include conserved water public benefits, in exchange for public funding of private ID modernization and efficiencies. 4. Federal Water Resource Investment General Requirements provide that Agencies must consider "protecting and restoring natural system functions" when analyzing Federal water resource investments. The failure to submit an analysis of a "restore instream flows alternative" is reason enough to reject this draft EA. The fact that other ID PL-566 projects actually do enhance instream flows demonstrates that both public and private benefits can be achieved.	Please see the response to Comment ID 1.01 related to project benefits. Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.
11.03	WAT	5. If PL-566 funding were routed through Oregon Conserved Water Statutes ("OCWS"), conserved water would be required to enhance instream flows. That would ensure that both IDs and the Public will benefit. The percentage of conserved water that must be returned instream is dependent upon the ratio of public to private funding. This NUID project would be 100% publicly funded, so under OCWS, 100% of any conserved water would need to be protected and returned instream. Routing funding under the Oregon statute would result in substantial public flow restoration benefits while also greatly enhancing and modernizing NUID's system. 6. Federal law requires that, if the project is not routed through the Oregon Conserved	Oregon's Allocation of Conserved Water Program provides a water rights administrative process for allocating saved water to additional uses or users. Please see Oregon Revised Statutes ORS 537.465 for additional detail on the program (please also see https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3143). The use of this voluntary, state program is neither identified in nor required by federal regulations or guidelines. As a water rights administrative process, Oregon's

		Water Process, the proposal must analyze and explain this decision. There is no such analysis in the NUID proposal, and that in itself mandates that NRCS reject this draft EA. 7. Perhaps most importantly, an alternative using OCWS funding for COID modernization would result in both NUID and the Deschutes receiving more water. There is an established, existing pathway for COID projects to provide conserved, senior rights water to NUID in exchange for NUID winter releases from Wickiup Reservoir. This alternative would unquestionably be a win for NUID, COID, the Deschutes, and the Public. It would also facilitate Deschutes Basin Irrigation Districts meeting their obligations for Wickiup releases under the HCP. The Sunriver Anglers have been a partner-advocate for both a more secure, predictable water supply for NUID and for increased Winter flows in the Upper Deschutes. We intend to continue advocating for both farmers and for the health of the Deschutes. We believe this Draft EA does not benefit both, as it clearly could. NRCS must fulfill their fiduciary responsibility to maximize the benefit of public investments. That is also a good business plan, and one we will strongly support. Please feel free to contact us if you need additional information or assistance.	Allocation of Conserved Water Program does not serve as a funding mechanism or pathway for either state or federal funds. Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Funding to improve COID infrastructure would not meet the purpose and need of the proposed project and therefore was not considered as an alternative. Please see Section 5.1 of the Plan-EA regarding how alternatives were formulated.
12.01	WAT	Dear District Staff and Other Planning Entities: Trout Unlimited is a non-profit organization with a mission to conserve, protect and restore North America's cold water fisheries and their watersheds. TU has over 3,000 members in Oregon and 650 in our local Deschutes Redbands Chapter (Chapter). Restoring instream flow to the Deschutes and its tributaries is a key objective for our members. To that end, we have been involved with a variety of projects in the Deschutes Basin intended to help restore instream flows and improve water quality in priority waterways. We support irrigation improvements as a key part of any long-term water conservation solution. Our Chapter appreciates this opportunity to provide comments on the Draft Watershed Plan - Environmental Assessment (draft EA) supporting the North Unit Irrigation District's (District) Infrastructure Modernization Project (Project). This $34 million project, of which $25.8 million will be funded through PL 83-566, is estimated to produce over 6,000-acre feet of water savings annually primarily through piping of 27 miles of laterals along with construction of four 1,000 cubic yard retention ponds. Our Chapter believes that there are gaps in the analysis and discussion contained in the draft EA which must be addressed in the final EA, as detailed below: 1. The final EA must describe the standard for public benefit required by PL 566 and how this project meets that standard. The proposed project does not include any specific statement of	Please see the response to Comment ID 2.01 about the water that will now be protected instream.

		public benefit relative to instream flows, aquatic species, or recreation from this $25.8 million expenditure of PL 83-566 funds. Defining public benefit is a fundamental requirement for access to these funds. The draft EA refers to Sections 6.3 and 6.4 as describing the relevant public benefit provided, but the benefits described focus only on human safety and socioeconomic factors. Indeed, Appendix D of the draft EA expressly states: "The conserved water from the proposed project is anticipated to be used by NUID irrigators with no expected direct benefit to...non-consumptive instream water uses such as habitat or recreation." (p D-3). The July 25th public meeting on this project did note that PL 83-566 funding requires an environmental value or benefit from the project. In response, the draft EA identifies the construction of four retention ponds to capture tailwater returns and perhaps incrementally improve water quality in the Deschutes. Unfortunately, there is no analysis in the draft EA regarding the current levels of pollutants in these tailwaters and the metrics used to estimate their likely impact on the quality of water in the Deschutes. If the only public benefit derived from the project is limited to these retention ponds as indicated in the draft EA, then they could be constructed without the 27 miles of proposed piping at a small fraction of the $34 million total construction cost. This minor aspect of the overall project cannot be accepted as a rationale for not analyzing the potential benefits of broader instream flow restoration. Other irrigation piping modernization projects in the Upper Deschutes Basin have resulted in conserved water being returned instream. During the era of the Oregon Watershed Enhancement Board ("OWEB") funding, this commitment of returning conserved water instream was incorporated into the criteria for evaluating grant proposals. Under PL 83-566 funding, the accepted standard in the Upper Deschutes Basin has been that 75% to 100% of conserved water be returned instream. Examples of this are PL 83-566 project funding for modernization projects completed or underway in the Central Oregon, Tumalo, Three Sisters and Swalley irrigation districts, pending approval of modernization projects in Arnold irrigation district and an approved modernization project in Lone Pine irrigation district. These irrigation projects have set the bar in equating public benefit to the amount of conserved water being returned instream. We do not see anything in the District's project proposal that provides similar public benefit to our community or rivers. The final EA should address why the standard set by the irrigation piping projects in other districts, which result in conserved water being returned and protected instream, is not being followed in this project.	

12.02	WAT	2. There would be a public benefit – to instream flows, aquatic species, and recreation – from this expenditure if the funding were routed through Oregon's "Allocation of Conserved Water" statutes and program (ORS 537.455 – ORS 537.500). Oregon's conserved water statutes provide a framework for when and how public funding for irrigation efficiency projects result in protected instream flow. In short, ORS 537.470(3) provides that if the state receives an application under the program, and more than 25% of funds used to finance the project are public and non-repayable, then a corresponding proportion of the water conserved is allocated to the state and eligible to be converted to an instream water right. If this project and its funding were required to make an application through these statutes, we believe there would be an important public benefit served by the project in the form of instream flow restoration.	Please see the response to Comment ID 1.01 related to project benefits. Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see the response to Comment ID 11.04 related to Oregon's Allocation of Conserved Water Program and PL 83-566.
12.03	WAT	3. The final EA must explain why this project's funding is not being routed through and reviewed under Oregon's conserved water statutes. The draft EA offers no explanation as to why this project is being evaluated without consideration of Oregon's conserved water statutes. The final EA must provide the rationale for this. In Section 3.4 and 3 Table 3-2 of the draft EA, numerous scoping questions regarding conserved water and instream flow are posed. The draft EA repeatedly refers these questions to Section 6.8.2 of the document. However, Section 6.8.2 of the draft EA provides no answers to such questions. This defect must be addressed, and the final EA must provide a clear statement and rationale as to why this project is not being evaluated and applied under Oregon's conserved water statutes.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see the response to Comment ID 11.04 related to Oregon's Allocation of Conserved Water Program and PL 83-566.
12.04	WAT	4. For this level of investment, there are other irrigation modernization projects in the Deschutes Basin that would provide more water savings and greater public benefit. The final EA must include an analysis of the comparative public benefit available from other modernization projects in the Basin. The alternatives analyzed in the draft EA do not include a modernization option based on directing this funding to other projects in the Deschutes Basin that would provide a greater "return on public investment" as measured by improved instream flows and benefits to aquatic species, while also meeting the stated modernization goal of improved water supply security for the District. For example, the geology underlying Central Oregon Irrigation District's (COID) open distribution systems are much more porous than those in the District, resulting in significantly higher seepage and water loss. In terms of water saved per dollar spent, piping within COID is therefore a better public investment. And this could be	Central Oregon Irrigation District (COID) has used the PL-566 program to access funds to modernize a portion of its system, and like COID, NUID is pursuing completion of the requirements that would enable the District to be eligible for funding through the same program. Consistent with NRCS and PL-566 program requirements, NUID requested assistance from NRCS to address the District's water resource needs. Please see the portion of the response to

		done while still enhancing the District's own water rights. Through the pathway implemented for current PL 83-566 funded COID projects, the District would receive the conserved water for their own use and under more secure senior rights than the District currently holds, in exchange for winter releases from Wickiup. For perspective, it is estimated that this yield will be ~35 cfs instream flow with an equal quantity of water for the District from the current COID modernization through PL 83-566. It could be argued that this may lessen the value of this pathway compared to the District's current project proposal, for operational efficiencies, but their obligations for Wickiup releases under the Deschutes Basin Habitat Conservation Plan (HCP) must be met. This obligation is a commitment of all signatories to the HCP, so fulfilling it is a benefit for not just the District, but for all Deschutes Basin Board of Control irrigation districts. The acceptance of this pathway was codified in a 2017 Deschutes River Conservancy (DRC) Joint Resolution among COID, the District and other basin stakeholders represented on the DRC Board which includes the Confederated Tribes of Warm Springs. We appreciate the opportunity to comment on this draft EA. Our Chapter looks forward to continued collaboration with the District and others to develop and implement water management solutions in the Deschutes Basin.	Comment ID 11.03 related to consideration of COID as an alternative.
13.01	WAT	To Whom It Concerns: Thank you for this opportunity to provide comments on the Draft Watershed Plan-Environmental Assessment for the NUID Infrastructure Modernization Project ("Project Draft EA"). Central Oregon LandWatch is a conservation organization which has advocated for the preservation of natural resources in Central Oregon for over 30 years. With over 750 members in Central Oregon, LandWatch has worked on water resource issues in the Deschutes River Basin for many years, and understands the complexities and challenges that three years of pervasive drought present for basin-wide water resource management. With the current drought and hydrologic unpredictability brought on by climate change, LandWatch supports North Unit Irrigation District (NUID) in its push to modernize and improve efficiencies across the district. Therefore, LandWatch supports NUID's adoption of a 27.5-mile pipeline project that will conserve a great deal of water as compared to the current open, leaky canals. That said, we believe there are shortcomings in the amount of water placed instream as part of this project, as currently outlined in the Project Draft EA. There is no question that NUID and its farmers are suffering in the current system and under the current climate conditions, and	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.

		LandWatch agrees that changes must be made to support NUID's irrigators—commercial farmers who help support our entire region. With that said, we must also protect the river, which is suffering from historic low flows that threaten the survival of many species. Further, the mechanisms at use here— Public Law 83-566 (PL-83-566) funding, in addition to instream flow requirements under the HCP, call for this Project to not only supply the Project's irrigators, but to also benefit the public and protect the river and its species—protections that are not outlined in the Project Draft EA. Providing benefits to both irrigators and the river is a central tenet to modernization efforts and is emphasized by elected leaders and water managers across the region, including by the President of the Deschutes Basin Board of Control who recently stated that "the districts are committed [to] putting water into the Deschutes River as soon as conservation piping and on-farm projects are completed." As such, we repeat many of our same arguments from our comments on the Project Preliminary Investigative Report, to further address our main concerns.	
13.02	WAT	I. Conserved Water Allocations Instream a. Make Public Benefit Explicit in Purpose and Need of Project The Project purpose and need statement should expressly state that the purpose for conserving water with the requested taxpayer dollars is to place the Project's conserved water instream for the public benefit of protections for fish and wildlife. The Natural Resource Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, PL-83-566, requires that projects must meet all requirements set forth in the National Watershed Program Manual, Title 390, Part 500, Section 500.0(C)(1) et seq., including the requirement that a proposed action must be carried out for the benefit of the general public. As we stated in our Project PIR comments, improved streamflow for the benefit of fish and wildlife are widely understood to be a primary motivating factor for water conservation Projects in Central Oregon, and our state's congressional delegation agrees. The Project Draft EA says the Project's purpose and need is "Agricultural Water Management through improved water delivery reliability and water conservation along District infrastructure," and is eligible for the federal public law funding under: "'…Authorized project purposes, (v) Agricultural Water Management' due to the proposed project's focus on irrigation water conservation and more reliable agricultural water supply delivery."	Based on public feedback during the public comment period, diminished instream flows in the Deschutes River that limit fish and aquatic habitat has been added to Section 2.2 Watershed Problems and Resource Concerns. Enhance streamflow and habitat conditions for fish and aquatic species has been added to Section 5.3 as contributing to the sponsor's objectives and to the Federal Objective and Guiding Principles. Language has also been added in Section 8 to include water released instream as water resource mitigation.

		LandWatch, however, believes that water conservation is not a public benefit unless the conserved water is put to a public purpose. While the Project can, and will, promote a more reliable agricultural water supply which serves the agricultural water management objective, the water conserved from reduced seepage and evaporation from piping infrastructure, estimated around 6,089 acre-feet, is going to private patron use. The project purpose should instead direct conserved Project water instream. As the Project Draft EA states: 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: …(3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.' This further supports that the Project must go beyond just creating a more reliable water delivery system— flows in the Deschutes and Crooked rivers have been highly modified by diversions for over a century, and are in dire need of protection and restoration. Therefore, the public benefit of this Project must be clear and explicit; increased instream flows are needed to restore the Basin's natural systems, and the District should allocate the Project's conserved water instream for fish and wildlife.	
13.03	WAT	b. District should allocate Project conserved water instream As laid out in the Project Draft EA, the NUID Modernization Project is funded under PL 83-566; in fact, PL 83-566 funds are covering 76 percent of the project cost—$25,810,000 of the total $34,020,000.6 As described above, projects from this funding source must meet all requirements set forth in the National Watershed Program Manual, including that the project is for the benefit of the general public.7 For the NUID Infrastructure Modernization Project, this means more water must be placed instream, as currently, no water is placed back instream under the proposed action. The public expects that public money spent on water conservation in Central Oregon will benefit public resources, especially habitat for fish and wildlife in the Deschutes River. Instream flows in the upper Deschutes Basin are critical to the proper functioning of floodplain, riparian, and aquatic ecosystems. However, as stated in Appendix D. D.1.2: The conserved water from the proposed project is anticipated to be used by NUID irrigators with no expected direct benefit to other consumptive water users in the region or to non-consumptive instream water uses such as habitat or recreation."8 (emphasis added). Therefore, a public benefit will only be realized if the District commits to transferring the Project's conserved water to instream flows.9 LandWatch is typically a staunch advocate for	Please see the response to Comment ID 1.01 related to project benefits. Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.

		100% of Modernization Projects' conserved water going back instream. Here, LandWatch understands the immense pressure commercial farmers face in NUID, and understand that a 100% commitment is not timely. However, rather than deliver 100% of the water to private water patrons, the District should commit to transferring a majority of the water conserved by the Project to instream uses to protect fish and wildlife, as this is the required public benefit and could help NUID meet its HCP conservation measure requirements.	
13.04	ALT	II. Improper Identification/ Range of Alternatives LandWatch carries over many of the same comments made on the Project Preliminary Investigative Report in regard to the Project Draft EA's improper identification and range of alternatives. The Project Draft EA only considers two alternatives: the no action alternative and the District's preferred alternative. The National Watershed Program Manual Title 390, Part 500, Section 501.12(A)(1) requires that "[a]ll reasonable alternatives that address the purpose and need for action must be presented in the watershed Project plan, including those not within the program authorities of the NRCS and those not preferred by sponsors." The draft EA only considers the piping alternative with 100% of conserved water going to private patrons. This limited consideration of alternatives results in a myopic analysis that assumes that complete piping of District canals is the only reasonable method for achieving the Project's purpose and need, which is already skewed against a public benefit. Several other alternatives would achieve that Project's goal, and would do so more efficiently, conserving more water for less cost to the public. A basic requirement of NEPA is that a Project such as this considers a reasonable range of alternatives; an agency's failure to analyze viable alternatives consistent with the objectives of its proposed action renders an EA inadequate. Reasonable Project alternatives exist; the recently completed Deschutes Basin Study Work Group study showed that the most cost-effective way for irrigation districts to conserve water is through on-farm efficiencies, piping of private laterals, voluntary duty reductions, and market-based water leasing and transfers. The alternatives are proven to be feasible, would meet the Project's purpose and need, and would conserve more water for less public money. Four documents from the Upper Deschutes Basin Work Group show the viability of alternatives to canal piping. They are: Multi-Criteria Evaluation of Alternatives and Scenarios; Market-Based Approaches as a Water Supply Alternative; Water Conservation Assessment; and Water Right, Legal and Policy Opportunities and Impediments Associated with Options for Water Movement.	The District and NRCS agree that water conservation through piping district infrastructure is one of various potential water management tools. Nine alternatives were initially considered during the scoping process, including on-farm efficiency upgrades. Section 5.1 of the Plan-EA briefly describes the process for formulating alternatives and Appendix D.3 has a list of the alternatives considered during formulation and a detailed discussion of why these alternatives were eliminated from further evaluation in the Plan EA. The formulation of alternatives followed the Council on Environmental Quality's regulations for implementing NEPA and USDA-NRCS watershed planning policies, specifically the USDA Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (PR&G). Please see the portion of the response to Comment ID 11.03 regarding the consideration of upgrading COID infrastructure as an alternative.

		Further, the reasons given by the draft EA for excluding from consideration these types of alternatives are inadequate. The EA must give a rationale for eliminating alternatives from detailed study. A cursory dismissal of all alternatives to a desired action, unsupported by agency analysis, does not amount to the full and meaningful consideration of alternatives that NEPA requires in an EA. A detailed consideration of the alternative water conservation methods identified by the Upper Deschutes Basin Work Group is in the public interest, and should have been considered in the Draft EA. Further, the Draft EA discusses taking a Watershed approach to its PR&G analysis. It defines the watershed approach as a: …broad, systems-based framework that explicitly recognizes the interconnectedness within and among physical, ecological, economic, and social/cultural systems. A watershed approach enables examination of multiple objectives, facilitates the framing of water resources problems, incorporates a broad range of stakeholders, and allows for identification of interdependence of problems and potential solutions. In this watershed approach, LandWatch believes a viable alternative could exist in facilitating an inter-district agreement with COID wherein open canals in COID are piped and conserved water benefits both NUID and instream flows. This type of solution takes into account the respective hydrology throughout the districts; significantly more water is saved when the permeable COID canals are piped, delivering more water for NUID during the irrigation season, and more water to benefit fish and wildlife habitat in the winter and meet HCP obligations. This is one example of another watershed-wide solution that would be a more efficient use of public funding. Thank you for your work and your attention to these views. Please consider this a formal request to be notified of further opportunities to participate in this matter. Central Oregon LandWatch [citations were provided in original letter]	
14.01	WAT	Dear Farmers Conservation Alliance: WaterWatch of Oregon is a river conservation group that works to protect and restore river flows statewide. We have been working to protect river flows in the Deschutes Basin for over three decades. We have a great interest ensuring that any PL 566 public funds that provide funding to	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. The use of "reduce" and "eliminate" has been clarified throughout the Plan-EA to make clear that only four operational spills would be eliminated.

		Deschutes Basin Irrigation District Watershed Plans ensure that there is a public environmental benefit in the form of protectable instream flow. It is our position that given that these are public funds, any PL 566 watershed plan should commit to putting the whole of the project through the Conserved Water Act, and 100 percent of saved water should be protected instream. While we are amenable to seasonal and location flexibility to restore water to the Upper Deschutes to help meet the needs of the Oregon spotted frog, we oppose any funding of projects that do not provide legally protected project instream. NUID proposes to pipe 27.5 miles of the District owned infrastructure and construct four 1,000 cubic yard retention ponds. The project will reduce water loss by up to 6,089 acre feet annually. Water saved from the project will augment water supplies for District patrons. No saved water is proposed to be returned to the stream. Senator Merkley has been instrumental in securing funds for Deschutes Irrigation District PL 566 Watershed Plans. The Senator has made clear that the funding was to serve a dual purpose of ensuring farmers and ranchers have sufficient irrigation while preserving the Oregon spotted frog, which is listed as a threatened species (Sept 25, 2018, press release). This has been a consistent directive which has carried through to 2022 Congressional funding, for which Senator Merkley's August 1, 2022 Press Release provides that "The bill includes a $175 million, a $75 million increase, for the Watershed and Flood Prevention Operations. This funding used to replace open irrigation ditches with pipes is crucial for irrigation districts that need to improve water efficiency and conservation or otherwise improve fish and wildlife habitat. This program is providing critical funding for the collaborative processes underway across the state working to conserve water and keep Oregon's family farms in business while improving the habitats of endangered species." Despite the clear intent of securing PL 566 funding for Oregon so that it could help both farmers and fish, NUID is not proposing to put any of the saved water instream. Instead, this project will shore up NUID supply without providing any public benefit in the form of instream flow. In fact, because of the unique hydrology of the Deschutes Basin, this project will result in a loss of up to 6,089 acre feet to river flows which will further compromise already degraded instream flow needed by listed fish in the basin. The EA does claim to benefit water quality; however, claims are inconsistent with some statements saying the project will "eliminate" tailwater spills and others saying the project will "reduce". It also does not reconcile the claim with the fact, acknowledged in section 4.8.5, instream flows are important to dilute pollutants.	NUID would continue to have operational spills elsewhere in their system. Updated language identifying how water quality would change as a result to water be protected instream has been added to Section 6.8 of the Plan-EA.

14.02	WAT	In addition to these overarching concerns, we offer the following comments on specific sections of the EA. Section 3.3., Identification of Resource Concerns, asserts that the proposed project will have no effect on water rights. This statement is incorrect. The project will result in a loss of up to 6,089 af of recharge to the Deschutes River system. Instream water rights are not met many months of the year, in some reaches all months. The Deschutes is protected to the mouth by instream water rights. Any loss of seepage will result in injury to downstream instream water rights.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see Section 6.8 of the Plan-EA describing the effects of the proposed project on surface water hydrology and water rights. Please see Section 6.8.2.4 for a description of effects on groundwater and discharge to downstream waterbodies. The term "injury" does not apply in this case as an efficiency improvement on its own does not cause injury to downstream water rights. The term "injury" generally refers to a water rights change that results in another existing water right not receiving water that it previously received and to which it was legally entitled (e.g., Oregon Administrative Rules 690-385-0100).
14.03	FISH	Section 4.9: Fish and Aquatic Resources Section 4.9.1.2. states that no adverse effects are expected to be incurred by fish and aquatic species or their habitats in the Crooked River between Bowman Dam and Lake Billy Chinook because of the DBHCP Crooked River Conservation Measures. Reliance on the DBHCP for protection of Crooked River fish and flows is ill placed. For example, the DBHCP does not require an irrigation season minimum flow, the result being that this year and last, flows have dropped to as low as 6 cfs in the Prineville reach. The DBHCP also does not require any measures to restore or protect water quality. The proposed action will result in a loss of up to 6,089 af of streamflow (in the form of recharge water). This will have a detrimental effect on both fish and their habitat. Affected fish include federally listed steelhead, as well as state sensitive redband trout. Section 4.9.2. fails to analyze the effect of the loss of up to 6,089 af of streamflow (in the form of recharge) on listed species in the Crooked and Deschutes River. Section 4.9.2.1 fails to analyze the effect of the loss of up to 6,089 af of streamflow (in the form of recharge) on listed Bull Trout. Section 4.9.2.3 fails to analyze the effect of the loss of up to 6,089 af of streamflow (in the form of recharge) on Middle Columbia River Steelhead.	As described in Section 6.8.2.4 and in footnote 49 of the Plan-EA, the Modernization Alternative would eliminate approximately 2,728 acre-feet of seepage and evaporation annually from the District's conveyance system. Please see this section for a discussion of the potential effects of the Modernization Alternative to groundwater discharge to the Deschutes and Crooked rivers. Please see response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Great Basin redband trout (*Oncorhynchus mykiss newberrii*) are listed as state sensitive (ODFW 2021). However, within the Blue Mountain ecoregion which contains the Crooked River and a portion of the Deschutes River, only the Malheur Lakes Significant Management Unit (SMU) is listed as sensitive. The Great Basin redband trout Malheur Lakes SMU is not distributed within the Crooked or Deschutes rivers (ODFW 2005). For this reason,

		Section 4.9.3 fails to analyze the effect of the loss of up to 6,089 af of streamflow (in the form of recharge) on state sensitive redband trout. It also does not note that redband trout are a state sensitive species.	Great Basin redband trout were not included in the Oregon state sensitive species list in the Plan-EA (Section 4.9.3). Please see Section 6.9.2.2.3 for a discussion of the effects of the project on Middle Columbia River Steelhead. References: Oregon Department of Fish and Wildlife (ODFW). (2012). Sensitive Species List. Retrieved from: https://www.dfw.state.or.us/wildlife/diversity/species/docs/Sensitive_Species_List.pdf. Oregon Department of Fish and Wildlife (ODFW). (2005). Oregon Native Fish Status Report Vol. I and Vol. II. Retrieved from: https://www.dfw.state.or.us/fish/onfsr/.
14.04	WAT	Section 5: Alternatives The EA failed to identify, let alone analyze, an alternative that put 100% of the saved water instream. NUID is well aware of basin stakeholder interest in insuring that piping projects supported by public funding return 100% of the water instream. This position has been articulated in numerous forums, including but not limited to the 10+ year discussions surrounding the development of the DBHCP, comments on other DBBC PL 566 watershed plans, legislative testimony in front of the Oregon legislature when the DBBC approached the State of Oregon for matching funds for PL 566 funds, Deschutes Basin Collaborative discussions, as well as many other forums. And, as noted, Senator Merkley's public statements on the PL 566 funding provisions made clear a benefit for the basins fish and frogs was expected. That this alternative was not only not analyzed, but not even listed as an alternative in Appendix D2, is a fatal flaw. Section 8, Preferred Alternative: The EA failed to consider mitigation, minimization, and avoidance measures to address the loss of up to 6,089 af of recharge to the Crooked and Deschutes Rivers. Conclusion: In whole, this EA fails to adequately analyze the effect of the loss of up to 6,089 af of recharge on resident and anadromous fish, fish habitat and water quantity, let alone propose mitigation for the effects of this 6,089 af loss on aquatic resources. The Watershed Plan is also remiss in failing to include as an alternative the protection of the	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. One purpose of the project is to reduce overall irrigation spills into the Crooked River and Lake Billy Chinook to improve water quality. The project will eliminate four operational spills by directing that water into four retention ponds. The water quality effects from eliminating these operational spills are analyzed in the Plan-EA but were not quantified due to lack of available data and the likelihood of minimal effects on groundwater and surface water. For example, the reduction in operational spill entering the Crooked River would account for less than 1 percent of streamflow in this reach which is below the level of detection.

		saved water instream. Regardless of NUID's preferred alternative, the EA should have provided this analysis. Thank for the opportunity to provide comments.	
15.01	WAT	To Whom It May Concern, North Unit Irrigation District (NUID} has always been on the forefront of modernization of the irrigation system that delivers water to the patrons of NUID. The request for funding to pipe the laterals 31, 32, 34 and 43 is just a continuation of the modernization of the NUID delivery system for maximum conservation of water. As the proposal explains there is water loss due to seepage and evaporation that piping will eliminate. The savings will aid in fulfilling water rights in the long term and during the fifth year of drought any water savings helps to meet delivery commitments to the patrons and help with the HCP compliance. We support the proposed modernization project. Sincerely, [NAME]	Thank you for your comment.
16.01	WAT	To Whom It May Concern: In reviewing the proposal to pipe and pressurize 27.5 miles of North Unit Irrigation District (NUID) Laterals 31, 32, 34, and 43 and to construct four 1,000-cubic yard retention ponds by NUID and the Farmers Conservation Alliance, we have a concern. While the League of Women Voters of Oregon recognizes that all water users must share in the cost of water management, conservation strategies should be encouraged to meet future demands of individuals, agriculture, and municipalities and the instream needs of aquatic species and recreation. Of concern in this proposal is the stated objective of NUID to retain all water "conserved" by piping for the needs of their patrons. Water in Oregon belongs to the people of Oregon. The League of Women Voters of Deschutes County (LWVDC) has consistently objected to the intentions, when so stated, of irrigation districts to keep, for their own use, "conserved" water. Conserved water should be returned to the river and not counted "conserved" for the irrigation district's use. The PL83-566 funding from the Natural Resources Conservation Services (Dept. of	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see Section 6.8 for a description of the proposed project's effects on surface water hydrology (including flows in the Deschutes River that were referenced in the comment) as well as effects on groundwater.

		Agriculture) for the district's projects is essential for modernization and water conservation in the Deschutes River Basin. This proposal asks for 76% of the funding to pipe and pressurize this portion of their system. The districts, in general, rely on additional funding from the State of Oregon and from other federal grants to help offset the growing costs of installation and for the purchase of necessary equipment. Water has been allocated to the district to make up for losses during transmission in the leaking canal systems so they can meet the obligations to their patrons. Piping and pressurizing will eliminate most of the water lost to the district during transmission, make monitoring and managing water use much easier, and improve delivery losses and water inequities. This water is not really "conserved" except to the extent it is not leaking into the groundwater. But surface and groundwater are intimately connected and contained in the Deschutes Basin. Surrounding well owners may find their wells have to be deepened or abandoned with accompanying costs for which they may need help from the State. The abundant flow of the springs that enter the Deschutes River above Lake Billy Chinook may be impacted. NUID operations during dry water years can result in dewatering portions of both the Deschutes and Crooked Rivers to meet their obligations to their patrons. We acknowledge and admire North Unit Irrigation District's management of water deliveries, especially as a junior water rights holder, during the increasing drought events. Their support of district farmer's conservation efforts has been of great benefit to all the residents of Central Oregon. However, public funds used for the improvements of water quality and quantity should benefit the public as well as the entities undertaking improvements.	
17.01	WAT	If public tax dollars (state or federal) are being used for this project by NUID, you must find a way to provide water savings instream. If the public is going to pay for conserving water, we must obtain a benefit for fish conservation, wildlife, and recreation.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.
18.01	WAT	While I applaud any efforts to conserve water in Central Oregon, this project is misguided and public funding for it should be denied. I grew up in a farming community, and I fully appreciate the importance of water to Oregon's agriculture industry and the families that power it. I am also an avid outdoorsman. I am concerned that the proposal, as written, amounts to a $34M public commitment for a project that will yield no direct public benefit. I strongly believe that at least some of the benefit of the evaporative loss savings from this proposed piping project should be	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.

		returned to in-stream flows. Given the extreme low flows on the rivers feeding the North Unit Irrigation District over the past several years, I strongly feel that this project should not be approved without returning some portion of the water saved to in-stream flows. We need to mitigate the impacts of our ongoing drought on all water uses, including those that support fish, wildlife, and the broader ecosystem that drives other important parts of Oregon's economy (namely recreation and tourism).	
18.02	ALT	What's more, this money would be better spent on similar efforts the Central Oregon Irrigation District where water loss on canals is exacerbated by the porous ground over which they flow. An investment on water savings for many COID canals would yield a far greater return than this proposed project and create a greater benefit to NUID users. I urge you to reject public funding for this project and apply it so a similar project that will provide a larger and broader benefit to all Oregonians.	Please see the portion of the response to Comment ID 11.03 regarding the consideration of upgrading COID infrastructure as an alternative.
19.01	WAT	I write in opposition to this proposal. Water savings would be minimal at public expense for purely private benefit. There are more cost effective projects to get more water benefit for our streams such as piping lateral feeder canals in the COID. Do not do this project!	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see the portion of the response to Comment ID 11.03 regarding the consideration of upgrading COID infrastructure as an alternative.
20.01	WAT	Hello, I see nothing in the proposed NUID pipeline that specifically states that the saved water would be returned to the Deschutes River, which sorely needs it. All irrigation projects that I'm aware of, up until now, have had returned water to the river as a, if not the, primary driver. I do not want any tax dollars, no matter how they arrive, spent on an irrigation project that does not put water into, and remain in the Deschutes River.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.
21.01	WAT	I believe public funding for this project should be denied as it does not increase flows in the Deschutes River. Public funding should not be used for purely private benefit. These same public funds could be used to pipe other canals with the benefits of increasing water security and reliability to NUID, increasing flows in the Upper Deschutes for public benefit, and further helping to meet the requirements of the DBHCP.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River.

22.01	WAT	The North Units Irrigation District's (NUID) proposal to use PL83-566 Grants from the USDA/NRCS for piping and pressurizing the main canal systems to conserve water is in keeping with the Deschutes Basin Board of Control's decision to meet the requirements of the HCP. North Unit is no stranger to conservation strategies. Of all the districts, it has, by necessity and innovation, accomplished more water management and on-farm savings than other districts. They are also the prime agricultural producer with the waters from the Deschutes and Ochoco Basins. They definitely should be awarded funding for their projects to reduce water losses within their system. That being said, NUID's application, like the previous ones influenced by FCA and Blackrock, makes the assumption that all diverted water belongs to the district and when conserved, is to be appropriated to its use and application. All of the districts in the Deschutes Basin have received additional decreed diversion rights above the original duties of water appropriated for and appurtenant to irrigated acres in the district's land grants. NUID allegedly received an additional 35-40% of its original appropriation for "canal leakage and obstruction" that prevented delivery of the duty of originally appropriated water to lands within the district. As the canals and laterals for which that additional water was decreed are piped with the concomitant elimination of "leakage and obstruction", that water should revert back to the public water resource pool. Despite current interpretations, the 1987 Conserved Water statute was envisioned for on-farm or private lateral waters savings incentives – canal piping was prohibitively expensive then and out of reach for any district. OWRD has wisely required water saved by piping main and major laterals with taxpayer funding to be returned to the public water resource pool, part of which may benefit NUID as a junior right holder. NUID's application Appendix D NEEA is predicated on the district's retention of the entire projected 4900 af of saved water. If canals piped with PL 85-566 funding did not exist at the time of the time of the district's receipt of an additional diversion decree, that might be a reasonable outcome; however, it is not a valid approach if the decreed water covered all or parts of these canals. Those savings should reduce the current diversion rights and revert to the public resource pool. In our over-appropriated basins, it is essential that any "conserved' water from piping and pressurizing the canals and district laterals should be rededicated to the respective basin rather than legally compartmentalized and allocated by multiple "plans" to certain irrigation districts or retained for the district's own purposes of "leasing", covering shortfalls or bloating their allotment. It will require that old laws and practices be re-evaluated and modified with new management principles based on science, community need, and cooperation to conserve and protect our water and the many species and people dependent on it. Thank you for this opportunity to comment.	Please see the response to Comment ID 2.01 related to water rights transferred to instream use in the Deschutes River. Please see Section 4.8.1 of the Plan-EA for more a description of the NUID's water rights.

23.01	WAT	I would just like to leave a comment on the proposal for the North Unit Irrigation District piping they are doing coming up. I'm totally for it, any amount of water they can save by piping is that much more water that is something productive in this county. So I'm all for it, thank you.	Thank you for your comment.

Appendix B

Project Map

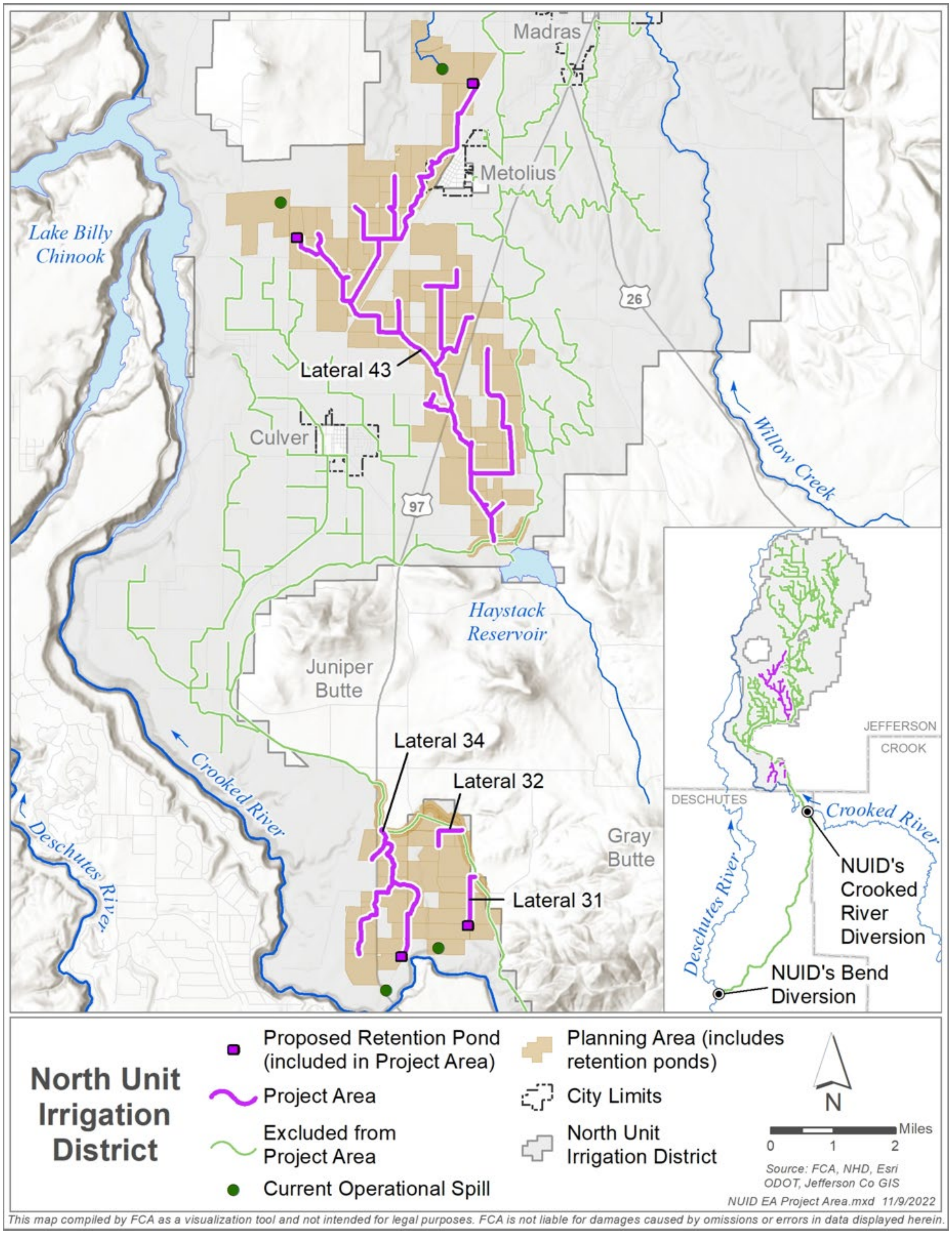

Figure B-1. North Unit Irrigation District Infrastructure Modernization Project area.

Appendix C

Supporting Maps

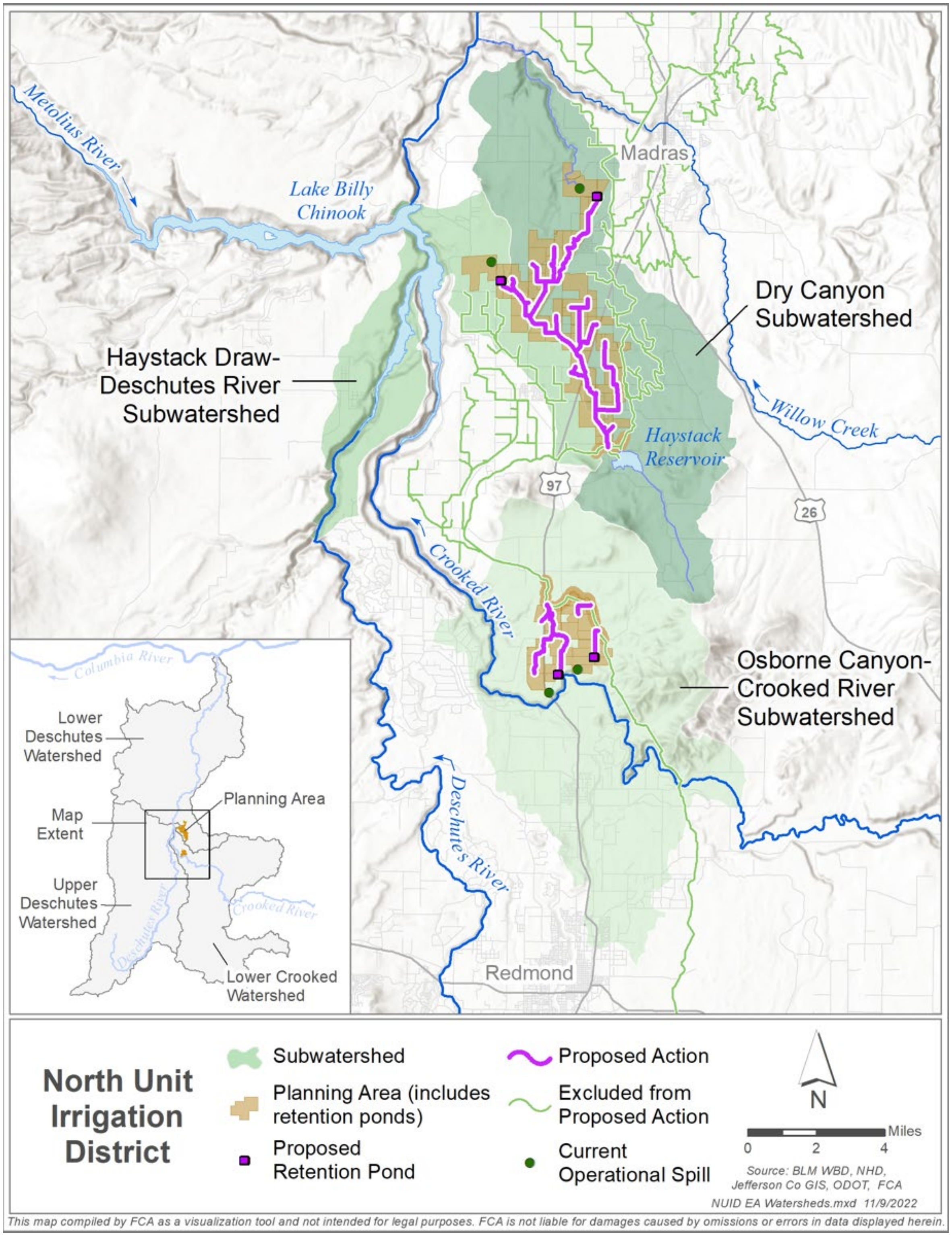

Figure C-1. The North Unit Irrigation District planning area.

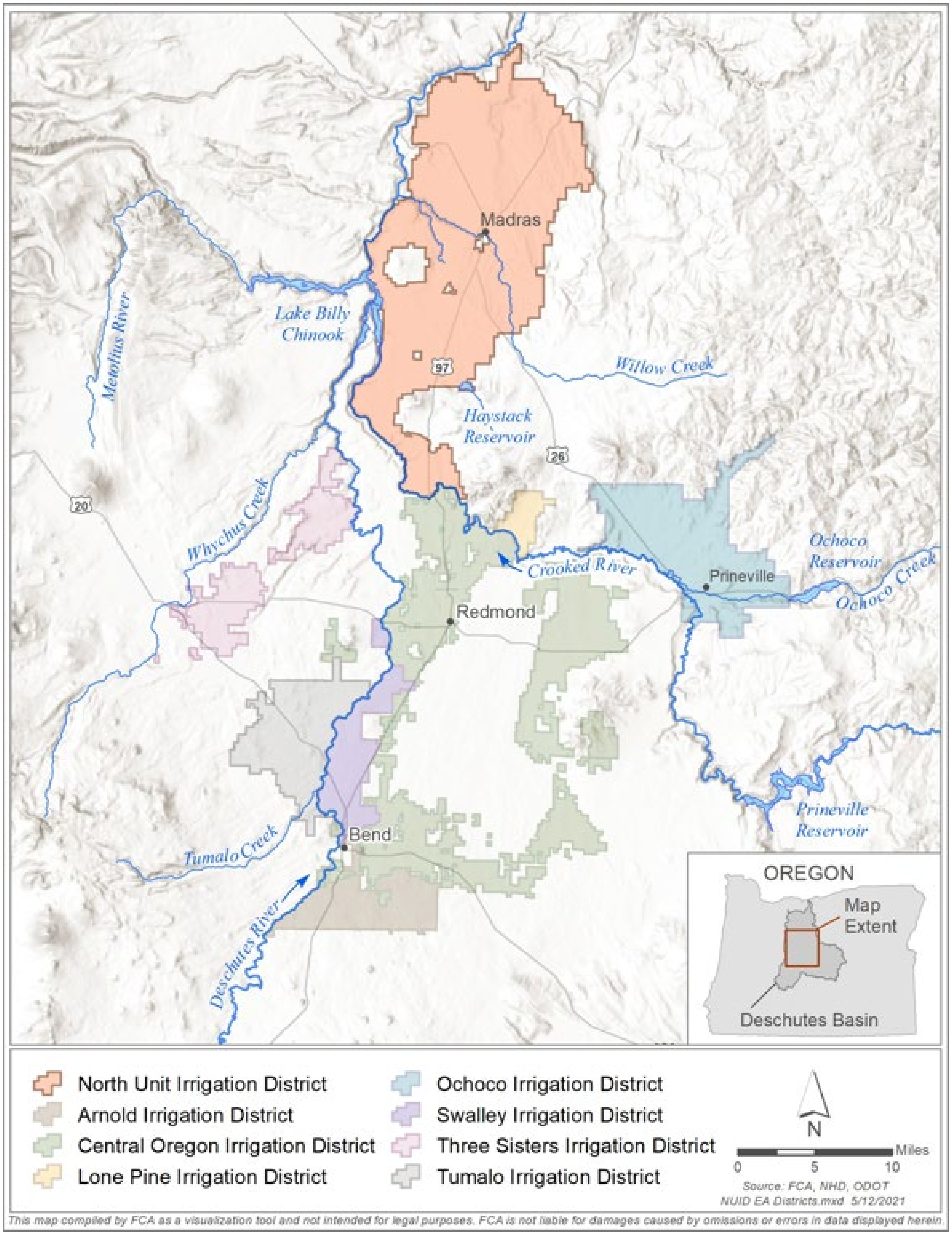

Figure C-2. Irrigation districts within the Deschutes Basin.

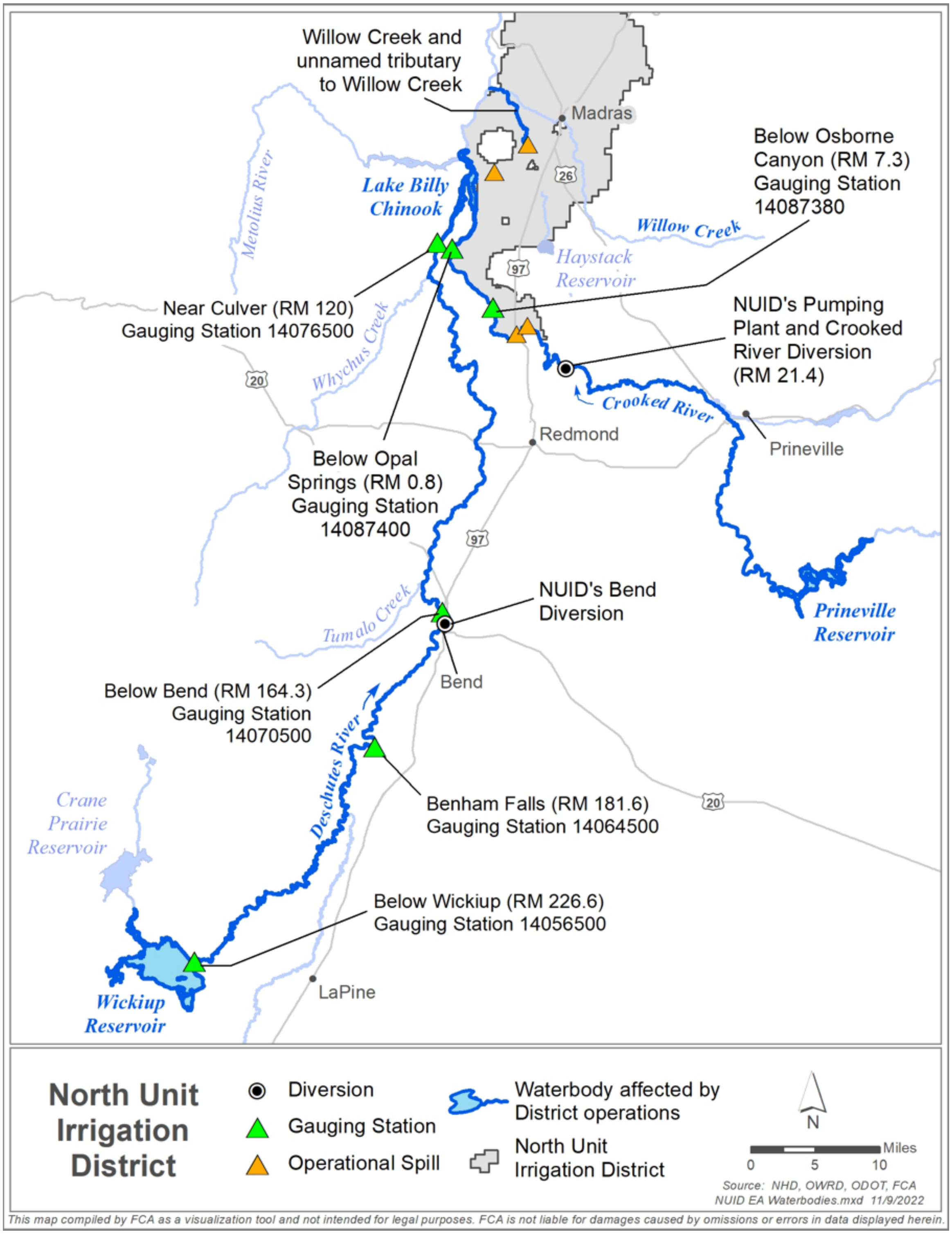

Figure C-3. Waterbodies and gauging stations associated with District operations.

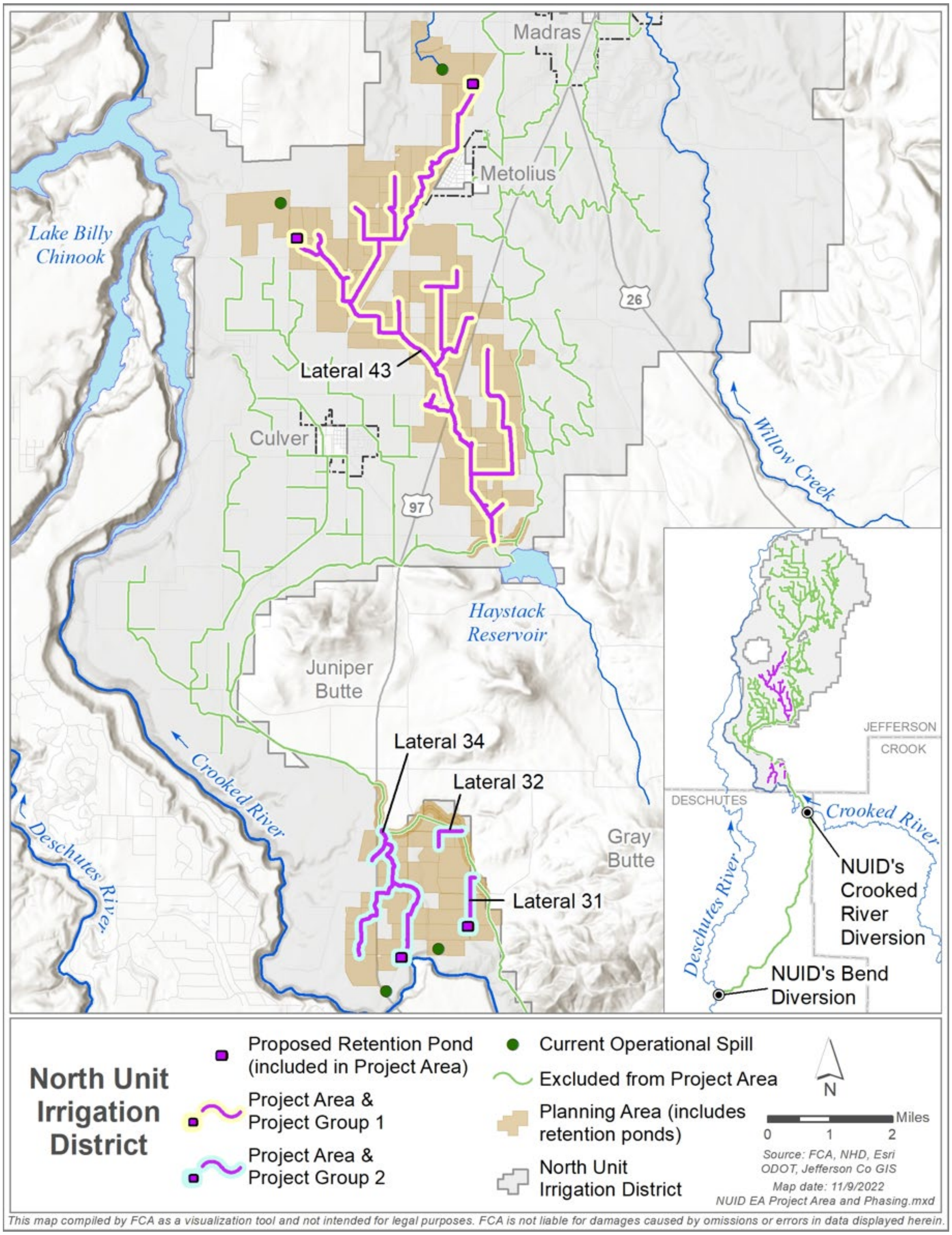

Figure C-4. Overview of the Modernization Alternative for the North Unit Irrigation District Infrastructure Modernization Project.

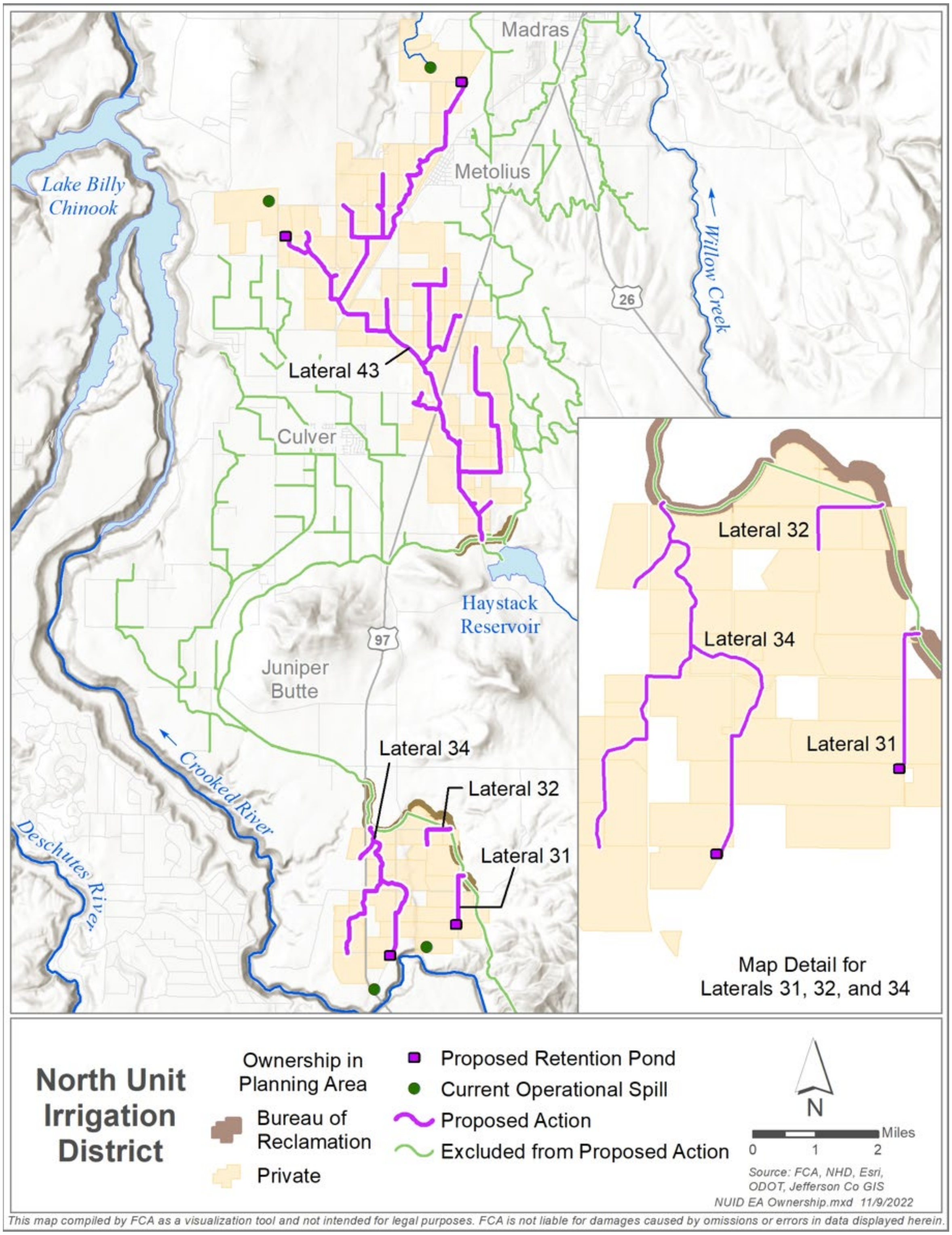

Figure C-5. Land ownership in the planning area.

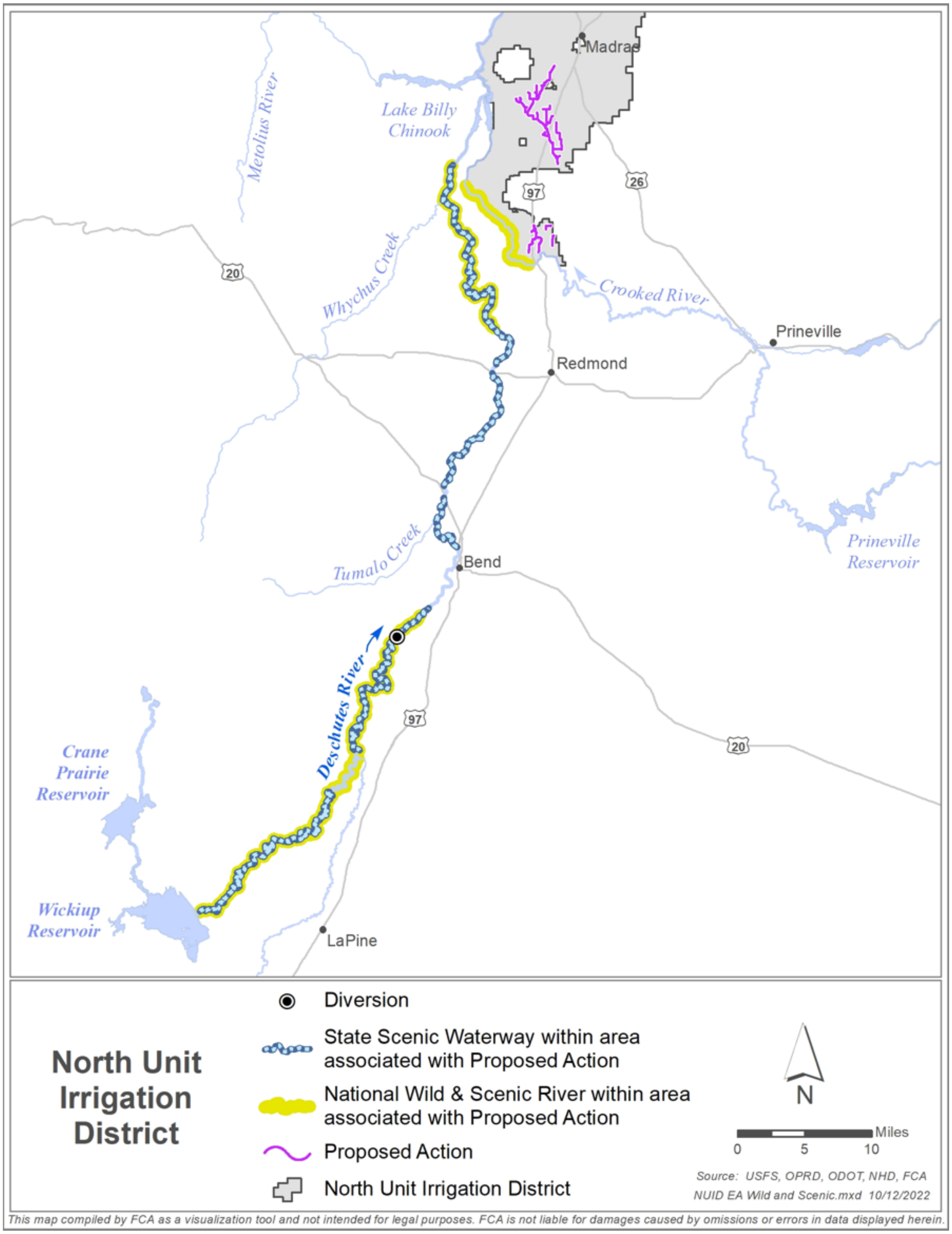

Figure C-6. National Wild and Scenic River and State Scenic Waterways within area associated with the Proposed Action.

Appendix D

Investigation and Analyses Report

D.1. National Economic Efficiency Analysis

Highland Economics LLC

National Economic Efficiency Analysis

Barbara Wyse and Winston Oakley
October, 14 2022

D.1.1. Modernization Alternative

This section provides a National Economic Efficiency (NEE) analysis that evaluates the costs and benefits of the Modernization Alternative over the No Action Alternative for the North Unit Irrigation District (NUID) Infrastructure Modernization Project (herein referred to as the 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 2022 dollars and have been discounted to present value and then amortized over the evaluation period (100 years) to average annual values using the fiscal year 2022 federal water resources planning rate of 2.25 percent.

D.1.2. Costs of the Modernization Alternative

This section evaluates the costs of the Modernization Alternative over the No Action Alternative. Under the No Action Alternative, the District would continue to operate and maintain the existing canal and lateral system in its current condition.

D.1.2.1. Analysis Parameters

This section describes the general parameters of the analysis, including funding sources and interest rates, the evaluation unit, the project implementation timeline, the period of analysis, and the project purpose. All values in this analysis are presented in 2022 dollars and rounded to the nearest $1,000.

D.1.2.1.1. FUNDING

PL 83-566 funds would cover $28,521,000 or 76 percent of the project cost. PL 83-566 funds identified is the total PL 83-566 estimate, which includes both financial and technical assistance. NUID would be required to fund $8,960,000 or 24 percent of the project.

D.1.2.1.2. EVALUATION UNIT

The proposed project is comprised of two phases, which are the evaluation units for this analysis. Phase 1 consists of piping Lateral 43 and associated retention ponds, which is 21.4 miles. Phase 2 consists of piping Laterals 31, 32, and 34 and associated retention ponds, which total 6 miles. Note that for the incremental analysis, costs for constructing any given project group would not change if it were the only project group to be constructed.

D.1.2.1.3. PROJECT IMPLEMENTATION TIMELINE

District staff indicate that, if PL 83-566 funds are made available, construction would likely be completed over approximately six years (see Section 8.7.2 and Table 8-2 in the Plan-EA). The project would be completed in the two phases described above. For each phase, this analysis assumes that full benefits would be realized the year after construction is completed (e.g., for Phase 1, which would complete construction in Year 3, full benefits would be realized in Year 4).

D.1.2.1.4. ANALYSIS PERIOD

The analysis period is defined as the implementation period plus the period of time over which any alternative would have meaningful beneficial or adverse effects (up to a maximum of 100 years). The analysis period for this NEE is 106 years (Year 0 to Year 105) since the installation period is 6 years and 100 years is the expected project life of buried high-density polyethylene (HDPE) pipe, which is expected to provide meaningful benefits throughout its useful life. Construction and installation of Phase 1 is assumed to start in Year 0 and finish in Year 3, with project life from Year 4 through Year 103. Phase 2 would begin construction in Year 4, finish in Year 5, and have a project life from Year 6 through Year 105.

D.1.2.1.5. PROJECT PURPOSE

The purpose of this project is to improve water conservation on 24.9 miles[1] of District-owned infrastructure and improve water supply management and delivery reliability to District patrons.

D.1.2.2. Proposed Project Costs

Table 8-3 (NWPM 506.11, Economic Table 1) and Table 8-4 (NWPM 506.12, Economic Table 2) in Section 8 of the Plan-EA summarize installation costs, distribution of costs, and total annual average costs for the Modernization Alternative. Table 8-5 (NWPM 506.18, Economic Table 4) in the Plan-EA summarizes the annualized costs over the No Action Alternative, which are estimated at $909,000 in amortized installation costs. The subsections included in this report provide detail on the derivation of the values in the tables of the Plan-EA.

D.1.2.3. Project Installation Costs

The cost of piping and associated turnouts is projected to be approximately $37,481,000 (Farmers Conservation Alliance, 2022).[2] See Appendix D.4.2 for detailed cost derivation by pipe size, cost category, etc. This total consists of construction costs ($30,901,000)[3]; construction-related, cost shareable engineering costs ($1,093,000)[4]; and design-related, non-cost shareable engineering ($1,537,000)[5]. Adding project administration ($988,000)[6] and technical assistance ($3,536,000)[7] costs from NRCS, and permitting costs ($961,000)[8], the total cost for the Piping Alternative is estimated at $37,481,000. The average annual installation cost of the Piping Alternative is $909,000, and because no other potential costs are quantified in this analysis, this is also the estimated total annual cost of the project.

D.1.2.4. Other Direct Costs

Water seepage from canals is one source of recharge for groundwater in the Deschutes Basin. Reduced recharge from canals may lead to groundwater declines, and thereby increase pumping costs for all

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1 The total project length is 27.4 miles, of which 24.9 miles is open canal. The remaining 2.6 miles is piping that would be replaced under the Modernization Alternative.
2 The original cost estimate of $31,284,000 in 2021 dollars was adjusted for inflation to 2022 dollars using the Engineering News-Record's construction cost index.
3 This includes general contracting costs (estimated as 10 percent of construction costs) and contingency costs (estimated as 15 percent of construction, engineering, and general contracting costs).
4 Calculated as 45 percent of total engineering costs.
5 Calculated as 55 percent of total engineering costs plus the engineering portion of contingency costs (about 5 percent).
6 The total project administration costs consist of a PL-566 portion (2 percent of the sum of PL-566 construction costs, PL-566 construction-related engineering costs, and non-construction-related engineering costs) and a sponsor portion (5 percent of the sum of non-PL-566 construction costs, non-PL-566 construction-related engineering costs, and non-construction-related engineering costs). In this project, NRCS will be paying for the sponsor portion of the project administration costs in addition to the PL-566 portion.
7 Calculated as non-cost shareable engineering costs plus 8 percent of the sum of PL-566 construction and engineering costs.
8 Estimated as 3 percent of the sum of all construction and engineering costs.

groundwater users in the basin. As such, it is possible that the Modernization Alternative may result in a slight increase in pumping costs for groundwater users. The magnitude of this effect is evaluated based on data from a 2013 study by the U.S. Geological Survey that estimated the effects on Central Deschutes Basin groundwater recharge of changes in climate (reduced precipitation), groundwater pumping, and canal lining and piping (Gannett & Lite, 2013). The U.S. Geological Survey estimated that since the mid-1990s, groundwater levels have dropped by approximately 5 to 14 feet in the central part of the Deschutes Basin,[9] with approximately 10 percent of this decline (0.5 to 1.4 feet) in groundwater level due to canal lining and piping. The cumulative effect of piping over the 12-year study period (1997 to 2008) was 58,000 AF of reduced recharge annually by 2008.[10] The Modernization Alternative would reduce canal seepage and other conveyance inefficiencies, and associated groundwater recharge, by up to approximately 6,089 AF annually in this part of the Deschutes Basin once the project is completed (Farmers Conservation Alliance, 2022). Given the relatively small change in groundwater elevations estimated from 58,000 AF of reduced recharge annually, we expect very minor changes in local groundwater elevations and associated groundwater pumping costs in the region due to the Modernization Alternative, and thus do not quantify these potential other direct costs.

D.1.3. Benefits of the Modernization Alternative

Table 8-7 in the Plan-EA compares the project benefits (over the No Action Alternative) to the annual average project costs presented in Table 8-5 in the Plan-EA. The remainder of this section provides details on these project benefits. Table 8-6 in the Plan-EA presents on-site damage reduction benefits that would accrue to agriculture and the local rural community, including reduced agricultural damages and power costs. It also presents off-site quantified benefits, which include the value of reduced carbon emissions from reduced energy use. Other benefits not included in the analysis, which may result indirectly from the Modernization Alternative, include further reduced agricultural damages in NUID (greater than those modeled in Section D.1.3.1.1), the potential for increased on-farm investments in irrigation efficiency (as patrons have more funds due to increased yields and reduced pumping costs), and the potential to enhance instream flow.

D.1.3.1. Benefits Considered and Included in Analysis

D.1.3.1.1. Agricultural Damage Reduction Benefits

Under the Modernization Alternative, NUID would save approximately 6,089 acre-feet (AF) of water annually. The District plans to use 75 percent of this saved water (roughly 4,567 AF per year) to supplement farm irrigation water supply. The remainder of the saved water would be put instream. Under the Modernization Alternative roughly 30 percent of the saved water would be lost to seepage in NUID's remaining unpiped laterals (Farmers Conservation Alliance, 2022). This would leave about 3,206 AF of the saved water that could be used on NUID farms. The 3,206-AF increase in water availability is expected to reduce the agricultural damages associated with water shortages currently experienced in NUID, as well as mitigate future larger water shortages in NUID that are expected to occur due to changes in water management required as part of the Deschutes Basin Habitat Conservation Plan (DBHCP).

Historically, NUID has experienced water shortages in which water supply is less than total water demand in the district (Britton, NUID District Manager, 2020). Since the adoption of the 2016 Settlement Agreement, which includes provisions for irrigation districts in Central Oregon to increase instream flows to support the Oregon spotted frog (which reduces water availability for irrigation), water supply reliability to NUID

[9] This refers to the portion of the basin that extends north from near Benham Falls to Lower Bridge and east from Sisters to the community of Powell Butte.

[10] Assuming a uniform increase in canal lining/piping over this timeframe, in 1997 the decreased canal seepage was 4,833 AF, rising each year by another 4,833 AF until the reduced canal seepage in 2008 was 58,000 AF. Cumulatively, this represents 377,000 AF of reduced recharge from canals during this period.

irrigators has been further decreased. While there have been just a few years since the Settlement Agreement, and water year type and market conditions also affect acreage planted in any given year. Figure D-1 shows that the average fallowed acreage in NUID increased from the 2009-2015 period to the 2016-2018 period.

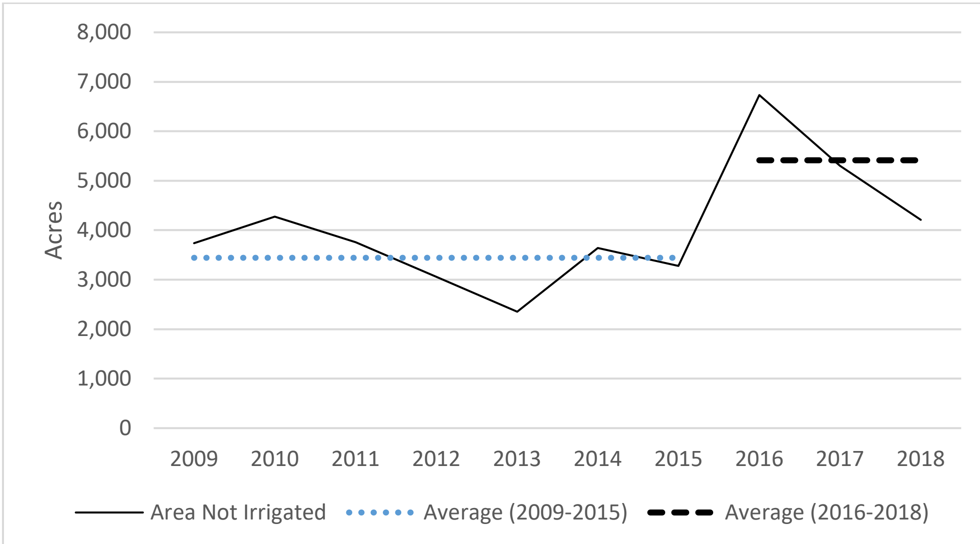

Figure D-1. District agricultural area not irrigated. [11]

Based on these data and an analysis of changes in NUID water supply contained in the environmental impact statement for the DBHCP (Oregon Fish and Wildlife, 2020), this analysis estimates that NUID currently experiences an annual average shortage in on-farm deliveries of nearly 25,500 AF per year (see Sections 4.2.3 and 6.2.2.3 in the Plan-EA). In 2030 (Year 5 of this analysis) when the DBHCP requirement increases to 300 cfs, the shortage is projected to grow to approximately 37,600 AF per year. Further, the shortages are projected to reach about 47,300 AF per year when the DBHCP requirement increases to 400 cfs in 2035 (Year 10). This does not factor in additional shortages that may occur in the future due to increased crop water demand and changes in hydrology related to climate change.

This analysis estimates the economic benefit of the 3,206 AF of additional water in mitigating water shortages and reducing agricultural damages. Specifically, the analysis estimates benefits of additional water that is expected to reduce deficit irrigation on hay acres that causes a loss of one hay cutting (estimated to total 25 percent of the annual yield under full irrigation). Because this analysis focuses on the impacts to hay only and does not include potential impacts to higher value specialty crops grown in NUID, the benefits presented in this section likely underestimate the benefits of additional water to NUID. Roughly one-quarter of NUID's irrigated acres are dedicated to high-value specialty crops, which, in the absence of water conservation projects like the Modernization Alternative, may be impacted by water shortages as the DBHCP changes in water management are phased into effect in future years.[12] In other words, if future NUID water shortages reduce acreage or yields of specialty crops, the value of additional water to NUID would be higher than is presented here. Further, the full irrigation hay yield used in this analysis likely is an underestimate of yield under full irrigation, which would also result in an underestimate of agricultural damage reduction benefits. To be conservative, the analysis uses NASS-reported recent county average hay yields as the expected 'full irrigation' yield, although these yields are from a period when irrigators were experiencing some water

[11] Source: (Bohle, North Unit Irrigation District 10 Year Average Crop Report 2009-2018, 2019)
[12] Source for NUID crop mix: (Bohle, North Unit Irrigation District 10 Year Average Crop Report 2009-2018, 2019)

shortages. Interviews with a local agricultural extension agent also indicate that the yield for full irrigation in NUID used in this analysis may be an underestimate (Bohle, 2018).

Under this approach, to estimate the value of reduced damages from deficit irrigation, we adapted a published Washington State University crop budget to model the net revenues of agricultural production in NUID for alfalfa hay. From this source budget we developed crop budgets to model the net returns to hay under full irrigation and under deficit irrigation. The crop budgets, which provide a breakdown of revenues, variable costs, and fixed costs, are provided in Section D.2 beginning on page D-21. This section also has a detailed explanation of the methods used to update revenues and costs to 2022-dollar values. The net returns from these crop budgets are summarized in the table below. The net returns in Year 1 differ from those in Years 2 to 6 because of alfalfa does not require fertilizers in the first season of harvest.

Note that the fixed costs in the crop budgets, which include machinery, management, and land costs, may be high relative to the actual cash costs faced by growers (for example, growers may be operating and repairing older machines or may own the land and not be paying land rent), which may explain why net returns estimated are fairly low or even negative. However, as the purpose of this analysis is to estimate the *difference in net returns* with additional irrigation water and associated yield, the fixed costs (which are nearly the same in both irrigation scenarios) do not affect the magnitude of estimated benefits from additional water.

Table D-1. Summary of Per-Acre Hay Net Returns Under Full and Deficit Irrigation in NUID, Deschutes Watershed, Oregon, 2022$.

Economic Variable (Per Acre)	Irrigation Level	
	25% Deficit (No Action)	Full (Modernization Alternative)
Production Year 1 Net Returns	$149	$323
Production Years 2–6 Net Returns	-$85	$45
Weighted Average Net Returns [1]	-$46	$91
Increased Value/Acre of Full Irrigation [2]	$137	
Increased Value/Acre-foot of Full Irrigation [3]	$228	

Note: Full crop budgets are provided in Section D.2.1.6. Prepared October 2022
1/ Averaged over a six-year stand life with 5 years comprised of Years 2-6 net returns.
2/ Equal to the difference of weighted average net returns between deficit and full irrigation.
3/ Calculated assuming a 0.6 acre-foot/acre difference between full and deficit irrigation.

Results from the analysis in Section D.2 indicate that alfalfa hay under full irrigation generates average annual net returns of approximately $91 per acre, while deficit irrigation generates an economic loss of approximately $46 per acre. Therefore, the marginal net benefit of providing full irrigation to deficit-irrigated alfalfa is approximately $137 per acre. The weighted average full water allocation in NUID is 2.4 AF per acre.[13] With deficit irrigation at 75 percent of full irrigation, each acre would receive an additional 0.6 AF under full irrigation.[14] Dividing the marginal net returns of full irrigation ($137 per acre) by the amount of additional water (0.6 AF per acre) provides the marginal net returns to water: $228 per AF. We use this amount to

13 Water allocations in NUID differ depending on the source; Deschutes River water rights get 2.5 AF per acre while Crooked River water rights get 1.5 AF per acre. Because there are 53,721 acres supplied by the Deschutes River and 5,164 acres supplied by the Crooked River, the weighted average allocation District-wide is 2.4 AF per acre (Britton, NUID District Manager, 2019).

14 2.4 x (1 - 0.75) = 0.6 AF per acre

estimate the damage-reduction benefit of each AF of water going to NUID under the Modernization Alternative.[15]

Under the Modernization Alternative, the NUID-saved water would help alleviate the shortages described above. Therefore, this analysis models the value of an increase of approximately 3,206 AF per year delivered to NUID farms once both project phases are complete. Valued at $228 per AF, this volume of water results in an undiscounted annual agricultural damage reduction value of about $731,000. When discounted to present value and annualized over 100 years, the value of the Modernization Alternative in avoiding agricultural damages in NUID totals $678,000 (as shown in Table D-2).

Table D-2. Avoided Damages to NUID Agriculture Resulting from the Modernization Alternative by Project Group, Deschutes Watershed, Oregon, 2022$.[1]

Project Group	Water contributed to NUID farms (acre-feet)	Undiscounted Annual Benefit of Increased Acres	Annualized Average Net Benefits of Piping
Phase 1	2,727	$621,000	$581,000
Phase 2	479	$110,000	$97,000
Total	**3,206**	**$731,000**	**$678,000**

Note: Totals may not sum due to rounding. Prepared October 2022
1/ Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.

D.1.3.1.2. VALUE OF INSTREAM SAVED WATER

As noted in the previous section, of the 6,089 AF per year saved by NUID once the project is completed, the District will release up to 25 percent (up to roughly 1,522 AF per year) instream. Placing this water instream would provide instream flow benefits over the No Action Alternative in the years prior to 2028, when the DBHCP governing flows on the Deschutes River requires wintertime instream flows to increase. Under the No Action Alternative, NUID would not be required to put this additional water instream until 2028. As such, instream flow benefits are estimated only until 2028.

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 Deschutes 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. Data on water right transactions in the Deschutes Basin were not available for this study. However, prices of water rights are 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 present market information on the value of water

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15 If 3,206 AF of additional water were distributed at 0.6 AF per acre (as is assumed in this analysis), less than 6,000 acres could receive additional water. Over the last 10 years, NUID has averaged about 37,000 acres in hay and grain, which the net returns analysis is meant to represent (Bohle, 2019). Because the total area receiving additional water is less than one-quarter the total area of relevant cropland, it is reasonable to apply the benefit per AF to all 3,206 AF.

rights to irrigators in the Deschutes Basin, as this indicates the potential cost of purchasing water rights from these irrigators.

Based on the following discussion, we estimate that the economic benefit of instream flow augmentation would be at least $80 per AF per year, such that this enhanced instream flow is estimated to have a value of approximately $122,000 per year once the project is complete under the Modernization Alternative (because of the project implementation timing and because the instream benefits only accrue prior to Year 5 [January 2028], the average annual benefit is roughly $2,000 as presented in Table D-3). 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, such as those that would benefit from the instream flows provided by the Modernization 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 saved water is estimated in this section using the prices of water from transactions for environmental water in the western United States. Table D-3 shows the estimated average annual benefits of enhanced instream flow that would occur prior to 2028 under the Modernization Alternative.

Table D-3. Annual Estimated Instream Flow Value of Modernization Alternative by Project Group, Deschutes Watershed, Oregon, 2022$ [1]

Project Group	Undiscounted Annual Benefit of Saved Water	Annualized Average Net Benefits of Piping
Project Group 1	$104,000	$2,000
Project Group 2	$18,000	$0
Total	**$122,000**	**$2,000**

Note: Totals may not sum due to rounding. Prepared October 2022
1/Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.

This value of $80 per AF per year is based on the following information (see Table D-4):

1. **Prices paid for water by environmental buyers throughout the western United States**—In the period 2000 to 2009, purchase price of environmental water varied from just over $0 to nearly $1,670 per AF per year, with an average permanent sale transaction price of $227 per AF per year. Among the 51 permanent water right purchases with the sales price and volume recorded in the water transaction database published by the UC Santa Barbara Bren School, the permanent sales price value in 26 transactions (51 percent) was above $80 per AF per year. As discussed at length below, these values paid are expected to provide a low range estimate of instream flow value to society.

2. **Value of water to irrigators in the Deschutes Basin**—For hay and grain irrigators (relatively low valued crops, which are likely the first to sell water for environmental purposes), this is estimated at approximately $40 (during water shortages when deficit irrigation is high and yields are low) to approximately $230 per AF per year. This value is important because 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 agricultural sellers'

willingness to accept a price for water), and because saved water avoids potential future reductions in irrigation.

Table D-4. Value per AF per Year of Water (Market Prices and Value to Agriculture), Deschutes Watershed, Oregon, 2022$.

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	$1,669	$82	$227
Value of water to Deschutes Basin irrigators (*Income Capitalization Approach*)	~$0	$230	~$100	N/A

Past Costs Paid as a Proxy for Value

Past piping projects in the Deschutes 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 the 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, then the value paid would 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 right transactions from agriculture to environmental flows).

In the Deschutes Basin, approximately 90 projects have restored approximately 80,000 AF of water instream (Central Oregon Irrigation District, 2016). Additionally, six major irrigation canal piping projects have been approved with total estimated costs of nearly $205 million, which will save an estimated 47,267 per year when all projects are completed.[16] On a combined average annual basis, these projects save water at a cost of $109 per AF.[17] Individual project costs range from $70 to $345 per AF.

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, five transactions of water right purchases averaged $404 per AF in Oregon, while 6 water right leases averaged $190 per AF per year. The paper also shows lease and purchase price by environmental use,

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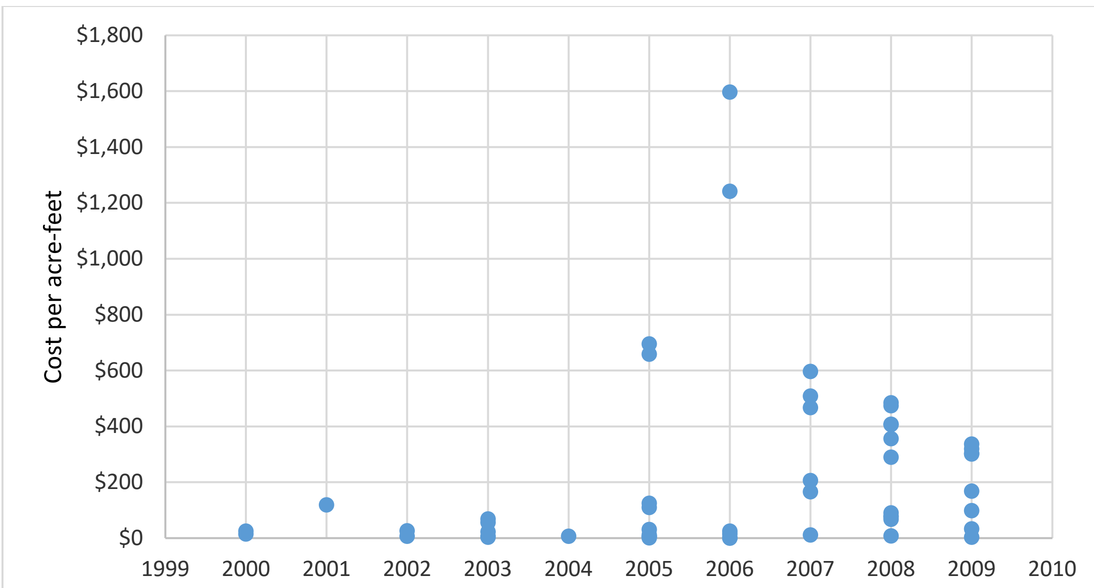
16 These include piping projects for Arnold, Central Oregon, Lone Pine, Ochoco, Swalley, and Tumalo irrigation districts ((Farmers Conservation Alliance, 2020) (Farmers Conservation Alliance, 2021) (Farmers Conservation Alliance, 2022) (Farmers Conservation Alliance, 2022)). All costs were adjusted from their respective dollar years to 2022 dollars using the Implicit Price Deflator for Gross Domestic Product (Bureau of Economic Analysis, 2022).

17 Annualized costs were calculated using an amortization period of 100 years and a discount rate of 2.25 percent.

including for riparian areas, wetlands, recreation, and instream flow. For instream flows, the average purchase price across 18 transactions per AF was $1,253, while across 35 lease transactions the annual price was $76 per AF.[18]

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, 2017). The two graphs shown below in Figure D-2 and Figure D-3 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 $300 per year while one-year leases typically fall below $1,000 per AF per year (with several transactions showing prices rising over a $4,000 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 26 transactions (51 percent) was above $80 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 $19 per AF per year.



Note that dollar per AF purchase prices were amortized using a 2.25 percent interest rate and a 100-year period to derive dollar per AF per year values.

Figure D-2. Western water right purchases for environmental purposes, 2000 to 2009, price paid per acre-foot per year.

18 All values were adjusted for inflation from 1999 dollars to 2022 dollars using the Implicit Price Deflator for Gross Domestic Product (Bureau of Economic Analysis, 2022).

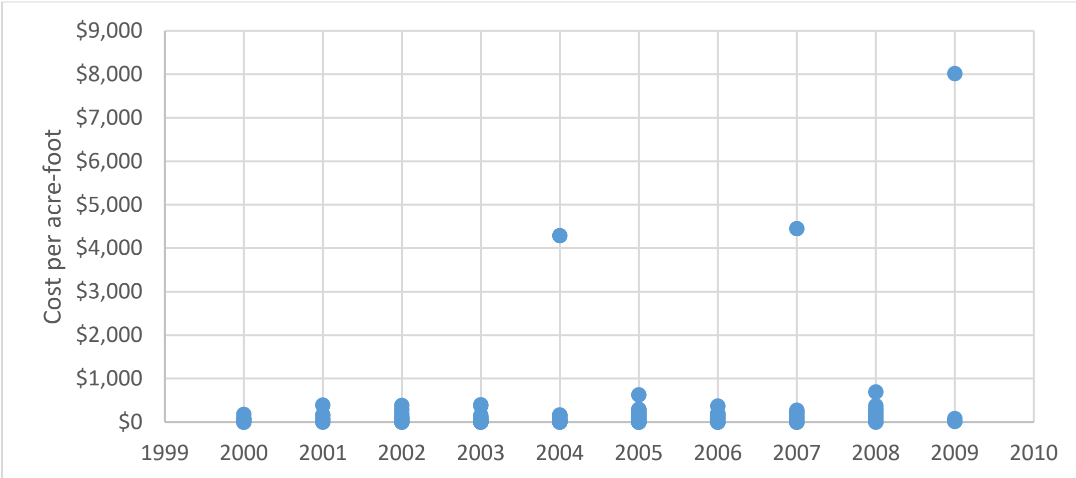


Figure D-3. One-year water leases for environmental purposes, price paid per acre-foot in the western United States.

Current and Potential Future Water Right Purchase Values in the Surrounding Area

The value of water to irrigators (i.e., the increased farm income from having access to water) is important, as it is a key determinant of the price at which irrigators would be willing to sell water rights (and the price at which environmental water buyers could obtain water from agricultural water right holders, which are the primary water right holders that could sell water rights to augment instream flows). In the project region, water rights sold several years ago from one irrigator to another within the Tumalo Irrigation District (which is also located in the Deschutes Watershed) have typically had a purchase price between $5,889 to $8,834 per acre (Rieck, 2017).[19] These values are very similar to values provided by area real estate agents regarding the increased value of property in TID with irrigation water rights, with all else equal. Assuming approximately 4 AF per year delivered on average to acreage in TID, this equates to approximately $1,472 to $2,208 per AF $5,889 to $8,834 per acre divided by 4 AF per acre delivery), or a value of approximately $40 to $60 per AF per year.

Because NUID's crop mix has a higher proportion of high-value crops than TID and higher yields, the value of NUID irrigation water is higher than for TID. Using the crop budgets created to model the agricultural benefits of the Modernization Alternative (shown in detail in Section D.2.1), we estimate that reduced irrigation of 0.6 AF per acre in a season causes hay growers in NUID to lose approximately $137 per acre in profits. This implies that NUID irrigators value water at the margin at approximately $228 per AF ($137 divided by 0.6). This analysis highlights the high value to farmers of each additional AF of irrigation water that helps reduce water shortages and deficit irrigation.

D.1.3.1.3. PATRON IRRIGATION PUMPING COST SAVINGS

NUID patrons currently use an estimated 3,778,035 kWh annually to power irrigation pumps (Farmers Conservation Alliance, 2022). System improvements associated with the Modernization Alternative would result in a net energy savings of 2,740,411 kWh per year.[20] This energy cost savings is evaluated using Pacific Power's Schedule 41 rate for irrigation pumping: $0.0797 per kWh (Pacific Power, 2022). Pacific Power is the primary power provider in NUID (Britton, NUID District Manager, 2020). At this price, the energy savings would provide NUID patrons approximately $218,000 in (undiscounted) annual savings once all project phases were completed. Table D-5 presents the energy use and cost savings to NUID patrons under the

[19] These values have been adjusted for inflation to 2022 dollars using the Implicit Price Deflator for Gross Domestic Product (Bureau of Economic Analysis, 2022).

[20] This is a based on an FCA analysis of NUID data on energy savings (Farmers Conservation Alliance, 2020).

Modernization Alternative. Once the project is complete, the average annual NEE savings to NUID patrons would be approximately $204,000 each year.

Table D-5. Annual Increased Average Energy Cost Savings to NUID Patrons of Modernization Alternative, Deschutes Watershed, Oregon, 2022$ [1]

Works of Improvement	Annual Energy Use Under Baseline Conditions (kWh)	Annual Energy Use Under Modernization Alternative (kWh)	Reduced Annual Energy Use (kWh)[2]	Undiscounted Annual Energy Cost Savings	Average Annual Discounted NEE Benefits (Avoided Energy Costs)
Phase 1	2,891,753	289,971	2,601,782	$207,000	$194,000
Phase 2	886,282	747,653	138,629	$11,000	$10,000
Total	**3,778,035**	**1,037,623**	**2,740,411**	**$218,000**	**$204,000**

Note: Totals may not sum due to rounding. Prepared October 2022
NEE = National Economic Analysis
1/ Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.
2/ As estimated by FCA (Farmers Conservation Alliance, 2022).

By providing a pressurized piping conveyance system, the Modernization Alternative would allow some irrigators to eliminate the need for pumping altogether. This would reduce pump operations, maintenance, and replacement (OM&R) costs to some NUID patrons. Data collected by the District found that there were 109 irrigation pumps within Phase 1 of NUID that would be eliminated under the Modernization Alternative (Windom, 2020).[21]

To estimate the avoided OM&R costs of pumping (that are additional to the energy cost savings estimated above), we add the annual power company fixed service charge, estimated annual pump repair costs, and the estimated annual pump replacement costs. Pacific Power charges a minimum annual service fee of $65 for agricultural pumping service under Schedule 41 (Pacific Power, 2022). For annual repair costs, interviews with irrigation pump professionals indicated that surface irrigation pumps typically require maintenance every 3 to 5 years, which costs $350 to $930 per instance (Scarborough, 2019; Mark, 2019).[22] From this, we assume the average irrigation pump receives maintenance once every 4 years, costing about $635 (the midpoint of the cost range), resulting in an average annual cost of approximately $160 per year. Based on interviews with irrigation pump experts and published sources, we estimate replacement costs for a 10-horsepower irrigation pump at $3,400 (including installation)[23], and assume replacement is required on average every 10 years (Haun, 2019; Fey, 2019). Amortizing this at the 2.25-percent annual rate, the average annual cost of replacing a 10-horsepower pump is about $390. Given that over 80 percent of the eliminated pumps are larger than 10 horsepower (Windom, 2020), and larger pumps are more expensive, $390 may underestimate the average

21 The Modernization Alternative is not expected to result in sufficient pressurization to eliminate the need for existing pumps in Phase 1.
22 The original cost range of $300 to $800 in 2019 dollars was adjusted for inflation to 2022 dollars using the "Labor, Wage Rate" Agricultural Producer Price Index (NASS, 2020).
23 The original cost of $3000 in 2020 dollars was adjusted for inflation to 2022 dollars using the Implicit Price Deflator for Gross Domestic Product (Bureau of Economic Analysis, 2022).

annual cost of replacing pumps in NUID, and therefore may understate the average annual benefits of avoided OM&R savings under the Modernization Alternative.

Combining the annual service charge ($65), repair costs ($160), and annualized replacement costs ($390) results an estimated total annual cost of approximately $610 per year per pump. We apply this cost to each eliminated pump to derive the annual benefit. Using this method, the 109 pumps eliminated would provide annual benefits of roughly $66,000, as shown in Table D-6. When expressed in average annual terms, the OM&R cost savings (or benefit) is $62,000 over the No Action Alternative.

Table D-6. Annual Increased Pump Maintenance Cost Savings to NUID Patrons Under the Modernization Alternative by Project Group, Deschutes Watershed, Oregon, 2022$.[1]

Works of Improvement	Pumps Eliminated under the Modernization Alternative [2]	Undiscounted Annual OM&R Costs Avoided	Discounted Annualized OM&R Costs Avoided
Phase 1	109	$66,000	$62,000
Phase 2	0	$0	$0
Total	**109**	**$66,000**	**$62,000**

Note: Totals may not sum due to rounding. Prepared October 2022
OM&R = operation, maintenance, and repair
1/ Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.
2/ As estimated by NUID (Windom, 2020).

D.1.3.1.4. Carbon Emission Reductions

Changes in energy use are expected to result in changes in carbon dioxide emissions from power generation. Every MWh of reduced energy use is estimated to translate into an estimated reduction of 0.7525 metric tons (Mt) of carbon emissions.[24] The Modernization Alternative would decrease carbon emissions by eliminating some pumping energy use by NUID patrons. Within the District, compared to the No Action Alternative, the annual energy savings (described in Section D.1.3.1.2) would reduce CO_2 emissions by approximately 2,062 Mt (approximately 2,740 MWh multiplied by 0.7525).

To value the potential decrease in carbon emissions, this analysis uses the social cost of carbon (SCC), which is the estimated total cost to society of emitting carbon related to the expected damages associated with 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 in 2013 developed a set of SCC estimates that could be used across federal agencies (Interagency Working Group on Social Cost of Greenhouse Gases,

24 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 result in reduced fossil fuel–powered generation. Furthermore, this estimate assumes 0.7521 metric tons of carbon emitted from one MWh of fossil fuel–powered electricity generation based on (a) the current proportion of fuel sources–oil, natural gas, and coal–for fossil fuel powered electrical power generation in the West, and (b) the associated metric tons of CO_2 produced per MWh powered by each fossil fuel source, as reported by the Energy Information Administration.

2013). In February 2021, the IWG updated its estimates of the SCC. They estimated that in the year 2022, at a 3-percent discount rate, the SCC value was $51 per Mt in 2020 dollars (Interagency Working Group on Social Cost of Greenhouse Gases, 2021). We adjust this value for inflation to roughly $57 per Mt in 2022 dollars using the Implicit Price Deflator for Gross Domestic Product (Bureau of Economic Analysis, 2022). We apply this value to the net change in carbon emissions each year throughout the project life to estimate the change in carbon emissions from the Modernization Alternative.

At this value, the reduction of 2,062 Mt of CO_2 emissions under the Modernization Alternative would bring annual benefits of $116,000. When discounted and annualized, the benefits of reduced CO_2 emissions under the Modernization Alternative would be roughly $109,000. This is shown in Table D-7.

Table D-7. Annual Average Reduction in Carbon Costs of Modernization Alternative, Deschutes Watershed, Oregon, 2022$.[1]

Works of Improvement	Annual Avoided Emissions (Reduced NUID Patron Energy Use, Mt Carbon)	Undiscounted Annual Average Benefit of Avoided Emission	Average Annual NEE Benefit (Social Cost of Carbon)
Phase 1	1,958	$111,000	$104,000
Phase 2	104	$5,000	$5,000
Total	**2,062**	**$116,000**	**$109,000**

Note: Totals may not sum due to rounding. Prepared October 2022
Mt = metric ton; NEE = National Economic Analysis; NUID = North Unit Irrigation District
1/ Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.

D.1.3.2. Benefits Considered but Not Included in Analysis

D.1.3.2.1. PUBLIC SAFETY AVOIDED COSTS

Piping irrigation water removes the hazard of drownings in canals and eliminates the potential for earthen canals to fail, causing potential damages to downstream property and lives. While NUID canal failure is very possible, the extent of damage varies dramatically depending on the timing and location of failure. A history of recent drownings in Central Oregon irrigation canals provides evidence that fast-moving water in irrigation canals, often with steep and slippery banks, can be a threat to public safety. In 2004, a toddler drowned in a Central Oregon Irrigation District canal, and in 1996 and 1997, respectively, a 12-year-old boy and a 28-year-old man drowned in North Unit Irrigation District canals (Flowers, 2004). Other drownings may have occurred in the past, as a comprehensive list of drownings in Central Oregon irrigation canals was not available from the Bureau of Reclamation or other sources. However, the data indicate at least three drownings over the last 21 years (1996 through 2016), or 0.143 deaths per year during this period. As the population in Central Oregon continues to grow and areas surrounding irrigation canals continue to urbanize, the risk to public safety would increase.

The Modernization Alternative would pipe 24.9 miles of NUID's open canals. This section qualitatively discusses the potential magnitude of the public safety benefit of piping this section. The analysis presents some information on the potential public safety hazard of the existing irrigation canals in NUID 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 open canals in NUID based on past drownings in unpiped canals in Central Oregon. Based on data from the Oregon Water Resources Department (OWRD) on canals in Central Oregon, there are 1,072 miles of irrigation canals in Central Oregon districts (see Table D-8). Starting in the late 1980s and early 1990s, sections of these canals began to be piped, with the result that today, the OWRD database records show that approximately 209 miles have been piped. Assuming piping occurred uniformly across the 21-year period from 1996 to 2016, approximately 9.9 miles were piped each year, leaving approximately 973 miles unpiped on an average annual basis during this period. Given that an average of 0.143 drowning deaths occurred annually during this period (three deaths over 21 years as described above), the annual drowning risk per mile of exposed canal was 0.000147 (0.143 divided by 973). This may be an overestimate of risk if there were an abnormally high number of drownings in the last 20 years.

Under the No Action Alternative, NUID would continue to have approximately 24.9 miles of unpiped canal. Assuming that the three drownings from 1996 to 2016 are representative of future drowning risk, and that the 0.000147 deaths per mile of exposed canal experienced during this period is an appropriate estimate of future risk, the unpiped canals in NUID carry a risk of 0.0037 deaths per year.

Table D-8. Irrigation Canal Mileage by District.

Irrigation District	Canal and Lateral Mileage
Arnold Irrigation District	47.3
Central Oregon Irrigation District	430.0
Lone Pine Irrigation District	2.4
North Unit Irrigation District	300.1
Ochoco Irrigation District	100.3
Swalley Irrigation District	27.6
Tumalo Irrigation District	95.8
Three Sisters Irrigation District	68.7
Total	**1,072.2**

Note: Totals may not sum due to rounding. Prepared October 2021
Source: Oregon Water Resources Department, database maintained and provided by Jonathon LaMarche on March 9, 2017.

D.1.3.3. Incremental Analysis

The Modernization Alternative is evaluated using an incremental analysis, which identifies how total costs and benefits change as project phases are added (Table D-9). The engineering pipeline design (pipe diameters, pressure ratings, etc.) and associated cost of each phase is independent of the number of phases and the order that the phases are installed. In engineering the design of the system, the District and Black Rock Consulting mapped and collected digital elevation data to create a hydraulic model that determined pipe sizes for each pipeline (canal or lateral to be piped) in the system.

Table D-9. Incremental Analysis of Annual NEE Costs and Benefits Under the Modernization Alternative for NUID, Deschutes Watershed, Oregon, 2022$.[1]

Project Phases	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1	$818,000		$943,000		$125,000
1, 2	$909,000	$91,000	$1,055,000	$112,000	$146,000

Notes: Prepared October 2022
[1/]Price Base: 2022 dollars amortized over 100 years at a discount rate of 2.25 percent.

D.1.4. References

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D.2. NEE Appendix

D.2.1. Crop Enterprise Budgets

This appendix presents the crop enterprise budgets used to estimate the benefits under the Modernization Alternative of avoiding agricultural damage to NUID (described in Section D.1.3.1.1). The analyses use a total of four crop budgets:

Table D-10. Summary of Crop Budgets.

Scenario	Production Year [1]	Budget Table
Deficit Irrigation	Year 1	Table D-11
	Years 2-6	Table D-12
Full Irrigation	Year 1	Table D-13
	Years 2-6	Table D-14

Notes:
1/ This refers to years in the alfalfa rotation and is not the same as the years measuring the study period in the analysis.

The costs and benefits of agricultural production are estimated using an enterprise budget that represents typical costs and returns of producing crops in the Deschutes Watershed of Central 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. As a starting point for the crop budgets in this analysis, we used a crop budget for alfalfa hay developed by Washington State University and then adjusted values in the budget to account for changes in prices through time and local conditions in NUID. A more recent published alfalfa hay budget for Central Oregon was not available from Oregon State or Washington State University. The following section outlines the data and assumptions used in adjusting the Washington State alfalfa hay budget.

D.2.1.1. Alfalfa Enterprise Budgets

The alfalfa hay enterprise budgets were based on a 2012 budget developed by Washington State University (WSU) for establishing and producing alfalfa hay in the Washington Columbia Basin (Norberg & Neibergs, 2012). We selected these budgets as the basis for NUID crop production costs because they are the most recent crop budgets developed for producing alfalfa hay in an area that is relatively close to Central Oregon.

We updated the costs presented in the original budgets to account for changing values over time and to reflect conditions specific to NUID. Returns to alfalfa were based on average hay yields in Jefferson County and 5-year normalized average hay prices in Oregon.[25]

D.2.1.2. Modeled Farm

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. Other than labor for irrigation, all labor is provided by hiring

25 A normalized average is calculated by removing the highest and lowest values in a set of data and taking the mean of the remaining values.

custom work (includes harvest, fertilizer application, and herbicide application). Irrigation is delivered by a center pivot.

D.2.1.3. Input Costs

For fertilizers in the non-establishment budgets, we adjust the amount used proportionally according to differences in yield from the original budget. For example, the original budget calls for 92 pounds (lbs) of dry phosphate to produce 8 tons of hay per acre; in the Deficit Irrigation Production Budget (Table D-12), we model a yield of only 5.4 tons per acre (68 percent of the original yield), so we reduce the amount of dry phosphate to 62.6 lbs (68 percent of 92 lbs). One exception to this method is the amount of dry sulfur applied, which is held constant at 30 lbs per acre during production years per guidance from an OSU Extension Agent in Central Oregon (Bohle, 2020). The Year 1 Production budgets (Table D-11 and Table D-13) retain the fertilizer levels from the original budget.

All costs are adjusted from the original values in the WSU budget. We used area-specific values for fuel prices, irrigation charges, and land costs. For costs that did not have area-specific values, we adjusted the value in the original budget using the national Producer Price Indices (PPI) produced by the National Agricultural Statistics Services (NASS), which are published for a variety of farm expenses (NASS, 2022). 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 a 12-percent increase in the price of Potash & Phosphorus to a 63-percent increase in Machinery costs.

For land costs in the establishment budget, we use NASS data on rental rates for irrigated cropland in Jefferson County ($123 per acre) (NASS, 2022).[26] Because alfalfa is seeded in the fall after another crop has been harvested, we only ascribe 25 percent of the land costs to establishing alfalfa.

D.2.1.4. Labor Costs

Because most of the labor is provided by custom work, the only direct labor costs are for irrigation labor. For the cost of this labor, we use the median hourly wage rate for the farmworkers occupation in Central Oregon in 2021 and adjust to 2022 dollars using the "Labor, Wage Rates" PPI.[27] We further adjust this wage rate up by 20 percent to account for non-wage employment costs, such as health care and insurance.[28] This results in total labor costs of $19.62 per hour for irrigation labor.

We adjusted the cost of custom work using the "Ag Services, Custom Rates" PPI. For the production budgets, we adjust some labor costs (including custom bailing, hauling, staking, and tarping) 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 underestimate benefits (and vice versa). Management labor costs are estimated at 5 percent of total costs (following the original budget). Other custom labor, including swathing and raking, are adjusted based on the number of hay cuttings. The original budget modeled four cuttings; the Full Irrigation Budgets (Table D-13 and Table D-14) models four cuttings, while the Deficit Irrigation Budgets (Table D-11 and Table D-12) models 3 cuttings.

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[26] For Jefferson County, we took the normalized average price from 2012-2021. The normalized average is calculated by removing the high and low values from dataset and taking the mean of the remaining values.

[27] This is the average wage for the Farmworkers and Laborers, Crop, Nursery, and Greenhouse (occupation code 45-2092) in the Central Oregon non-metropolitan area according to the Bureau of Labor Statistics' Occupational Employment and Wage Estimates data in May 2021 (Bureau of Labor Statistics, 2019).

[28] This is roughly the average proportion of non-wage labor costs for all private, part-time workers in the U.S. in December 2018 (Bureau of Labor Statistics, 2018).

D.2.1.5. Revenues

To estimate the gross revenues of alfalfa hay, we use the normalized average price per ton for alfalfa hay in Oregon using the NRCS method[29] and data from 2019 to 2021. This results in an average price of $200.92 per ton. For yields in NUID under deficit irrigation, we use the average yield in Jefferson County from 2013 to 2017: 5.4 tons per acre (NASS, 2022).

D.2.1.6. Alfalfa Enterprise Budget Tables

The tables below present alfalfa hay enterprise budgets used to estimate the costs and returns under different irrigation levels.

[29] The NRCS method adjusts the average price at the state level by the relative change in prices at the national level. This involves taking the most recent 3-year average in the state (in this case, 2019-2021), multiplying it by the most recent 3-year average in the US, and dividing by the most recent 5-year average price in the US (2017-2021).

Table D-11. Alfalfa Net Returns Under Deficit Irrigation, Production Year 1.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	4.06	ton	$200.92	$815.61
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.74	$0.00
Dry Phosphate	0.0	lb	$1.00	$0.00
Dry Potash	0.0	lb	$0.71	$0.00
Dry Sulfur	0.0	lb	$0.37	$0.00
Custom - Swath	2.0	ac	$24.47	$48.93
Custom - Rake	2.0	ac	$12.23	$24.47
Custom - Bail	4.1	ton	$20.80	$84.42
Custom - Haul & Stack	4.1	ton	$11.01	$44.69
Custom - Tarping	4.1	ton	$6.12	$24.83
Irrigation - power	1.0	ac	$51.62	$51.62
Irrigation - water access	1.0	ac	$3.67	$3.67
Irrigation - repairs	1.0	ac	$19.90	$19.90
Irrigation - labor	0.5	ac	$19.62	$9.81
Gopher control	1.0	ac	$6.98	$6.98
Fuel	2.3	gal	$4.45	$10.15
Lubricants	1.0	ac	$1.12	$1.12
Machinery repairs	1.0	ac	$2.39	$2.39
Haystack Insurance	4.1	ton	$2.35	$9.52
Overhead	1.0	ac	$32.96	$32.96
Operating interest	1.0	ac	$8.45	$8.45
Total variable costs				$383.90
FIXED COSTS				
Machinery depreciation	1.0	ac	$8.81	$8.81
Machinery interest	1.0	ac	$3.56	$3.56
Machinery insurance, taxes, housing, license	1.0	ac	$3.27	$3.27
Management (5% of total cost)	1.0	ac	$26.14	$26.14
Establishment cost	1.0	ac	$117.67	$117.67
Land cost	1.0	ac	$123.33	$123.33
Total fixed costs				$282.79
Total costs				$666.69
NET RETURNS PER ACRE				**$148.92**

Notes: ac = acre; gal = gallon; lb = pound

Table D-12. Alfalfa Net Returns Under Deficit Irrigation, Production Years 2–6.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	4.06	ton	$200.92	$815.61
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.60	$0.00
Dry Phosphate	46.7	lb	$1.00	$46.85
Dry Potash	71.0	lb	$0.71	$50.70
Dry Sulfur	30.0	lb	$0.37	$11.08
Zinc	2.5	lb	$3.75	$9.51
Boron	1.0	lb	$8.44	$8.57
Custom Application	1.0	ac	$11.01	$11.01
Soil Test	1.0	ac	$0.37	$0.37
Herbicide	2.0	lb	$21.32	$42.63
Custom Application	1.0	ac	$11.01	$11.01
Custom - Swath	2.0	ac	$24.47	$48.93
Custom - Rake	2.0	ac	$12.23	$24.47
Custom - Bail	4.1	ton	$20.80	$84.42
Custom - Haul & Stack	4.1	ton	$11.01	$44.69
Custom - Tarping	4.1	ton	$6.12	$24.83
Irrigation - power	1.0	ac	$58.08	$58.08
Irrigation - water access	1.0	ac	$3.67	$3.67
Irrigation - repairs	1.0	ac	$19.90	$19.90
Irrigation - labor	0.4	ac	$19.62	$7.36
Haystack insurance	4.1	ton	$2.35	$9.52
Gopher control	1.0	ac	$6.98	$6.98
Fuel	2.3	gal	$4.45	$10.15
Lubricants	1.0	ac	$1.12	$1.12
Machinery repairs	1.0	ac	$2.39	$2.39
Overhead	1.0	ac	$49.62	$49.62
Operating interest	1.0	ac	$13.23	$13.23
Total variable costs				$601.07
FIXED COSTS				
Machinery depreciation	1	ac	$8.81	$8.81
Machinery interest	1	ac	$3.56	$3.56
Machinery insurance, taxes, housing, license	1	ac	$3.27	$3.27
Management (5% of total cost)	1	ac	$42.89	$42.89
Establishment cost	1	ac	$117.67	$117.67
Land cost	1	ac	$123.33	$123.33
Total fixed costs				$299.53
Total costs				$900.60
NET RETURNS PER ACRE				**-$84.99**

Notes: ac = acre; gal = gallon; lb = pound

Table D-13. Alfalfa Net Returns Under Full Irrigation, Production Year 1.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	5.4	ton	$200.92	$1,087.48
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.74	$0.00
Dry Phosphate	0.0	lb	$1.00	$0.00
Dry Potash	0.0	lb	$0.71	$0.00
Dry Sulfur	0.0	lb	$0.37	$0.00
Custom - Swath	3.0	ac	$24.47	$73.40
Custom - Rake	3.0	ac	$12.23	$36.70
Custom - Bail	5.4	ton	$20.80	$112.56
Custom - Haul & Stack	5.4	ton	$11.01	$59.59
Custom - Tarping	5.4	ton	$6.12	$33.11
Irrigation - power	1.0	ac	$51.62	$51.62
Irrigation - water access	1.0	ac	$3.67	$3.67
Irrigation - repairs	1.0	ac	$19.90	$19.90
Irrigation - labor	0.5	ac	$19.62	$9.81
Gopher control	1.0	ac	$6.98	$6.98
Fuel	2.3	gal	$4.45	$10.15
Lubricants	1.0	ac	$1.12	$1.12
Machinery repairs	1.0	ac	$2.39	$2.39
Haystack Insurance	5.4	ton	$2.35	$12.69
Overhead	1.0	ac	$32.96	$32.96
Operating interest	1.0	ac	$10.50	$10.50
Total variable costs				$477.14
FIXED COSTS				
Machinery depreciation	1.0	ac	$8.81	$8.81
Machinery interest	1.0	ac	$3.56	$3.56
Machinery insurance, taxes, housing, license	1.0	ac	$3.27	$3.27
Management (5% of total cost)	1.0	ac	$30.81	$30.81
Establishment cost	1.0	ac	$117.67	$117.67
Land cost	1.0	ac	$123.33	$123.33
Total fixed costs				$287.45
Total costs				$764.59
NET RETURNS PER ACRE				**$322.89**

Notes: lb = pound; Gal = gallon; ac = acre

Table D-14. Alfalfa Net Returns Under Full Irrigation, Production Years 2–6.

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	5.4	ton	$200.92	$1,087.48
VARIABLE COSTS				
Dry Nitrogen	0.0	lb	$0.60	$0.00
Dry Phosphate	62.2	lb	$1.00	$62.47
Dry Potash	94.7	lb	$0.71	$67.60
Dry Sulfur	30.0	lb	$0.37	$11.08
Zinc	3.4	lb	$3.75	$12.68
Boron	1.4	lb	$8.44	$11.43
Custom Application	1.0	ac	$11.01	$11.01
Soil Test	1.0	ac	$0.37	$0.37
Herbicide	2.0	lb	$21.32	$42.63
Custom Application	1.0	ac	$11.01	$11.01
Custom - Swath	3.0	ac	$24.47	$73.40
Custom - Rake	3.0	ac	$12.23	$36.70
Custom - Bail	5.4	ton	$20.80	$112.56
Custom - Haul & Stack	5.4	ton	$11.01	$59.59
Custom - Tarping	5.4	ton	$6.12	$33.11
Irrigation - power	1.0	ac	$58.08	$58.08
Irrigation - water access	1.0	ac	$3.67	$3.67
Irrigation - repairs	1.0	ac	$19.90	$19.90
Irrigation - labor	0.5	ac	$19.62	$9.81
Haystack insurance	5.4	ton	$2.35	$12.69
Gopher control	1.0	ac	$6.98	$6.98
Fuel	2.3	gal	$4.45	$10.15
Lubricants	1.0	ac	$1.12	$1.12
Machinery repairs	1.0	ac	$2.39	$2.39
Overhead	1.0	ac	$49.62	$49.62
Operating interest	1.0	ac	$16.20	$16.20
Total variable costs				$736.22
FIXED COSTS				
Machinery depreciation	1.0	ac	$8.81	$8.81
Machinery interest	1.0	ac	$3.56	$3.56
Machinery insurance, taxes, housing, license	1.0	ac	$3.27	$3.27
Management (5% of total cost)	1.0	ac	$49.64	$49.64
Establishment cost	1.0	ac	$117.67	$117.67
Land cost	1.0	ac	$123.33	$123.33
Total fixed costs				$306.29
Total costs				$1,042.51
NET RETURNS PER ACRE				**$44.96**

Notes: ac = acre; gal = gallon; lb = pound

D.3. Alternatives Considered During Formulation

This section presents the alternatives considered in the formulation phase.

During the formulation phase, alternatives were evaluated based on meeting both NEPA and environmental review requirements specific to NRCS federal investments in water resources projects (USDA *Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments* [PR&G]) (Table D-15). According to NEPA, "agencies shall rigorously explore and objectively evaluate all reasonable alternatives" (40 CFR 1502.14). According to the PR&G DM 9500-013, 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 shown in Table D-15 and discussed below. Alternatives selected for further evaluation are discussed in the Plan-EA.

Table D-15. 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	
Conversion to Dryland Farming			X		
Voluntary Duty Reduction			X		
Partial Use of Groundwater					
On-Farm Efficiency Upgrades		X		X	
Piping Private Laterals		X		X	
Canal Lining	X	X		X	X
Piping Across NUID		X	X	X	
No Action (Future without Federal Investment)			X		X
Modernization Alternative	X	X	X	X	X

Notes:
NUID = North Unit Irrigation District; PR&G = Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments

D.3.1. 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. The lack of rainfall throughout the growing season coupled with hot temperatures, desiccating winds, as well as generally shallow and well- to excessively drained soils with low storage potentials, makes dryland farming infeasible within the District (Daly et al. 1994; Gannett et al. 2001). In the District, agricultural production would substantially decrease if dryland farming were implemented. With decreased production and income, farmers could potentially sell their land due to the development pressure the area is experiencing. Dryland farming would not meet any of the purposes of the project and would be inconsistent with ensuring agricultural production is maintained in an area undergoing rapid urbanization.

Conversion to dryland farming was eliminated from further evaluation because it would not meet the proposed project's purpose and need; its effectiveness would be uncertain since conversion to dryland farming would be voluntary; it would be inconsistent with public policy supporting and maintaining existing agricultural land use; and because it would not achieve the Federal Objective and Guiding Principles.

D.3.2. Voluntary Duty Reduction

Voluntary duty reduction refers to patrons voluntarily accepting less than their full water delivery rate from the District. A reduction in duty could mean the District diverts less water. Voluntary duty reduction would not meet any of the proposed project purposes. The District already sets limits on patrons' annual usage in the District, and additional duty reductions would reduce a patron's reliable agricultural water supply and decrease agricultural production, which would impact the local rural community. Voluntary duty reduction would not meet any of the other identified needs of the proposed project.

Voluntary duty reduction was eliminated from further evaluation because it would not meet the proposed project's purpose and need; its effectiveness would be uncertain since duty reduction would be voluntary; 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. Partial Use of Groundwater

The partial conversion from surface-water-sourced- to groundwater-sourced-irrigation was also initially considered as a possible alternative. To use groundwater in the Deschutes Basin, the District would have to apply for groundwater rights under the OWRD Deschutes Basin Groundwater Mitigation (DBGM) program pursuant to OAR 690-505-0500. The DBGM program is part of OWRD's goal to limit groundwater use by imposing restrictions to new users obtaining groundwater rights. Under the DBGM program, only 16.65 cfs[30] is available for the whole Deschutes Basin, and it is unlikely the District could obtain rights to all the remaining water (S. Henderson, personal communication, March 11, 2021).

The partial use of groundwater for irrigation would have logistical and legal constraints. The District and patrons could use their surface water rights for groundwater mitigation credits[31] required by the DBGM program. However, 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.

Exclusive and partial use of groundwater would not meet any of the purposes of the proposed project. If water saved from conversion to groundwater was applied to other uses in the District, it could improve water availability for agricultural use in the District, but this is not certain to occur because switching to groundwater would be voluntary. Additionally, the District lacks the statutory authority or responsibility to carry out, operate, and maintain groundwater wells on private lands owned by NUID patrons. Therefore, carrying out this alternative would be logistically complex. The partial use of groundwater was eliminated from further evaluation because it would not meet the proposed project's purpose and need; its effectiveness would be uncertain since conversion to groundwater would be voluntary; of inefficiencies associated with logistical and legal constraints obtaining groundwater rights; of low acceptability since converting to groundwater rights would result in junior water rights; and because it would not achieve the Federal Objective and Guiding Principles.

D.3.4. On-Farm Efficiency Upgrades

On-farm efficiency upgrades refer to patrons upgrading their on-farm infrastructure to use irrigation technologies that provide a more precise application of water. On-farm infrastructure is distinct from the

[30] Currently OWRD has 40.9 cfs left under the 200 cfs cap, however they have pending applications with the amount of 25.24 cfs. Although there is no guarantee that these applications will be approved or processed, it is suggested that the cap would be at 16.65 cfs remaining (S. Henderson, personal communication, March 11, 2021).
[31] NUID would not create groundwater mitigation credits under either the No Action or the Modernization Alternatives analyzed in this Plan-EA.

District's infrastructure because it is owned and operated by patrons. Once delivered by the District and arriving on-farm, water can either be released to flow over the land for flood irrigation or stored in a holding pond and later pumped out for sprinkler irrigation systems. Typical on-farm irrigation systems include center-pivots, wheel-lines, hand-lines, K-lines, drip systems, and flood irrigation. 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). Farms within the District are irrigated almost entirely through sprinkler irrigation[32] (97 percent of the total acreage in NUID; NUID 2016).

Voluntary programs to increase on-farm water use efficiency by other agencies and organizations are ongoing within the District and the Deschutes Basin. However, on-farm efficiency upgrades would not meet the proposed project purpose. Water loss due to seepage would still occur in District infrastructure as would operational inefficiencies. Water delivery reliability would not be improved and would remain an issue.

If P.L. 83-566 funds were used to develop and implement on-farm efficiency upgrades, the use of these funds would require NUID to complete a SHPO/NHPA analysis for each individual property owner. It would potentially put NUID into a position of having to mitigate cultural resources on private property and could result in NUID having to develop long-term maintenance or preservation agreements on lands not subject to NUID control. This approach is logistically complex and would increase costs of the proposed project. Additionally, NUID lacks the authority or responsibility to carry out, operate, and maintain on-farm infrastructure owned by NUID patrons which would add to logistical complexity. The on-farm efficiency upgrade alternative was eliminated from further study because it does not meet the purpose and need of the proposed project, would be logistically unreasonable, and because it did not achieve the Federal Objective and Guiding Principles.

D.3.5. Piping Private Laterals

Piping private laterals refers to converting patron-owned open laterals to piped laterals from the NUID point of delivery to the point of use on-farm. Private laterals are owned and operated by patrons; NUID does not have responsibility for the operation or maintenance of private laterals.

Since NUID lacks the authority or responsibility to carry out, operate, and maintain private laterals owned by NUID patrons, this alternative would have the same logistical complexities, which make this alternative unreasonable.

Piping private laterals, similar to on-farm irrigation upgrades, would not meet the project purpose of conserving water or improving water delivery reliability on District-owned infrastructure. Piping private laterals was eliminated from further study because it does not meet the purpose of the propose project and would be logistically unreasonable.

D.3.6. Piping Entire District

In 2016, NUID worked with Black Rock Engineering to perform a water loss assessment and to identify potential energy and water conservation projects along NUID-owned infrastructure. The result of this work was a System Improvement Plan (2017) which included a 10 percent engineering design of the entire system piped and the associated costs, energy conservation/generation, and potential water savings.

When NUID developed the System Improvement Plan, it was identified that piping the District ($809M), plus the Main Feed Canal from Bend ($540M) would cost $1.35B (2017 dollars). This would be logistically

[32] This includes all sprinkler application methods including center-pivot, wheel-line, hand-line, etc.

unreasonable for NUID to pursue, as it would not reasonably be able to find match funding for a project of this size. However, upon completion of the System Improvement Plan and during the P.L. 83-566 scoping process, NUID assessed what areas of its District had high water loss and other benefits, would be acceptable to patrons, and would address the resource concerns within the District. Based on these criteria, laterals 31, 32, 34, and 43 were determined to be of high priority. After initial analysis, Lateral 43 was shortened because it was shown that the benefits from piping the full extent of the lateral would not outweigh the costs.

Piping across the entire district was eliminated because it would be logistically unreasonable to find the match funding for a project of this scale. However, piping laterals 31, 32, 34, and 43 were moved forward for detailed analysis.

D.4. Capital Costs

D.4.1. Canal Lining Alternative Costs

The capital cost of the Canal Lining Alternative (Table D-16) was estimated by calculating the length of geotextile membrane for existing open canals assuming an anchor of membrane extends 7 feet on either side. The membrane would be covered by a 1-inch-thick 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 channels deeper than 2.5 feet. Costs related to earthwork and labor were estimated by a construction cost multiplier of 2. Turnouts were estimated using the same assumptions as the Modernization Alternative. The cross-section dimensions for lining the canals were calculated for each corresponding pipe diameter size using transects on a digital elevation model, which were estimated from an irrigation district in Central Oregon.

Table D-16. Canal Lining Alternative Costs.

Feature	Equivalent Pipe Diameter (inches)	Length (feet) or Quantity	Cross Section (feet)	Channel Width (feet)	Channel Depth (feet)	Materials & Construction ($)
Lining	72	2,543	31.4	29.3	5.2	$1,230,000
Lining	66	2,393	29.2	27.2	4.9	$1,086,000
Lining	63	11,866	34.4	32.7	3.9	$6,227,000
Lining	54	29	23.6	23.6	4.3	$12,000
Lining	48	5,661	25.9	23.5	4.4	$2,893,000
Lining	42	4,523	25.3	22.8	4.6	$2,249,000
Lining	36	5,473	22.2	19.5	4.9	$2,431,000
Lining	34	4,818	19.7	18.5	3.3	$1,937,000
Lining	32	1,302	25.3	24.0	3.3	$647,000
Lining	28	1,749	23.6	22.5	3.0	$819,000
Lining	26	3,917	23.6	22.5	3.0	$1,452,000
Lining	24	19,133	23.8	22.6	3.1	$10,823,000
Lining	20	8,872	22.2	20.9	3.2	$4,720,000
Lining	18	8,974	14.5	13.1	2.8	$3,399,000
Lining	16	17,743	14.8	14.1	2.3	$6,725,000
Lining	14	4,329	12.5	11.8	2.2	$1,458,000
Lining	12	14,022	12.7	11.8	2.4	$4,764,000
Lining	10	12,879	12.7	11.8	2.4	$5,069,000
Lining	8	5,832	12.3	11.6	2.0	$2,032,000
Lining	6	8,815	12.3	11.6	2.0	$3,279,000
Turnouts	N/A	153	N/A	N/A	N/A	$164,000

Feature	Equivalent Pipe Diameter (inches)	Length (feet) or Quantity	Cross Section (feet)	Channel Width (feet)	Channel Depth (feet)	Materials & Construction ($)
Retention Ponds	N/A	4	N/A	N/A	N/A	$171,000
					Subtotal	$63,587,000
					Engineering, Construction Management, and Survey (10%)	$6,359,000
					Construction Manager/General Contractor (10%)	$6,359,000
					Contingency (15%)	$11,446,000
					Total	$87,751,000

Notes: Prepared October 2022
N/A = not applicable. Totals rounded to nearest $1,000 and may not sum.

D.4.2. Modernization Alternative/Preferred Alternative Costs

This section presents capital costs for the Modernization Alternative, which is the Preferred Alternative (Table D-17).

A wide variety of materials are available for piping; availability of piping materials, prices, and new products change over time. Materials that could be used for the Modernization Alternative include, but are not limited to, polyvinyl chloride, steel, high-density polyethylene (HDPE), bar-wrapped concrete cylinder, fiberglass, and ductile iron. The Modernization Alternative was priced using HDPE pipe, which at the time of this analysis was considered to be the most cost-effective material.

At the time of proposed project implementation, the specific piping material would be selected based on a number of considerations: the cost of the proposed project must meet the NEE requirements; design must meet construction requirements; the pipe material must be appropriate based on local conditions and risk factors; and the pipe material must result in a no or minor change to project effects described in Section 6 of the Plan-EA, as determined through the tiered decision framework approach outlined in Section 1.4 of the Plan-EA. The NRCS State Conservationist and the Sponsoring Local Organization would possess the final discretion to select the appropriate piping material.

Table D-17. Preferred Alternative Costs.

Feature	Diameter (in)	Quantity	Units	Materials & Construction
Piping	6	8,815	feet	$78,000
Piping	8	5,832	feet	$100,000
Piping	10	12,878	feet	$286,000
Piping	12	14,023	feet	$444,000
Piping	14	4,328	feet	$161,000
Piping	16	17,743	feet	$794,000
Piping	18	8,974	feet	$610,000
Piping	20	8,872	feet	$699,000
Piping	24	19,133	feet	$2,275,000
Piping	26	3,917	feet	$369,000
Piping	28	1,749	feet	$256,000
Piping	32	1,302	feet	$273,000
Piping	34	4,818	feet	$1,139,000
Piping	36	5,473	feet	$956,000
Piping	42	4,523	feet	$1,256,000
Piping	48	5,661	feet	$2,389,000
Piping	54	29	feet	$14,000
Piping	63	11,866	feet	$7,530,000

Feature	Diameter (in)	Quantity	Units	Materials & Construction
Piping	66	2,393	feet	$1,284,000
Piping	72	2,543	feet	$1,624,000
Turnouts	N/A	153	each	$1,312,000
Retention Reservoirs	N/A	4	each	$171,000
Energy Dissipator	N/A	2	each	$124,000
Pressure Reducing Valve	N/A	4	each	$155,000
Subtotal				$24,298,000
Engineering, Construction Management, and Survey (10%)				$2,430,000
Construction Manager/General Contractor (10%)				$2,430,000
Contingency (15%)				$4,373,000
Total				$33,531,000

Notes: Prepared October 2022
N/A = not applicable. Totals rounded to nearest $1,000 and may not sum.

D.5. Net Present Value of the Preferred Alternative

This section presents the estimated net present value of the Preferred Alternative and the Canal Lining Alternative.

Discount Rate: 2.25%

Period of Analysis: 100 years

Table D-18. Net Present Value of the Preferred Alternative and the Canal Lining Alternative.

	Preferred Alternative	Canal Lining Alternative
Design Life	100 years	33 years
Capital Costs[1]	$33,531,000	$87,751,000
Net Present Value of Replacement Costs[2]	$0	$77,786,000
Annual O&M Costs	$0	$124,000
Percent Change in O&M	0%	+25%
Net Present Value of O&M Costs	$0	$4,916,000
Total Net Present Value of Project	$33,531,000	$170,333,000

Notes: Prepared October 2022
Totals rounded to nearest $1,000.
N/A = not applicable; O&M = operation and maintenance
[1] The Capital Cost for the Preferred Alternative shown in this table does not match the cost shown elsewhere in the Plan-EA due to rounding.
[2] For canal lining, 100 percent was replaced at both 33 years and 66 years.

References

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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 action.

Table E-1. Intensity Threshold Table for the North Unit Irrigation District Infrastructure Modernization Project.

Beneficial	Changes in the resource or resource-related values are favorable or advantageous with respect to the resource. The effects on the resource or environment may range from slight to regional.
Negligible	Changes in the resource or resource-related values would be below or at the level of detection. If detected, the effects on the resource or environment would be considered slight with no perceptible impacts.
Minor	Changes in resource or resource-related values would be measurable but small. The effects on the resource or the environment would be localized.
Moderate	Changes in the resource or resource-related values would be measurable and apparent. The effects on the resource or the environment would be relatively local.
Major	Changes in resource or resource-related values would be measurable and substantial. The effects on the resource or the environment would be regional.
Impact Duration Definitions	
Temporary	Transitory effects which only occur over a period of days or months.
Short-Term Effect	Resource or resource-related values recover in fewer than 5 years.
Long-Term Effect	Resource or resource-related values take more than 5 years to recover.

E.2. Supporting Information for Land Use

Table E-2. Project Area Land Use.

Land Ownership	Project Area Length	Project Area Length Crossing each Land Use Class (miles)
Federal (Reclamation)	66%	18.2
Private	34%	9.25
Total	**100%**	**27.45**

Source: Deschutes County GIS; Jefferson County GIS

E.3. Supporting Information for Soil Resources

Table E-3. Project Area Length Crossing Farmland.

NRCS Farmland Class	Project Area	Project Area (miles)
Prime Farmland if Irrigated	66%	18.2
Farmland of Statewide Importance	34%	9.25
Total	**100%**	**27.45**

Source: NRCS gSSURGO FY2020 data.

E.4. Supporting Information for Vegetation Resources

The Jefferson County Noxious Weed Policy and Classification System designates three weed categories. Weeds designated "A" are of highest priority for control and are subject to intensive eradication, containment, or control measures using County resources. Weeds designated "B" have a limited distribution; intensive containment control and monitoring by landowners is required, and support from the County is provided when resources allow. Weeds designated "C" are the lowest priority for control. They have a widespread distribution, and landowner control and monitoring are recommended (Jefferson County, 2018). Table E-4 lists the noxious weeds and corresponding classifications known to occur in the project area.

Table E-4. Noxious Weeds Occurring in Jefferson County, Oregon.

Vegetation Species	Scientific Name	Jefferson County Noxious Weed Rating
Buffalobur	*Solanum rostratum*	A
Dalmatian Toadflax	*Linaria dalmatica*	A
Eurasian Milfoil	*Myriophyllum spicatum*	A
Houndstongue	*Cynoglossum officinale*	A
Iberian and Purple Starthistle	*Hydrilla verticillate*	A
Japanese Knotweed	*Polygonum cuspidatum*	A
Jointed Goatgrass	*Aegilops cylindrica*	A
Leafy Spurge	*Euphorbia esula*	A
Meadow Knapweed	*Centaurea debeauxii*	A
Musk Thistle	*Carduus acanthoides*	A
Perennial Pepperweed	*Lepidium latifolium*	A
Purple Loosestrife	*Lythrum salicaria*	A
Rush Skeletonweed	*Chondrilla juncea*	A
Scotch Broom	*Cytisus scoparius*	A
Scotch Thistle	*Onopordum acanthium*	A
Slender False Broom	*Brachypodium sylvaticum*	A
Spotted Knapweed	*Centaurea stoebe*	A
Squarrosa Knapweed	*Centaurea virgata*	A
Tansy Ragwort	*Senecio jacobaea*	A
Ventenata	*Ventenata dubia*	A
Wild Carrot	*Daucus carota*	A
Yellow Flag Iris	*Iris pseudacorus*	A
Yellow Starthistle	*Centaurea solstitialis*	A

Vegetation Species	Scientific Name	Jefferson County Noxious Weed Rating
Canada Thistle	*Cirsium arvense*	B
Canadian Goldenrod	*Solidago canadensis*	B
Common Groundsel	*Senecio vulgaris*	B
Curly Dock	*Rumex crispus*	B
Diffuse knapweed	*Centaurea diffusa*	B
Field Bindweed (Morning Glory)	*Convolvulus arvensis*	B
Flixweed	*Descurainia sophia*	B
Kochia	*Kochia scoparia*	B
Marestail	*Conyza canadensis*	B
Myrtle Spurge	*Euphorbia myrsinites*	B
Puncturevine	*Tribulus terrestris*	B
Quack Grass	*Elytrigia repens*	B
Russian Knapweed	*Acroptilon repens*	B
Ribbon Grass	*Phalaris arundinacea* var. *picta*	B
Russian Thistle (Tumbleweed)	*Salsola* spp.	B
Tumble Mustard	*Sisymbrium altissimum*	B
White Top Hoary Cress	*Cardaria chalepensis*	B
Common Mullein	*Verbascum thapsus*	C
Common St. Johnswort	*Hypericum perforatum*	C
Dead Nettle (Henbit)	*Lamium amplexicaule*	C
Medusahead Rye	*Taeniatherum caput-medusae*	C
Purple Mustard	*Chorispora tenella*	C
Rattail Fescue	*Vulpia myuros*	C
Western Salsify	*Tragopogon dubius*	C

Vegetation Species	Scientific Name	Jefferson County Noxious Weed Rating
Wild Oat	*Avena fatua*	C
Yellow Sweet Clover	*Melilotus officinalis*	C

Notes:
Noxious weeds occur throughout Jefferson County but not all may be in the project area.
Source: Jefferson County Public Works, Vegetation Management.

References

Jefferson County. (2018, March 28). *Jefferson County noxious weed list*. Jefferson County, Oregon. Retrieved from **https://www.jeffco.net/publicworks/page/weed-control-and-abatement**

E.5. Supporting Information for Water Resources

This section presents calculations used when evaluating effects of the proposed action with respect to water resources.

E.5.1. Method of Estimating Volume of Water Savings following Completion of the Proposed Project

In 2016, Black Rock Consulting worked with NUID to coordinate a water loss study performed by Farmers Conservation Alliance staff under direction the direction of Kevin L. Crew, P.E., and David C. Prull, P.E. of Black Rock Consulting. During the summer of 2016, the Seepage Loss Assessment Program (LAP), supported by Oregon State University and the Oregon Water Resources Department (OWRD), was implemented in seven of the eight Central Oregon irrigation districts, including NUID, to inform the districts of current system losses. Although titled the Seepage Loss Assessment Program, the water loss assessment that was completed included assessing water loss as a result of both seepage and evaporation, which were not differentiated in the analysis. The program included the use of newly purchased and calibrated Sontek Flowtracker II flow meters and office and field training in accordance with U.S. Geological Survey and U.S. Bureau of Reclamation practices (USGS 2010).

The primary purpose of the LAP was to perform a one-time measurement program in each district. The program provided the approximate seepage and evaporation losses in the elements of each system. The measurements were performed at different times of the irrigation season within each district. Therefore, the percentage of peak flow at the time of measurement varied by district as the LAP team entered, measured, and exited each district. The results were used to provide a strong indication of losses. The results were interpolated or extrapolated based upon the maximum expected loss within each district. The final loss information was used to identify losses by project phase or lateral.

For NUID, the LAP was implemented throughout the District's Main Canal and system laterals. Direct measurements identified a total seepage loss of approximately 18.7 cfs in laterals 31, 32, 34, and 43 (Black Rock 2017).

To calculate a volume (acre-feet) of water loss in each irrigation season, the estimated loss rate (see footnotes for fourth through seventh columns in Table E-5) was multiplied by the number of days in each period (third column of Table E-5) and again by the conversion factor of 1.9835 (acre-feet per cfs per day). The product is shown in the fourth through seventh columns of Table E-5, Estimated Volume of Loss in each lateral.

NUID diversion rates vary across the season, and the start of the irrigation season is dependent on many external and internal factors. To calculate the volume as described in the paragraph above, the mean number of days for irrigation years 2002 through 2018 was determined using data from OWRD Gauge No. 14069000 (Table E-6). April and October were typically the only two months during the irrigation season when the number of days varied from year to year.

For purposes of quantifying the volume of loss (acre-feet) in a system where loss is variable and dependent on many external factors, this appeared to be the most accurate approach for this level of analysis.

Table E-5. Calculations for Estimating Volume of Water Savings following Completion of the Proposed Project.

Time Period	2001–2018 Percentage of Maximum Average Diversion Rate [1]	Number of Days used in Volume Calculation [2]	Estimated Loss Volume in Lateral 31 (acre-feet/ time period) [3]	Estimated Loss Volume in Lateral 32 (acre-feet/ time period) [4]	Estimated Loss Volume in Lateral 34 (acre-feet/ time period) [5]	Estimated Loss Volume in Lateral 43 (acre-feet/ time period) [6]
April 1–April 30	74%	22	35.4	12.9	41.9	513.3
May 1–May 31	100%	31	67.8	24.6	80.1	982.1
June 1–June 30	97%	30	63.4	23.1	75.0	919.3
July 1–July 31	100%	31	67.5	24.6	79.8	978.4
Aug 1–Aug 30	88%	31	59.9	21.8	70.8	868.3
Sept 1–Sept 30	69%	30	45.5	16.5	53.8	659.1
Oct 1–Oct 31	58%	14	17.8	6.5	21.1	258.7

Notes:
[1] The season average was only taken during the days the district was diverting water. See Table E-6 showing the length of irrigation season.
[2] Estimated Loss Rate (cfs) in Lateral 31 is 1.1 cfs (Black Rock 2017).
[3] Estimated Loss Rate (cfs) in Lateral 32 is 0.4 cfs (Black Rock 2017).
[4] Estimated Loss Rate (cfs) in Lateral 34 is 1.3 cfs (Black Rock 2017).
[5] Estimated Loss Rate (cfs) in Lateral 43 is 15.9 cfs (Black Rock 2017).

Table E-6. Length of Irrigation Season.

Year	Irrigation Start Date [1]	Irrigation End Date [1]
2002	4/8/2002	10/12/2002
2003	4/18/2003	10/11/2002
2004	4/13/2004	10/12/2003
2005	4/4/2005	10/8/2005
2006	4/19/2006	10/20/2006
2007	4/2/2007	10/17/2007
2008	4/7/2008	10/23/2008
2009	4/13/2009	10/13/2009
2010	4/9/2010	10/15/2010
2011	4/12/2011	10/13/2011
2012	4/9/2012	10/18/2012
2013	4/3/2013	10/9/2013
2014	4/16/2014	10/17/2014
2015	4/7/2015	10/6/2015
2016	4/1/2016	10/12/2016
2017	4/10/2017	10/13/2017
2018	4/2/2018	10/9/2018

Notes:
[1] Source: North Unit Irrigation District Website, 2022
https://northunitid.com/allotment-and-charges/#toggle-id-2

References

Black Rock. (2017). North Unit Irrigation District System Improvement Plan. Bend, Oregon.

United States Geological Survey (USGS). (2010). Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods Book 3, Chap. A8, 87 p.

E.5.2. Method of Estimating the Volume of Water Available for On-Farm Deliveries

This section describes the method used to quantify the estimated volume of water available for deliveries throughout the District that would be realized through the proposed project. This calculation used data derived from the water loss assessment performed during the summer of 2016, see the previous section for more information. The loss measured in laterals 31, 32, 34, and 43 during this assessment was 18.7 cfs (Black Rock 2017). Table E-7 and Table E-8 provide the data used in these calculations.

To provide a water loss estimate for the NUID Main Canal, the canal was divided into three reaches (Table E-7):

1. Reach 1 – Main Canal from Deschutes River to Crooked River Inflow
2. Reach 2 – Crooked River Inflow to Haystack Reservoir
3. Reach 3 – Haystack Reservoir to Tail

System losses in Reach 1 were measured to provide an estimated volume at the start of Reach 2 (Table E-8). Although losses in this part of the system occur, for this calculation it was assumed that this water would not be conserved, as it is conveyed through open canals that are not included in the proposed project and that would remain open for the reasonably foreseeable future.

To estimate losses in Reach 2, the Estimated Volume at the Start of Main Canal Reach 2 (second column of Table E-8 under Reach 2) was multiplied by 10.13 percent, the average loss in Main Canal Reach 2 (Table E-7), and then again by 10.31 percent, the weighted average loss in laterals served off of the Main Canal in Reach 2 (Table E-7). The product is shown in column six of Table E-8 under Reach 2, the Estimated Volume at Start of Main Canal Reach 3.

To estimate losses in Reach 3, the Estimated Volume at Start of Main Canal Reach 3 (second column of Table E-8 under Reach 3) was multiplied by 13.99 percent, the average loss in Main Canal Reach 3 (Table E-7), and then again by 9.93 percent, the weighted average loss in laterals served off of the Main Canal in Reach 3 (Table E-7). The product is shown in column six of Table E-8 under Reach 3.

The sum of the total losses is shown in column two of Table E-8 under Total Loss in System and Estimated On-Farm Delivery. Column three of Table E-8 under Total Loss in System and Estimated On-Farm Delivery is the sum of the Estimated Seepage and Evaporative Loss in System (1,814.5 acre-feet/year) and the Reach 3 Tailwater (167.3 acre-feet/year). The Estimated On-Farm Delivery was then calculated by subtracting the Estimated Seepage and Evaporative Loss in System (1,814.5 acre-feet/year) from the Total Savings (6,088.9 acre-fee/year).

For purposes of quantifying the volume of loss (acre-feet) in a system where loss is variable and dependent on many external factors, this was determined to be the most accurate and conservative approach for this level of analysis. All water savings will be verified following completion of the conservation project by OWRD.

Table E-7. Measured Loss Percentages.

Lateral/Canal Name	Measured Discharge (cfs) [1]	Percent Loss [1]	Group	Weight (Measured Discharge/ Subtotal Measured Discharge)	Weighted Loss
MAIN CANAL					
Reach 1 – Main Canal from Deschutes River to Crooked River Inflow					
At Start of Reach	483.75	NA	--	--	--
Delivered to Laterals	0	--	--	--	--
Measured Loss	0	0.00% [2,3]	--	--	--
Flow Remaining	483.75	--	--	--	--
Reach 2 – Crooked River Inflow to Haystack Reservoir					
At Start of Reach	531.44	--	--	--	--
Delivered to Laterals in Reach 2 (see below)	129.75	--	--	--	--
Measured Loss	53.82	10.13% [2]	--	--	--
Flow Remaining	347.87	--	--	--	--
Reach 3 – Haystack to Tail					
At Start of Reach	232.57	--	--	--	--
Delivered to Laterals in Reach 3 (see below)	192.73	--	--	--	--
Measured Loss	32.53	13.99% [2]	--	--	--
Flow Remaining	7.31	--	--	--	--
LATERALS IN REACH 2					
Lateral 34	0	8.34%	Reach 2 Laterals	0.00%	0.00%
Lateral 34-2	0	4.12%	Reach 2 Laterals	0.00%	0.00%
Lateral 37	61.27	5.47%	Reach 2 Laterals	42.73%	2.34%
Lateral 37-3	20.62	3.59%	Reach 2 Laterals	14.38%	0.52%
Lateral 37-4	7.97	14.93%	Reach 2 Laterals	5.56%	0.83%
Lateral 37-5	2.96	29.51%	Reach 2 Laterals	2.06%	0.61%
Lateral 37-8	3.42	47.57%	Reach 2 Laterals	2.39%	1.13%
Lateral 38	2.33	53.65%	Reach 2 Laterals	1.62%	0.87%
Lateral 41	30.76	14.98%	Reach 2 Laterals	21.45%	3.21%
Lateral 41-5	4.83	10.14%	Reach 2 Laterals	3.37%	0.34%
Lateral 41-8	2.09	15.64%	Reach 2 Laterals	1.46%	0.23%

Lateral/Canal Name	Measured Discharge (cfs) [1]	Percent Loss [1]	Group	Weight (Measured Discharge/ Subtotal Measured Discharge)	Weighted Loss
Lateral 41-10	3.27	-1.22%	Reach 2 Laterals	2.28%	-0.03%
Lateral 41-11	3.87	9.30%	Reach 2 Laterals	2.70%	0.25%
Lateral 43	0	16.20%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-2	0	10.37%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-7	0	47.21%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-7-2	0	12.70%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-9	0	46.67%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-10-1	0	5.19%	Reach 2 Laterals	0.00%	0.00%
Lateral 43-12	0	1.59%	Reach 2 Laterals	0.00%	0.00%
Subtotal	143.39	--	--	100%	10.31%
LATERALS IN REACH 3					
Lateral 45	19.5	13.28%	Reach 3 Laterals	5.02%	0.67%
Lateral 45-1	2.52	4.37%	Reach 3 Laterals	0.65%	0.03%
Lateral 45-2	6.3	5.40%	Reach 3 Laterals	1.62%	0.09%
Lateral 50	3.4	11.45%	Reach 3 Laterals	0.88%	0.10%
Lateral 51	24.96	4.79%	Reach 3 Laterals	6.43%	0.31%
Lateral 51-1	6.93	13.42%	Reach 3 Laterals	1.78%	0.24%
Lateral 55	2.5	18.04%	Reach 3 Laterals	0.64%	0.12%
Lateral 55-1	1.23	18.56%	Reach 3 Laterals	0.32%	0.06%
Lateral 56	1.2	8.33%	Reach 3 Laterals	0.31%	0.03%
Lateral 57	13.79	18.13%	Reach 3 Laterals	3.55%	0.64%
Lateral 57-2	3	59.67%	Reach 3 Laterals	0.77%	0.46%
Lateral 57-6	0.42	9.52%	Reach 3 Laterals	0.11%	0.01%
Lateral 58	94.78	6.40%	Reach 3 Laterals	24.41%	1.56%
Lateral 58-2	2.08	2.40%	Reach 3 Laterals	0.54%	0.01%
Lateral 58-3	6.02	12.13%	Reach 3 Laterals	1.55%	0.19%
Lateral 58-8	6.44	13.07%	Reach 3 Laterals	1.66%	0.22%
Upper Lateral 58-11	68.37	9.23%	Reach 3 Laterals	17.61%	1.63%
Lower Lateral 58-11	44.36	4.81%	Reach 3 Laterals	11.43%	0.55%
Lateral 59	7.62	8.27%	Reach 3 Laterals	1.96%	0.16%
Lateral 59-2	1.69	2.96%	Reach 3 Laterals	0.44%	0.01%

Lateral/Canal Name	Measured Discharge (cfs) [1]	Percent Loss [1]	Group	Weight (Measured Discharge/ Subtotal Measured Discharge)	Weighted Loss
Lateral 59-3	4.03	7.69%	Reach 3 Laterals	1.04%	0.08%
Lateral 59-5	1.17	12.72%	Reach 3 Laterals	0.30%	0.04%
Lateral 60	5.33	4.69%	Reach 3 Laterals	1.37%	0.06%
Lateral 61	4.2	3.88%	Reach 3 Laterals	1.08%	0.04%
Lateral 61-1	3.83	56.37%	Reach 3 Laterals	0.99%	0.56%
Lateral 63	14.65	11.60%	Reach 3 Laterals	3.77%	0.44%
Lateral 63-1	5.49	13.66%	Reach 3 Laterals	1.41%	0.19%
Lateral 63-1-1	3.05	24.93%	Reach 3 Laterals	0.79%	0.20%
Lateral 63-4	3.11	6.75%	Reach 3 Laterals	0.80%	0.05%
Lateral 64	16.77	20.57%	Reach 3 Laterals	4.32%	0.89%
Lateral 64-4	7.42	9.03%	Reach 3 Laterals	1.91%	0.17%
Lateral 64-5	1.72	27.91%	Reach 3 Laterals	0.44%	0.12%
Lateral 64-6	0.37	5.41%	Reach 3 Laterals	0.10%	0.01%
Subtotal	388.25	--	--	100%	9.93%

Notes:
cfs = cubic feet per second
[1] Source: Black Rock 2017
[2] This percent loss is derived from measured loss divided by start of reach.
[3] It is assumed that there is zero loss in the NUID Main Canal between the NUID diversion on the Deschutes River and Lateral 43 as this water would have already been lost in the system to get to the laterals proposed for piping.

Table E-8. Estimated Volume of Water Available for On-Farm Deliveries.

Reach 1					
Project Group	**Estimated Savings in the NUID Proposed Project (acre-feet/year)**	**Estimated Volume at Start of Main Canal Reach 1 - Deschutes River to Crooked River Inflow (acre-feet/year)**	**Loss in Main Canal Reach 1 (acre-feet/year) [1]**	**Estimated Volume at Start of Main Canal Reach 2 - Crooked River Inflow to Haystack Reservoir (acre-feet/year) [1]**	
1	3884.4	3884.4	0.0	3884.4	
2	682.3	682.3	0.0	682.3	
Total	**4,566.7**	**4,566.7**	**0.0**	**4,566.7**	
Reach 2					
Project Group	**Estimated Volume at Start of Main Canal Reach 2 - Crooked River Inflow to Haystack Reservoir (acre-feet/year)**	**Loss in Main Canal Reach 2 (acre-feet/year)**	**Delivery to Main Canal Reach 2 Laterals (acre-feet/year)**	**Loss in Main Canal Reach 2 Laterals (acre-feet/year)**	**Estimated Volume at Start of Main Canal Reach 3 - Haystack Reservoir to Tail (acre-feet/year)**
1	3884.4	393.4	96.0	9.9	3,395.0
2	682.3	69.1	16.9	1.7	596.4
Total	**4,566.7**	**462.5**	**112.9**	**11.6**	**3,991.4**

Reach 3					
Project Group	**Estimated Volume at Start of Main Canal Reach 3 - Haystack Reservoir to Tail (acre-feet/year)**	**Loss in Main Canal Reach 3 (acre-feet/year)**	**Delivery to Main Canal Reach 3 Laterals (acre-feet/year)**	**Loss in Main Canal Reach 3 Laterals (acre-feet/year)**	**Reach 3 Tailwater (acre-feet/year)**
1	3,395.0	475.0	2,813.4	279.3	106.7
2	596.4	83.4	494.2	49.1	18.7
Total	**3,991.4**	**558.4**	**3,307.6**	**328.4**	**125.5**

Total Loss in System and Estimated On-Farm Delivery			
Project Group	**Estimated Seepage and Evaporative Loss in System (acre-feet/year)**	**Estimated Total Loss in System (acre-feet/year)**	**Estimated On-Farm Delivery (acre-feet/year)**
1	1,157.6	1,264.3	2,726.8
2	203.3	222.1	479.0
Total	**1,360.9**	**1,486.4**	**3,205.8**

Notes:
[1] It is assumed that there is zero loss in this reach, as this water would have already been lost in the system to get to the laterals proposed for piping.

E.5.3. Instream Flow Targets

This section presents supporting calculations used when evaluating effects of the proposed action with respect to water resources.

Table E-9. Monthly Instream Flow Targets for the Deschutes River.

Source	From	To	Certificate	Priority Date	Instream Rates (cfs)											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Deschutes River	Crane Prairie Reservoir	Wickiup Reservoir	73233	10/11/1990	130	130	130	130	130	130	130	130	130	130	130	130
Deschutes River	Wickiup Reservoir	Little Deschutes River	59776	11/3/1983	300	300	300	300	300	300	300	300	300	300	300	300
Deschutes River	Little Deschutes River	Spring River	59777	11/3/1983	400	400	400	400	400	400	400	400	400	400	400	400
Deschutes River	Spring River	North Canal Dam	59778	11/3/1983	660	660	660	660	660	660	660	660	660	660	660	660
Deschutes River	North Canal Dam	Lake Billy Chinook	70695	Pending	250	250	250	250	250	250	250	250	250	250	250	250

Notes:
cfs = cubic feet per second

E.5.4. Deschutes River, Below Wickiup Reservoir

This section presents supporting calculations used when evaluating effects of the proposed action with respect to water resources in the Deschutes River at Wickiup Reservoir (see Table E-10 and Table E-11).

Table E-10. Deschutes River Daily Average Streamflow below Wickiup Reservoir following the 2016 Settlement Agreement.

Month	Low Streamflow (cfs) – 80% Exceedance	Lower Bar	Average Streamflow (cfs) – 50% Exceedance	Upper Bar	High Streamflow (cfs) – 20% Exceedance
Oct	107	8	115	409	524
Nov	107	10	117	13	129
Dec	103	2	105	82	187
Jan	104	4	108	92	200
Feb	101	7	108	87	195
Mar	100	8	108	86	194
Apr	415	192	607	106	712
May	728	255	983	238	1,220
Jun	1,030	180	1,210	220	1,430
Jul	1,358	52	1,410	190	1,600
Aug	1,300	120	1,420	122	1,542
Sep	690	350	1,040	220	1,260

Note: Streamflow in the Deschutes River downstream from Wickiup Reservoir at OWRD Gauge No. 14056500 from the October 2016 through September 2020 water years.

Table E-11. Deschutes River Post-Project Streamflow below Wickiup Reservoir.

Month	Pre-Project Daily Average Streamflow (cfs) [1]	Streamflow Restored Through Project (cfs)	Post-Project Daily Average Streamflow (cfs) [1, 2, 3]	ODFW Instream Water Right [4] in the Deschutes River from Wickiup Reservoir to the mouth of the Little Deschutes River	Post-Project Percentage Increase in Average Streamflow [2, 3]
Oct	115.0	0.00	115.0	300	0%
Nov	116.5	5.1	121.6	300	5%
Dec	105.0	5.1	110.1	300	5%
Jan	108.0	5.1	113.1	300	5%
Feb	108.0	5.1	113.1	300	5%
Mar	108.0	5.1	113.1	300	5%
Apr	606.5	0.00	606.5	300	0%
May	982.5	0.00	982.5	300	0%
Jun	1,210.0	0.00	1,210.0	300	0%
Jul	1,410.0	0.00	1,410.0	300	0%
Aug	1,420.0	0.00	1,420.0	300	0%
Sep	1,040.0	0.00	1,040.0	300	0%

Notes:
[1] Uses streamflow data in Table E-10 above.
[2] Post-Project Average Daily Streamflow does not include water saved and allocated instream in this reach from other water conservation projects currently being implemented in the Upper Deschutes Basin.
[3] This additional flow would be beneficial to the Deschutes River until Year 8 of the DBHCP when the minimum winter flow target is increased to 300 cfs.
[4] Certificate No. 59776.

E.5.5. Deschutes River at Benham Falls

This subsection presents supporting calculations used when evaluating effects of the proposed action with respect to water resources in the Deschutes River at Benham Falls (see Table E-12 and Table E-13).

Table E-12. Deschutes River Daily Average Streamflow at Benham Falls following the 2016 Settlement Agreement.

Month	Low Streamflow (cfs) – 80% Exceedance	Lower Bar	Average Streamflow (cfs) – 50% Exceedance	Upper Bar	High Streamflow (cfs) – 20% Exceedance
Oct	525	114	639	399	1,038
Nov	503	65	568	68	635
Dec	519	43	562	131	693
Jan	524	48	572	163	734
Feb	524	65	589	140	729
Mar	525	146	671	151	822
Apr	1,070	160	1,230	250	1,480
May	1,370	260	1,630	112	1,742
Jun	1,530	170	1,700	150	1,850
Jul	1,710	95	1,805	255	2,060
Aug	1,670	110	1,780	200	1,980
Sep	1,190	265	1,455	215	1,670

Notes:
cfs = cubic feet per second
Streamflow in the Deschutes River at Benham Falls at OWRD Gauge No. 14064500 varies within and between years. Data represents the October 2016 through September 2020 water years.

Table E-13. Deschutes River Post-Project Streamflow at Benham Falls.

Month	Pre-Project Daily Average Streamflow (cfs) [1]	Streamflow Restored Through Project (cfs) [2]	Post-Project Daily Average Streamflow (cfs) [1, 3, 4]	ODFW Instream Water Right [5] in the Deschutes River from the Mouth of the Little Deschutes River to the Confluence of Spring River	ODFW Instream Water Right [6] in the Deschutes River from the Mouth of Spring River to the North Canal Dam at Bend	Post-Project Percentage Increase in Average Streamflow [3, 4]
Oct	639.0	0.0	639.0	400	660	0%
Nov	567.5	4.4	571.9	400	660	1%
Dec	562.0	4.4	566.4	400	660	1%
Jan	571.5	4.4	575.9	400	660	1%
Feb	589.0	4.4	593.4	400	660	1%
Mar	671.0	4.4	675.4	400	660	1%
Apr	1,230.0	0.0	1,230.0	400	660	0%
May	1,630.0	0.0	1,630.0	400	660	0%
Jun	1,700.0	0.0	1,700.0	400	660	0%
Jul	1,805.0	0.0	1,805.0	400	660	0%
Aug	1,780.0	0.0	1,780.0	400	660	0%
Sep	1,455.0	0.0	1,455.0	400	660	0%

Notes:
[1] Uses streamflow data in Table E-12 above.
[2] This additional streamflow includes an estimated 12.5 percent channel loss from Wickiup Reservoir to Benham Falls.
[3] Post-Project Daily Average Streamflow does not include water saved and allocated instream in this reach from other water conservation projects currently being implemented in the Upper Deschutes Basin.
[4] This additional flow would be beneficial to the Deschutes River until Year 8 of the DBHCP when the minimum winter flow target is increased to 300 cfs.
[5] Certificate No. 59777
[6] Certificate No. 59778

E.5.6. Deschutes River at Bend, Below North Canal Dam

This subsection presents supporting calculations used when evaluating effects of the proposed action with respect to water resources in the Deschutes River at Bend, below North Canal Dam (see Table E-14 and Table E-15).

Table E-14. Deschutes River Daily Average Streamflow at Bend – Below North Canal Dam following the 2016 Settlement Agreement.

Month	Low Streamflow (cfs) – 80% Exceedance	Lower Bar	Average Streamflow (cfs) – 50% Exceedance	Upper Bar	High Streamflow (cfs) – 20% Exceedance
Oct	81	369	450	87	537
Nov	454	47	501	77	577
Dec	474	31	505	130	634
Jan	450	40	490	171	661
Feb	431	65	496	146	642
Mar	447	107	554	124	678
Apr	91	281	372	371	742
May	81	35	117	17	133
Jun	121	4	125	257	382
Jul	122	4	126	7	133
Aug	119	6	125	7	132
Sep	90	33	123	14	137

Notes:
cfs = cubic feet per second
Streamflow in the Deschutes River downstream from the City of Bend at OWRD Gauge No. 14070500 from the October 2016 through September 2020 water years.

Table E-15. Deschutes River Post-Project Streamflow at Bend – Below North Canal Dam.

Month	Pre-Project Daily Average Streamflow (cfs) [1]	Streamflow Restored Through Project (cfs) [2]	Post-Project Daily Average Streamflow (cfs) [1, 3, 4]	Oregon Department of Fish and Wildlife Instream Water Right [5]	Post-Project Percentage Increase in Average Streamflow [3, 4]
Oct	450.0	0.0	450.0	250	0%
Nov	500.5	4.4	504.9	250	1%
Dec	504.5	4.4	508.9	250	1%
Jan	490.0	4.4	494.4	250	1%
Feb	496.0	4.4	500.4	250	1%
Mar	553.5	4.4	558.9	250	1%
Apr	371.5	0.0	371.5	250	0%
May	116.5	0.0	116.5	250	0%
Jun	125.0	0.0	125.0	250	0%
Jul	126.0	0.0	126.0	250	0%
Aug	125.0	0.0	125.0	250	0%
Sep	86.0	0.0	86.0	250	0%

Notes:
[1] Uses streamflow data in Table E-14 above.
[2] This additional streamflow includes an estimated 7 percent channel loss from Benham Falls to the City of Bend.
[3] Post-Project Daily Average Streamflow does not include water saved and allocated instream in this reach from other water conservation projects currently being implemented in the Upper Deschutes Basin.
[4] This additional flow would be beneficial to the Deschutes River until Year 8 of the DBHCP when the minimum winter flow target is increased to 300 cfs.
[5] Pending Instream Application #70695.

E.5.7. Crooked River Below Osborne Canyon

This section presents supporting calculations used when evaluating the effects of the proposed action with respect to water resources in the Crooked River below Osborne Canyon.

Table E-16. Crooked River Pre-Project Average Daily Mean Streamflow Below Osborne Canyon.

Month	Low Streamflow (cfs) – 80% Exceedance	Lower Bar	Average Streamflow (cfs) – 50% Exceedance	Upper Bar	High Streamflow (cfs) – 20% Exceedance
Oct	208	31	239	55	294
Nov	186	17	203	33	236
Dec	173	19	192	44	236
Jan	180	40	220	220	440
Feb	191	42	233	291	524
Mar	200	68	268	804	1,072
Apr	269	304	573	1,079	1,652
May	150	164	314	515	829
Jun	136	66	202	177	378
Jul	114	29	143	41	184
Aug	124	32	156	33	189
Sep	166	56	222	56	278

Notes:
cfs = cubic feet per second
Streamflow in Crooked River at OWRD Gauge No. 14087380 from the 2003 through 2018 water years.

E.5.8. Crooked River Below Opal Springs

This subsection presents supporting calculations used when evaluating effects of the proposed action with respect to water resources in the Crooked River below Opal Springs.

Table E-17. Crooked River Pre-Project Average Daily Mean Streamflow Below Opal Springs.

Month	Low Streamflow (cfs) – 80% Exceedance	Lower Bar	Average Streamflow (cfs) – 50% Exceedance	Upper Bar	High Streamflow (cfs) – 20% Exceedance
Oct	1,330	40	1,370	70	1,440
Nov	1,310	30	1,340	30	1,370
Dec	1,300	30	1,330	30	1,360
Jan	1,300	40	1,340	250	1,590
Feb	1,310	50	1,360	320	1,680
Mar	1,320	80	1,400	840	2,240
Apr	1,400	325	1,725	1,105	2,830
May	1,260	220	1,480	540	2,020
Jun	1,260	75	1,335	195	1,530
Jul	1,240	20	1,260	60	1,320
Aug	1,240	30	1,270	50	1,320
Sep	1,280	70	1,350	70	1,420

Notes:
cfs = cubic feet per second
Streamflow in Crooked River at OWRD Gauge No. 14087400 from the 2003 through 2018 water years.

E.5.9. Summary of the Requirements Set forth by the Deschutes Basin Habitat Conservation Plan

This section presents a summary of the operation measures set forth by the Deschutes Basin Habitat Conservation Plan (DBHCP; NMFS and USFWS 2020). Figure C-3 in Appendix C includes locations of all the gages described.

1. From April 1 through September 15, flow at OWRD Gage 14056500 will be at least 600 cfs. An adaptive management element will be used to test whether going directly to 600 cfs by April 1 provides enhanced survival of Oregon spotted frog. In coordination with the U.S. Fish and Wildlife Service (USFWS), flows may be set at 400 cfs by April 1 and increased to 600 cfs within the first 2 weeks of April. Annual snowpack, weather, and instream conditions will inform this decision.
2. From April 1 through April 30, flow at OWRD Gage 14056500 shall not exceed 800 cfs unless USFWS or a biologist approved by USFWS has verified that Oregon spotted frog eggs at Dead Slough in La Pine State Park have hatched or are physically situated in a portion of the slough where an increase in flow will not harm them.
3. If the flow at OWRD Gage 14056500 is increased above 600 cfs during the month of April, it will not subsequently be allowed to decrease more than 30 cfs, whether in a single flow adjustment or cumulatively over the course of multiple flow adjustments, until after April 30 or an earlier date approved after coordination with USFWS.
4. From May 1 through June 30, flow decrease at OWRD Gage 14056500 over any 5-day period shall be no more than 20 percent of total flow at the time the decrease is initiated.
5. Flow at OWRD Gage 14064500 shall be no less than 1,300 cfs from July 1 through at least September 15.
6. For the first 7 years of DBHCP implementation, flow at OWRD Gage 14056500 shall be at least 100 cfs from September 16 through March 31. Beginning in Year 1 of DBHCP implementation, minimum flow at OWRD Gage 14056500 from September 16 through March 31 shall be increased above 100 cfs in proportion to the amount of live Deschutes River flow made available to NUID during the prior irrigation season as a result of the piping of COID-owned canals. For each acre-foot (or portion thereof) of live flow made available to NUID as a result of the piping of COID-owned canals after the date of incidental take permit issuance, an equal volume of water shall be added to the minimum flow below Wickiup Dam from September 16 through March 31. This water shall be in addition to the amount of water needed to maintain a flow at OWRD Gage 14056500 of at least 100 cfs. The timing for release of the additional water shall be determined in coordination with USFWS for optimal benefit to Oregon spotted frog.
7. Beginning no later than Year 8 of DBHCP implementation, flow at OWRD Gage 14056500 shall be at least 300 cfs from September 16 through March 31, and not more than 1,400 cfs for more than 10 days per year between April 1 and September 15. If NUID anticipates the need to exceed 1,400 cfs at OWRD Gage 14056500 in Years 8 through 12, it will contact USFWS in advance to discuss options for minimizing the adverse effects on the Deschutes River and Oregon spotted frog, such as conditioning the rate or timing of flow increases above 1,400 cfs.
8. Beginning no later than Year 13 of DBHCP implementation, minimum flow at OWRD Gage 14056500 shall be between 400 cfs and 500 cfs from September 16 through March 31 (with actual flow during this period determined according to the variable flow tool described in the DBHCP) and not more than 1,200 cfs for more than 10 days per year between April 1 and September 15.
9. For all years, the volume of water equivalent to the amount scheduled for winter releases in excess of 100 cfs may be stored in Wickiup Reservoir for release later in the same water year. Water stored in this

manner and released during the irrigation season will be treated as NUID storage and available for diversion by NUID at North Canal Dam. Water stored in this manner and not released for Oregon spotted frog or fish by the end of the same water year can be used to meet the minimum flow requirements of this conservation measure at OWRD Gage 14056500 through March 31 of the subsequent water year. Any water stored in this manner and not released to meet DBHCP minimum flow requirements by March 31 will become NUID storage and available for irrigation use.

10. During the fall ramp-down, flow reductions at OWRD Gage 14056500 shall be halted for 5 days when the corresponding flow at OWRD Gage 14064500 reaches 1,200 cfs, and again for 5 days when the corresponding flow at OWRD Gage 14064500 reaches 1,100 cfs.

References

National Marine Fisheries Service and U.S. Fish and Wildlife Service – Bend Office (NMFS and USFWS). (2020). *Final Deschutes Basin Habitat Conservation Plan.* **https://www.fws.gov/Oregonfwo/articles.cfm?id=149489716**

E.6. Supporting Information for Fish and Aquatic Resources

This section presents supporting information associated with Primary Constituent Elements for critical habitat of federally listed species and their associated Biological Opinions.

Table E-18. Primary Constituent Elements for Oregon Spotted Frog Critical Habitat.

Primary Constituent Element (PCE) Number	Habitat Description	Characteristics
PCE 1	Nonbreeding (N), Breeding (B), Rearing (R), and Overwintering Habitat (O); Ephemeral or permanent bodies of fresh water including, but not limited to, natural or manmade ponds, springs, lakes, slow-moving streams, or pools within or oxbows adjacent to streams, canals, and ditches	Inundated for a minimum of 4 months per year (B, R) (timing varies by elevation but may begin as early as February and last as long as September)
		Inundated from October through March (O)
		If ephemeral, areas are hydrologically connected by surface water flow to a permanent water body (e.g., pools, springs, ponds, lakes, streams, canals, or ditches) (B, R)
		Shallow water areas (less than or equal to 30 centimeters [12 inches], or water of this depth over vegetation in deeper water (B, R)
		Total surface area with less than 50 percent vegetative cover (N)
		Gradual topographic gradient (less than 3 percent slope) from shallow water toward deeper, permanent water (B, R)
		Herbaceous wetland vegetation (i.e., emergent, submergent, and floating-leaved aquatic plants), or vegetation that can structurally mimic emergent wetland vegetation through manipulation (B, R)
		Shallow water areas with high solar exposure or low (short) canopy cover (B, R)
		An absence or low density of nonnative predators (B, R, N)

Primary Constituent Element (PCE) Number	Habitat Description	Characteristics
PCE 2	Aquatic movement corridors; Ephemeral or permanent bodies of fresh water	Less than or equal to 3.1 miles (5 kilometers) linear distance from breeding areas
		Impediment free (including, but not limited to, hard barriers such as dams, impassable culverts, lack of water, or biological barriers such as abundant predators, or lack of refugia from predators)
PCE 3	Refugia Habitat	Nonbreeding, breeding, rearing, or overwintering habitat or aquatic movement corridors with habitat characteristics (e.g., dense vegetation and/or an abundance of woody debris) that provide refugia from predators (e.g., nonnative fish or bullfrogs)

Notes:
Source: Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Oregon Spotted Frog 50 CFR 17

Table E-19. 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.

Primary Constituent Element Number	Habitat Description and Characteristics
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 historical 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.

Notes:
Source: Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States, 50 CFR 17

Table E-20. Fish and Mollusk Species within the Area Affected by District Operations for the North Unit Irrigation District Infrastructure Modernization Project.

Species Common Name	Scientific Name	Wickiup Reservoir	Upper Deschutes River	Middle Deschutes River	Crooked River
Bull trout	*Salvelinus confluentus*			X	X
Steelhead trout	*Oncorhynchus mykiss*			X	X
Spring Chinook salmon	*Oncorhynchus tshawytscha*			X	X
Sockeye salmon	*Oncorhynchus nerka*				X
Redband trout	*Oncorhynchus mykiss gairdneri*	X	X	X	X
Kokanee Salmon	*Oncorhynchus nerka*	X	X	X	
Mountain whitefish	*Prosopium williamsoni*	X	X	X	X
Largescale sucker	*Catostomus macrocheilus*	X	X	X	X
Bridgelip sucker	*Catostomus columbianus*	X	X	X	X
Chiselmouth	*Acrocheilus alutaceus*	X	X	X	X
Dace species	*Rhinichthys* (spp.)	X	X	X	X
Sculpin species	Family Cottidae	X	X	X	X
Brook trout	*Salvelinus fontinalis*	X	X	X	X
Brown trout	*Salmo trutta*	X	X	X	X
Western pearlshell mussel	*Margaritifera falcata*		X	X	X
Western ridged mussel	*Gonidea angulata*			X	X

Source: NMFS and USFWS 2020

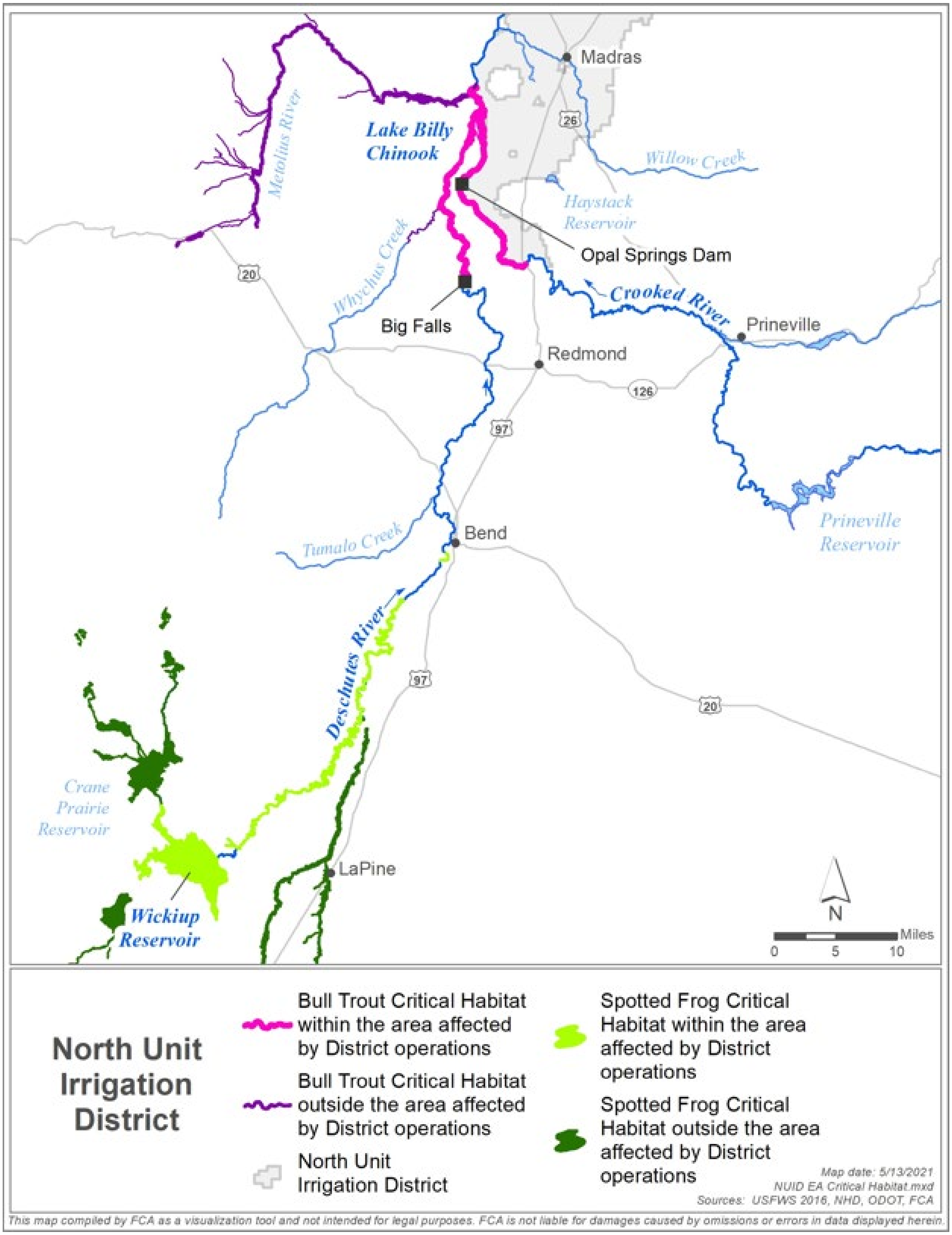

Figure E-1. Bull trout and Oregon spotted frog critical habitat within and outside the area affected by District operations.

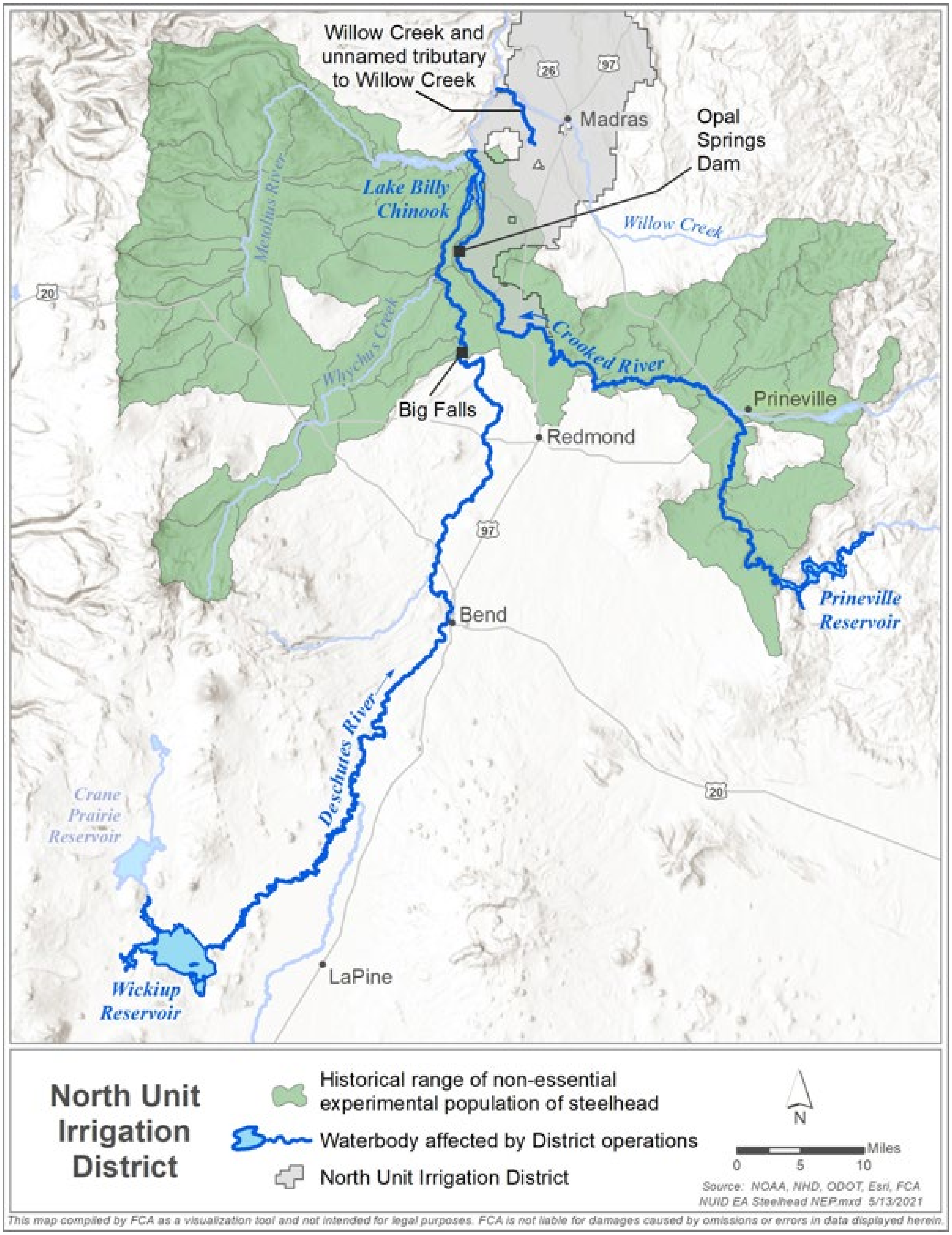

Figure E-2. Steelhead non-essential experimental population within and outside of area affected by District operations.

United States Department of the Interior

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In Reply Refer To:
01EOFW00-2017-F-0528-R001
X-Ref: 01EOFW00-2017-F-0528

JUL 2 6 2019

Memorandum

To: Deputy Area Manager, Bureau of Reclamation
Columbia-Cascades Area Office
Yakima, Washington

From: Field Supervisor, Bend Field Office
Bend, Oregon

Subject: Reinitiation of Formal Consultation on Bureau of Reclamation Approval of Contract Changes to the 1938 Inter-District Agreement for the Operation of Crane Prairie and Wickiup Dams, and Implementation of the Review of Operations and Maintenance (ROM) and Safety Evaluation of Existing Dams (SEED) Programs at Crane Prairie and Wickiup Dams, Deschutes Project, Oregon (2017-2019)

This memorandum responds to your June 17, 2019 request for reinitiation of formal consultation on the subject actions. Please attach it to the U.S. Fish and Wildlife Service (Service) September 29, 2017 Biological Opinion (Service reference no. 01EOFW00-2017-F-0528) addressing the same actions. Collectively, these documents represent your new Biological Opinion (Opinion) on the effects of the subject actions on the threatened Oregon spotted frog (*Rana pretiosa*) and its critical habitat (CH). Please note that the Incidental Take Statement (ITS) accompanying the 2017 Opinion has also been revised and is included in this memorandum. The revised Opinion and ITS were prepared in accordance with the requirements of section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for reinitiation of formal consultation was received on June 17, 2019.

Figure E-3. USFWS 2019 Biological Opinion Cover page. *Reinitiation of Formal Consultation on Bureau of Reclamation Approval of Contract Changes to the 1938 Inter-District Agreement for the Operation of Crane Prairie and Wickiup Dams, and Implementation of the Review of Operations and Maintenance (ROM) and Safety Evaluation of Existing Dams (SEED) Programs at Crane Prairie and Wickiup Dams.* **Deschutes Project, Oregon (2017-2019), July 26, 2019.**

FINAL
Deschutes Basin
Habitat Conservation Plan

Volume I: Chapters 1-12

Submitted by:

Arnold Irrigation District
Lone Pine Irrigation District
Ochoco Irrigation District
Three Sisters Irrigation District
City of Prineville, Oregon
Central Oregon Irrigation District
North Unit Irrigation District
Swalley Irrigation District
Tumalo Irrigation District

October 2020

Figure E-4. Cover page of the Final DBHCP submitted by the eight irrigation districts of the Deschutes Basin to USFWS and National Marine Fisheries Service.

References

National Marine Fisheries Service and U.S. Fish and Wildlife Service – Bend Office (NMFS and USFWS). (2020). *Final Deschutes Basin Habitat Conservation Plan.* **https://www.fws.gov/Oregonfwo/articles.cfm?id=149489716**

E.7. Supporting Information for Wildlife Resources

This section presents supporting information for the wildlife resources section.

Table E-21. Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act Species Potentially Occurring within the Project Area.[1]

Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act Species	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Brewer's sparrow	*Spizella breweri*
Calliope hummingbird	*Stellula calliope*
Cassin's finch	*Carpodacus cassinii*
Eared grebe	*Podiceps nigricollis*
Flammulated owl	*Otus flammeolus*
Fox sparrow	*Passerella iliaca*
Golden eagle	*Aquila chrysaetos*
Green-tailed towhee	*Pipilo chlorurus*
Lewis's woodpecker	*Melanerpes lewis*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Olive-sided flycatcher	*Contopus cooperi*
Peregrine falcon	*Falco peregrinus*
Pinyon jay	*Gymnorhinus cyanocephalus*
Rufous hummingbird	*Selasphorus rufus*
Sage thrasher	*Oreoscoptes montanus*
Short-eared owl	*Asio flammeus*
Swainson's hawk	*Buteo swainsoni*

Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act Species	**Scientific Name**
Western grebe	*Aechmophorus occidentalis*
White-headed woodpecker	*Picoides albolarvatus*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Willow flycatcher	*Empidonax traillii*

Notes:
Source: U.S. Fish and Wildlife Service (USFWS). (2021). IPaC information for planning and consultation, Retrieved from https://ecos.fws.gov/ipac/
[1] This is only a partial list of migratory birds that potentially occur within the project area.

E.8. Wild and Scenic Outstandingly Remarkable Values

This section presents supporting information associated with Outstandingly Remarkable Values identified for the upper and middle Deschutes River and the lower Crooked River (see Table E-22 and Table E-23).

Table E-22. Outstandingly Remarkable Values for the Upper Deschutes River.

Outstandingly Remarkable Value	Outstandingly Remarkable Value Description
Vegetative	Aquatic, riparian, and upland vegetation is a significant element of all other river values. The vegetative resource is an Outstandingly Remarkable Value in Segments 3 [1] and 4 [2] because of Estes' Artemisia (*Artemisia ludoviciana* spp. *estesii*), which is a Federal Category 2 Candidate[3] for protection under the Endangered Species Act.
Cultural	The upper Deschutes Corridor contains more than 100 known prehistoric sites that are eligible for inclusion in the National Register of Historic Places, making the prehistoric resources an Outstandingly Remarkable Value. Until further research on historic and traditional uses of the corridor is complete, they will also be treated as Outstandingly Remarkable Values.
Fisheries	The brown trout fishery in Segments 2 [4] and 3 is an Outstandingly Remarkable Value. The determination of value of the native redband rainbow trout population in Segment 4 has been deferred until a genetic study has been completed. Until that time the population is to be treated as an Outstandingly Remarkable Value.
Geologic	The upper Deschutes River consists of two major features: the lava flows which have pushed the river west of earlier channels and created the stair step of falls and rapids, and the landforms created by the interaction of depositional and erosive actions. The river channel shape, size, and rate of change are not an Outstandingly Remarkable Value within themselves, primarily because the dynamics are so affected by human-controlled flows.
Hydrology	The hydrologic resource is a significant element of several Outstandingly Remarkable Values associated with the upper Deschutes River. Most Outstandingly Remarkable Values in and along the river are protected and enhanced by an abundant, stable flow of clear clean water.
Recreational	Recreation is an Outstandingly Remarkable Value on the upper Deschutes River because of the range of activities, the variety of interpretive opportunities, and the attraction of the river for vacationers from outside of the region.

Outstandingly Remarkable Value	Outstandingly Remarkable Value Description
Scenic	The mix of geologic, hydrologic, vegetative, and wildlife resources found along portions of Segments 2 and 4 of the upper Deschutes makes scenery an Outstandingly Remarkable Value. Although the level and proximity of private development intrudes on the scenic quality of Segment 3, the scenic value is still a significant element of the recreational value.
Wildlife	Wildlife populations in Segments 2 and 4 were determined to be Outstandingly Remarkable Values because of the populations of nesting bald eagles and ospreys in Segment 2 and the diversity of the bird population in Segment 4. Despite extensive private development in Segment 3, the wildlife habitat was considered to be significant because it provides important nesting habitat for birds and travel corridors for migrating game animals such as deer and elk.

Source: USDA, 1996
Notes:
[1] Segment 3 includes the south boundary of the LaPine State Recreation Area to the north boundary of Sunriver.
[2] Segment 4 includes the north boundary of Sunriver to the Central Oregon Irrigation District Canal.
[3] The upper Deschutes Wild and Scenic River and State Scenic Water Management Plan was written in 1996. Since the time of the management plan, this species has been reclassified as Species of Concern—taxa for which additional information is needed to support a proposal to list under the Endangered Species Act
[4] Segment 2 includes Wickiup Dam to the east end of Pringle Falls Campground and the east end of Pringle Falls campground to the south boundary of the LaPine State Recreation Area.

Table E-23. Outstandingly Remarkable Values for the Middle Deschutes River and the Lower Crooked River.

Outstandingly Remarkable Value	Outstandingly Remarkable Value Description
Botany/ Ecology	The middle Deschutes River segments are in an ecological condition unusual for similar areas within the region and contain a significant portion of Estes' wormwood.
Cultural	Cultural resources on the middle Deschutes River include prehistoric and historic sites found along the corridor and traditional uses associated with the area. Evidence that rare and/or special activities took place in the river canyon areas is represented by lithic scatters or flaking stations, shell middens, rock shelters, rock features, and rock art. These sites have the potential to contribute to the understanding and interpretation of the prehistory of the Deschutes River and the region and are considered to eligible for inclusion in the National Register of Historic Places.
Fisheries	Surveys have identified fishing as the number one recreation activity in the upper sections. Stories and pictures of huge catches are found in historical records of the early 1900s.
Geologic	Fifty million years of geologic history are dramatically displayed on the canyon walls of the middle Deschutes and lower Crooked rivers. Volcanic eruptions which occurred over thousands of years created a large basin

Outstandingly Remarkable Value	Outstandingly Remarkable Value Description
	dramatized by colorful layers of basalt, ash, and sedimentary formations. The most significant contributor to the outstandingly remarkable geologic resource are the unique intra-canyon basalt formations created by recurring volcanic and hydrologic activities.
Hydrology	Water from springs and the stability of flows through the steep basalt canyons have created a stream habitat and riparian zone that is extremely stable and diverse; it is unique in a dry semi-arid climate environment. Features such as Odin, Big, and Steelhead falls; springs and seeps; white-water rapids; water-sculpted rock; and the river canyons are very prominent and represent excellent examples of hydrologic activity within central Oregon.
Recreational	These river corridors offer a diversity of year-round, semi-primitive recreation opportunities such as fishing, hiking, backpacking, camping, wildlife and nature observation, expert-level kayaking and rafting, picnicking, swimming, hunting, and photography. Interpretive opportunities are exceptional and attract visitors from outside the geographical area.
Scenic	The exceptional scenic quality along the middle Deschutes River is due to the rugged natural character of the canyons, outstanding scenic vistas, limited visual intrusions, and scenic diversity resulting from a variety of geologic formations, vegetation communities, and dynamic river characteristics. These canyons truly represent the spectacular natural beauty created by various forces of nature.
Wildlife	The river corridor supports critical mule deer winter range habitat and nesting/hunting habitat for bald eagles, golden eagles, ospreys, and other raptors. Bald eagles are known to winter along the Deschutes River downriver from Lower Bridge and also within the lower Crooked River segment. Outstanding habitat areas include high vertical cliffs, wide talus slopes, numerous caves, pristine riparian zones, and extensive grass/sage-covered slopes and plateaus.

Source: National Wild and Scenic Rivers System 2018 and BLM 1992

References

National Wild and Scenic Rivers System. 2018. Deschutes River, Oregon. Website. Retrieved from: www.rivers.gov/rivers/deschutes.php. Accessed September 10, 2018.

U.S. Department of Agriculture (USDA). 1996. Upper Deschutes Wild and Scenic River and State Scenic Water Way – Comprehensive Management Plan.

U.S. Department of the Interior, Bureau of Land Management BLM. (1992). Lower Crooked Wild and Scenic River (Chimney Rock Segment) Management Plan.

E.9. Supporting Information for Energy Savings

This section presents supporting information associated with energy savings realized by implementation of the Preferred Alternative.

Table E-24. Estimated Pump Energy Conservation Realized by Implementation of the Preferred Alternative.

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	1.50	102.9	42,614	41,016	1,598
Lateral 43	Phase 1	2.26	126.8	52,512	49,545	2,967
Lateral 43	Phase 1	2.33	49.1	20,334	19,149	1,184
Lateral 43	Phase 1	11.69	12.8	5,301	3,752	1,549
Lateral 43	Phase 1	12.38	17.1	7,082	4,890	2,192
Lateral 43	Phase 1	14.02	56.2	23,274	15,117	8,158
Lateral 43	Phase 1	14.21	16.3	6,750	4,352	2,398
Lateral 43	Phase 1	18.37	346.7	143,579	77,640	65,939
Lateral 43	Phase 1	18.81	99.5	41,206	21,829	19,377
Lateral 43	Phase 1	18.82	40.3	16,689	8,837	7,852
Lateral 43	Phase 1	19.13	117.9	48,826	25,475	23,351
Lateral 43	Phase 1	29.57	71.5	29,610	7,721	21,889
Lateral 43	Phase 1	29.57	75.3	31,184	8,131	23,053
Lateral 43	Phase 1	35.15	48.2	19,961	2,420	17,541
Lateral 43	Phase 1	38.72	1.5	621	20	601
Lateral 43	Phase 1	38.85	6.4	2,650	76	2,574
Lateral 43	Phase 1	42.21	65.8	27,250	-	27,250
Lateral 43	Phase 1	42.83	15.3	6,336	-	6,336

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	43.70	39.6	16,400	-	16,400
Lateral 43	Phase 1	44.46	12	4,970	-	4,970
Lateral 43	Phase 1	44.50	13.4	5,549	-	5,549
Lateral 43	Phase 1	44.51	61.7	25,552	-	25,552
Lateral 43	Phase 1	44.54	66.8	27,664	-	27,664
Lateral 43	Phase 1	44.68	81.4	33,710	-	33,710
Lateral 43	Phase 1	44.74	26.5	10,974	-	10,974
Lateral 43	Phase 1	44.88	152	62,948	-	62,948
Lateral 43	Phase 1	45.00	0.6	248	-	248
Lateral 43	Phase 1	46.26	38.8	16,068	-	16,068
Lateral 43	Phase 1	47.22	32.5	13,459	-	13,459
Lateral 43	Phase 1	48.20	37.7	15,613	-	15,613
Lateral 43	Phase 1	49.75	17	7,040	-	7,040
Lateral 43	Phase 1	49.78	63.4	26,256	-	26,256
Lateral 43	Phase 1	50.02	75.7	31,350	-	31,350
Lateral 43	Phase 1	50.06	42.1	17,435	-	17,435
Lateral 43	Phase 1	50.27	36.7	15,199	-	15,199
Lateral 43	Phase 1	50.32	39	16,151	-	16,151
Lateral 43	Phase 1	50.62	65.3	27,043	-	27,043
Lateral 43	Phase 1	51.39	129.7	53,713	-	53,713
Lateral 43	Phase 1	51.68	31.8	13,169	-	13,169
Lateral 43	Phase 1	52.82	6.3	2,609	-	2,609

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	52.94	14.9	6,171	-	6,171
Lateral 43	Phase 1	53.71	37.4	15,489	-	15,489
Lateral 43	Phase 1	53.91	78.8	32,634	-	32,634
Lateral 43	Phase 1	54.50	146.8	60,794	-	60,794
Lateral 43	Phase 1	54.57	3.8	1,574	-	1,574
Lateral 43	Phase 1	54.69	69.4	28,741	-	28,741
Lateral 43	Phase 1	54.69	92.1	38,141	-	38,141
Lateral 43	Phase 1	55.11	41	16,979	-	16,979
Lateral 43	Phase 1	55.34	9.6	3,976	-	3,976
Lateral 43	Phase 1	55.37	28.2	11,678	-	11,678
Lateral 43	Phase 1	55.54	36.6	15,157	-	15,157
Lateral 43	Phase 1	55.66	118.5	49,075	-	49,075
Lateral 43	Phase 1	55.78	62.5	25,883	-	25,883
Lateral 43	Phase 1	55.97	74.7	30,936	-	30,936
Lateral 43	Phase 1	55.98	128.4	53,174	-	53,174
Lateral 43	Phase 1	56.01	33.7	13,956	-	13,956
Lateral 43	Phase 1	56.32	76.8	31,805	-	31,805
Lateral 43	Phase 1	56.46	80.5	33,338	-	33,338
Lateral 43	Phase 1	57.58	76	31,474	-	31,474
Lateral 43	Phase 1	57.58	113.2	46,880	-	46,880
Lateral 43	Phase 1	58.20	15.9	6,585	-	6,585
Lateral 43	Phase 1	59.07	149.3	61,830	-	61,830

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	59.61	35.3	14,619	-	14,619
Lateral 43	Phase 1	59.67	79.3	32,841	-	32,841
Lateral 43	Phase 1	59.98	31.4	13,004	-	13,004
Lateral 43	Phase 1	59.99	134.7	55,783	-	55,783
Lateral 43	Phase 1	60.00	18	7,454	-	7,454
Lateral 43	Phase 1	60.00	99	40,999	-	40,999
Lateral 43	Phase 1	60.00	36.4	15,074	-	15,074
Lateral 43	Phase 1	60.00	77.5	32,095	-	32,095
Lateral 43	Phase 1	60.00	49.4	20,458	-	20,458
Lateral 43	Phase 1	60.00	35	14,495	-	14,495
Lateral 43	Phase 1	60.00	75.4	31,225	-	31,225
Lateral 43	Phase 1	60.00	135.2	55,991	-	55,991
Lateral 43	Phase 1	60.00	39	16,151	-	16,151
Lateral 43	Phase 1	60.00	89.9	37,230	-	37,230
Lateral 43	Phase 1	60.00	80.6	33,379	-	33,379
Lateral 43	Phase 1	60.00	77.3	32,012	-	32,012
Lateral 43	Phase 1	60.00	106.9	44,271	-	44,271
Lateral 43	Phase 1	60.00	2	828	-	828
Lateral 43	Phase 1	60.00	104.5	43,277	-	43,277
Lateral 43	Phase 1	60.00	102.6	42,490	-	42,490
Lateral 43	Phase 1	60.00	78.2	32,385	-	32,385
Lateral 43	Phase 1	60.00	129.1	53,464	-	53,464

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	60.00	5.6	2,319	-	2,319
Lateral 43	Phase 1	60.00	24.5	10,146	-	10,146
Lateral 43	Phase 1	60.00	3.2	1,325	-	1,325
Lateral 43	Phase 1	60.00	8.6	3,562	-	3,562
Lateral 43	Phase 1	60.00	75.9	31,433	-	31,433
Lateral 43	Phase 1	60.00	77.6	32,137	-	32,137
Lateral 43	Phase 1	60.00	75.4	31,225	-	31,225
Lateral 43	Phase 1	60.00	13.6	5,632	-	5,632
Lateral 43	Phase 1	60.00	107.2	44,395	-	44,395
Lateral 43	Phase 1	60.00	92.4	38,266	-	38,266
Lateral 43	Phase 1	60.00	14.5	6,005	-	6,005
Lateral 43	Phase 1	60.00	31.5	13,045	-	13,045
Lateral 43	Phase 1	60.00	70.8	29,320	-	29,320
Lateral 43	Phase 1	60.00	78.2	32,385	-	32,385
Lateral 43	Phase 1	60.00	117	48,453	-	48,453
Lateral 43	Phase 1	60.00	77.5	32,095	-	32,095
Lateral 43	Phase 1	60.00	139	57,564	-	57,564
Lateral 43	Phase 1	60.00	12.7	5,259	-	5,259
Lateral 43	Phase 1	60.00	38.8	16,068	-	16,068
Lateral 43	Phase 1	60.00	43.9	18,180	-	18,180
Lateral 43	Phase 1	60.00	24.7	10,229	-	10,229
Lateral 43	Phase 1	60.00	75.7	31,350	-	31,350

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 43	Phase 1	60.00	72.2	29,900	-	29,900
Lateral 43	Phase 1	60.00	68.9	28,534	-	28,534
Lateral 43	Phase 1	60.00	3	1,242	-	1,242
Lateral 43	Phase 1	60.00	6	2,485	-	2,485
Lateral 43	Phase 1	60.00	51.3	21,245	-	21,245
Lateral 43	Phase 1	60.00	128.6	53,257	-	53,257
Lateral 31	Phase 2	3.09	81.1	33,586	30,992	2,595
Lateral 31	Phase 2	3.32	20	8,283	7,595	687
Lateral 31	Phase 2	3.99	76.8	31,805	28,633	3,173
Lateral 31	Phase 2	7.50	103.9	43,028	34,960	8,068
Lateral 31	Phase 2	12.27	103.1	42,697	29,600	13,097
Lateral 31	Phase 2	14.38	99.9	41,372	26,499	14,873
Lateral 31	Phase 2	14.91	79.6	32,965	20,677	12,288
Lateral 32	Phase 2	0.94	21.5	8,904	8,695	209
Lateral 32	Phase 2	0.94	32.6	13,501	13,183	317
Lateral 32	Phase 2	1.19	109.5	45,347	43,998	1,349
Lateral 32	Phase 2	12.57	44.1	18,263	12,524	5,739
Lateral 34	Phase 2	0.81	1.7	704	690	14
Lateral 34	Phase 2	0.83	65.5	27,126	26,563	563
Lateral 34	Phase 2	0.96	31.8	13,169	12,853	316
Lateral 34	Phase 2	1.36	38.7	16,027	15,482	545
Lateral 34	Phase 2	1.91	16.1	6,668	6,349	318

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 34	Phase 2	1.91	123.8	51,269	48,821	2,448
Lateral 34	Phase 2	1.97	71.1	29,445	27,995	1,450
Lateral 34	Phase 2	2.00	70.6	29,238	27,776	1,462
Lateral 34	Phase 2	2.36	34.6	14,329	13,484	845
Lateral 34	Phase 2	2.40	34.4	14,246	13,391	855
Lateral 34	Phase 2	3.01	7	2,899	2,681	218
Lateral 34	Phase 2	3.32	6.7	2,775	2,544	230
Lateral 34	Phase 2	3.72	158.3	65,557	59,460	6,097
Lateral 34	Phase 2	3.85	30.8	12,755	11,528	1,228
Lateral 34	Phase 2	3.96	27.3	11,306	10,187	1,119
Lateral 34	Phase 2	4.48	36.3	15,033	13,349	1,684
Lateral 34	Phase 2	4.52	35.8	14,826	13,151	1,675
Lateral 34	Phase 2	7.48	14.3	5,922	4,815	1,107
Lateral 34	Phase 2	7.48	35.2	14,577	11,851	2,726
Lateral 34	Phase 2	7.77	36.9	15,281	12,313	2,968
Lateral 34	Phase 2	7.83	29.8	12,341	9,925	2,416
Lateral 34	Phase 2	7.83	75.1	31,101	25,013	6,088
Lateral 34	Phase 2	8.03	135.8	56,239	44,949	11,290
Lateral 34	Phase 2	8.34	72.8	30,149	23,863	6,286
Lateral 34	Phase 2	9.83	21.6	8,945	6,747	2,198
Lateral 34	Phase 2	10.39	35.4	14,660	10,852	3,808
Lateral 34	Phase 2	11.16	12.9	5,342	3,852	1,490

Lateral	Phase	Proposed Pressure (psi)[1]	Irrigated Lands (acres)	Existing Pump Energy (kWh)[2,3,4]	Proposed Pump Energy (kWh)[2,4,5]	Pump Energy Conservation (kWh)[2,6]
Lateral 34	Phase 2	13.02	36.4	15,074	10,168	4,907
Lateral 34	Phase 2	13.37	16.2	6,709	4,466	2,242
Lateral 34	Phase 2	13.39	55.1	22,819	15,180	7,639

Notes:
[1] Pounds per square inch (psi)
[2] Kilowatt-hour (kWh)
[3] Existing pump energy was calculated by assuming all patrons are currently pumping and no gravity pressure is provided in the open canal system.
[4] Existing and proposed pump energy was calculated assuming alfalfa was the predominate crop and has annual consumptive use of 3 feet, application efficiency is 70 percent, a pump efficiency of 70 percent, a minimum pressure of 60 psi, and an irrigation season of 180 days.
[5] Proposed pump energy was calculated by incorporating the partial pressure that would be provided as part of the preferred alternative.
[6] Pump energy conserved was calculated by taking the difference between existing and proposed pump energy.

E.10. Guiding Principles

Guiding Principles (USDA 2017) The Guiding Principles identified in the PR&G are considered when developing and evaluating alternatives, as described below.	
Healthy and Resilient Ecosystems	A primary objective of the PR&G analysis is the identification of alternatives that will protect and restore the functions of ecosystems. Alternatives should first avoid adverse impact. When environmental consequences occur, alternatives should minimize the impact and mitigate unavoidable damage. If damage occurs, mitigation to offset environmental damage must be included in the alternative's design and costs.
Sustainable Economic Development	Alternatives for resolving water resources problems should improve the economic well-being of the Nation for present and future generations. The PR&G analysis will consider the effects of alternatives on both water availability and water quality to evaluate the sustainability of economic activity and ecosystem services. Water use or management factors that provide improved sustainability or reduced uncertainty should be identified in alternatives.
Floodplains	The PR&G seek to avoid unwise use of floodplains and flood prone areas. Alternatives should avoid investments that adversely affect floodplain function, such that the floodplain is no longer self-sustaining. If an alternative impacts floodplain function, then the alternative should describe efforts to minimize and mitigate the impact and the residual loss of floodplain function. The PR&G investment evaluation of alternatives must be consistent with Executive Order 11988 of May 24, 1977 (Floodplain Management), as modified by Executive Order 13690 of January 30, 2015 (Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input), and the Federal Flood Risk Management Standard, which require executive departments and agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. The PR&G investment evaluation is informed by the processes to evaluate the impacts of Federal actions affecting floodplains consistent with Executive Order 11988, as amended.
Public Safety	An objective of the PR&G is to reduce risks to people, including life, injury, property, essential public services, and environmental threats concerning air and water quality. These risks to public health and safety must be evaluated and documented for all alternatives, including those using nonstructural approaches. The residual risks to public health and safety associated with each of the water investment alternatives should be described, quantified if possible, and documented.

Environmental Justice	An objective of the PR&G investment evaluation process is the fair treatment of all people including meaningful involvement in the public comment process. Any disproportionate impact to minority, Tribal, and low-income populations should be avoided. In implementing the PR&G, agencies should seek solutions that would eliminate or avoid disproportionate adverse effects on these communities. For watershed investments, particular attention should be focused to downstream areas. The study area may need to be reexamined to include the concerns of affected communities downstream of the immediate investment area. The PR&G process should document efforts to include the above-mentioned populations in the planning process. The PR&G process must be in compliance with Executive Order 12898 of February 11, 1994 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). Applications of the PR&G process in USDA agencies must be in compliance with USDA DR 5600-002 (Environmental Justice).
Watershed Approach	A watershed approach must be used when completing a PR&G analysis. This approach recognizes that there may be upstream and downstream impacts of a water resources activity that may be outside of the applicable political or administrative boundaries. A watershed approach is not necessarily limited to analyzing impacts within a specific hydrologic unit. Rather, it is broad, systems-based framework that explicitly recognizes the interconnectedness within and among physical, ecological, economic, and social/cultural systems. A watershed approach enables examination of multiple objectives, facilitates the framing of water resources problems, incorporates a broad range of stakeholders, and allows for identification of interdependence of problems and potential solutions. In many instances, a specific hydrologic unit may be the appropriate scale to examine alternatives to address water resources problems and opportunities. In this case, the watershed would become the study area. In other cases, environmental, economic, or social conditions may merit a study area that is a combination of various hydrologic units or other geographic groupings. Ideally, the area of analysis should represent a geographical area large enough to ensure plans address cause and effect relationships among affected resources, stakeholders, and investment options, both upstream and downstream of an investment site. The watershed approach also establishes the framework to examine cumulative effects and the interaction of a potential Federal investment with other water resources projects and programs. When considering the impact of Federal investments against some economic and ecological measures, the analysis may need to be expanded to include regional markets and habitat considerations beyond the initial study area (e.g., beyond the immediate hydrologic unit).

References

U.S. Department of Agriculture (USDA). (2017). *Guidance for conducting analyses under the principles, requirements, and guidelines for water and land related resources implementation studies and federal water and resource investments.* DM 9500-013. **https://www.usda.gov/directives/dm-9500-013**

E.11. Consultation Letters

USDA United States Department of Agriculture

NRCS

State Office

1201 NE Lloyd Blvd.,
Suite 900
Portland, OR 97232
503.414.3212

10/6/22

Oregon Parks and Recreation
State Historic Preservation Office
725 Summer Street NE, Suite C
Salem, OR 97301

Subject: Initiate Consultation for North Unit Irrigation District Infrastructure Improvements.

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) is proposing to provide the North Unit Irrigation District (NUID) with financial and technical assistance to improve the efficiency and delivery of water within NUID service area through the Watershed and Flood Prevention Act (PL-566). In addition to the USDA-NRCS the proposed project involves NUID, and the U.S. Bureau of Reclamation (USBR). The USDA-NRCS is acting as the Lead Federal Agency for this undertaking.

NUID proposes to convert the following 27.5 miles of laterals to pipelines: Lateral 31 (4,427 ft.), Lateral 32 (3,241 ft.), Lateral 34 (24,188 ft.), and Lateral 43 (113,167 ft.). Existing pipe that would need to be upgraded would be installed. Throughout Lateral 43, 3 pressure reducing valves would be installed. Additionally, NUID would construct four 1,000 yd^3 retention ponds, each approximately 0.5 ac. in size, at the terminal ends of laterals 31, 34-2, 43, and 43-10. Construction of these retention ponds would eliminate discharge from current operational tailwater spills into the Crooked River, Lake Billy Chinook, and an unnamed ephemeral creek. The proposed project would include vegetation clearing before construction, mobilization and staging of construction equipment, excavations of trenches, fusing of pipelines, placement of pipe in trenches in some cases below the grade of the lateral, upgrading existing outdated pipe in certain areas, compaction of backfill, and restoration and reseeding of the disturbed areas.

In some locations, construction access would need to be created before delivering pipe or equipment into construction areas and could include vegetation removal within the construction area. Appropriately sized construction equipment would be used to minimize disturbance in the construction area. Pipe installation would most likely require some borrow or fill material and storage areas for pipe, other materials, and construction equipment. These areas have not yet been identified and will be determined prior to construction. Areas that have been previously disturbed and are accessible through existing access routes would be selected.

Construction would occur in two project groups over the course of 6 years occurring predominantly during the non-irrigation season (November to April), with construction anticipated to begin as early as the 2023 non-irrigation season.

In accordance with 36 CFR §800.3(c), the USDA-NRCS would like to take this opportunity to formally initiate the §106 consultation process with you. We will consider your comments during the next steps of the NEPA and NRHP process. Thank you in advance for your comments and we look forward to hearing from you. If you or your staff have any questions, concerns or need clarification on this proposed project please contact me at my office telephone (503) 484-3212 or at Michael.Petrozza@usda.gov

Sincerely,

Michael Petrozza
USDA-NRCS Oregon State Cultural Resources Specialist

cc: Gary Diridoni, **USDA-NRCS Oregon Conservationist, Watershed Planning Program Lead**

Kacee Lathrop, **USDA-NRCS Oregon State Resources Conservationist (Acting)**

Raija Bushnell, **Farmers Conservation Alliance, Watershed Planning Program Manager**

Chris Horting-Jones, **Archaeologist U.S. Bureau of Reclamation, Bend Field Office**

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

November 3, 2022

Mr. Michael Petrozza
USDA-Natural Resources Conservation Service
1201 NE Lloyd Blvd., Ste 900
Portland, OR 97232

RE: SHPO Case No. 22-1486
NRCS, North Unit Irrigation District NUID Infrastructure Improvement Project
Piping open irrigation canals
Multiple legals, Jefferson County

Dear Mr. Petrozza:

Thank you for submitting information for the undertaking referenced above. We look forward to additional consultation around the APE, Identification and Evaluation of Historic Properties, and Finding of Effect as they are made. Make sure the undertaking definition includes the entirety of the project over the full duration and is not pieced out into smaller projects. We also suggest looking at our offices linear guidance when documenting and evaluating potential historic properties.

When consultation docments are ready, provide them to our office via Go Digital. If you have not already done so, be sure to consult with all appropriate Native American tribes regarding the proposed undertaking. In order to help us track the undertaking accurately, reference the SHPO case number above in all correspondence. Your reviewers for this undertaking will be Jamie French and Jessica Gabriel

Please contact our office if you have any questions, comments or need additional assistance.

Sincerely,

Jamie French, M.A.
Assistant State Archaeologist
(503) 979-7580
Jamie.French@oprd.oregon.gov

USDA

United States Department of Agriculture

NRCS

State Office

1201 NE Lloyd Blvd.,
Suite 900
Portland, OR 97232
503.414.3212

10/6/22

Confederated Tribes of Warm Springs Reservation of Oregon
1233 Veterans Way
P.O. Box C
Warm Springs, OR 97761

Subject: Initiate Consultation for North Unit Irrigation District Infrastructure Improvements.

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) is proposing to provide the North Unit Irrigation District (NUID) with financial and technical assistance to improve the efficiency and delivery of water within NUID service area through the Watershed and Flood Prevention Act (PL-566). In addition to the USDA-NRCS the proposed project involves NUID, and the U.S. Bureau of Reclamation (USBR). The USDA-NRCS is acting as the Lead Federal Agency for this undertaking.

NUID proposes to convert the following 27.5 miles of laterals to pipelines: Lateral 31 (4,427 ft.), Lateral 32 (3,241 ft.), Lateral 34 (24,188 ft.), and Lateral 43 (113,167 ft.). Existing pipe that would need to be upgraded would be installed. Throughout Lateral 43, 3 pressure reducing valves would be installed. Additionally, NUID would construct four 1,000 yd^3 retention ponds, each approximately 0.5 ac. in size, at the terminal ends of laterals 31, 34-2, 43, and 43-10. Construction of these retention ponds would eliminate discharge from current operational tailwater spills into the Crooked River, Lake Billy Chinook, and an unnamed ephemeral creek. The proposed project would include vegetation clearing before construction, mobilization and staging of construction equipment, excavations of trenches, fusing of pipelines, placement of pipe in trenches in some cases below the grade of the lateral, upgrading existing outdated pipe in certain areas, compaction of backfill, and restoration and reseeding of the disturbed areas.

In some locations, construction access would need to be created before delivering pipe or equipment into construction areas and could include vegetation removal within the construction area. Appropriately sized construction equipment would be used to minimize disturbance in the construction area. Pipe installation would most likely require some borrow or fill material and storage areas for pipe, other materials, and construction equipment. These areas have not yet been identified and will be determined prior to construction. Areas that have been previously disturbed and are accessible through existing access routes would be selected.

Construction would occur in two project groups over the course of 6 years occurring predominantly during the non-irrigation season (November to April), with construction anticipated to begin as early as the 2023 non-irrigation season.

In accordance with 36 CFR §800.3(c), the USDA-NRCS would like to take this opportunity to formally initiate the §106 consultation process with you. We will consider your comments during the next steps of the NEPA and NRHP process. Thank you in advance for your comments and we look forward to hearing from you. If you or your staff have any questions, concerns or need clarification on this proposed project please contact me at my office telephone (503) 484-3212 or at Michael.Petrozza@usda.gov

Sincerely,

Michael Petrozza
USDA-NRCS Oregon State Cultural Resources Specialist

cc: Gary Diridoni, **USDA-NRCS Oregon Conservationist, Watershed Planning Program Lead**

Kacee Lathrop, **USDA-NRCS Oregon State Resources Conservationist (Acting)**

Raija Bushnell, **Farmers Conservation Alliance, Watershed Planning Program Manager**

Chris Horting-Jones, **Archaeologist U.S. Bureau of Reclamation, Bend Field Office**

USDA

United States Department of Agriculture

Natural Resources Conservation Service

1201 NE Lloyd Blvd.
Suite 900
Portland, OR 97232
503-414-3200

December 9, 2022

Mr. Craig Rowland
Acting State Supervisor, Oregon Fish and Wildlife Office
U.S. Fish and Wildlife Service
2600 SE 98th Avenue
Portland, OR 97266

Subject: Request to Initiate Informal Consultation Under Section 7 of the Endangered Species Act for the North Unit Irrigation District Infrastructure Modernization Project

Dear Mr. Rowland,

The purpose of this letter is to initiate informal consultation under Section 7 of the Endangered Species Act for potential effects of the North Unit Irrigation District Infrastructure Modernization project on the Federally threatened Oregon spotted frog (*Rana pretiosa*) and Oregon spotted frog critical habitat. The North Unit Irrigation District Infrastructure Modernization Project is an agricultural water conveyance efficiency project proposed to improve water conservation in District-owned infrastructure and improve water supply management and delivery reliability to District patrons. The proposed Action is located within the Upper Deschutes Watershed of the Deschutes Basin in Jefferson County, Oregon.

North Unit Irrigation District (NUID or District) is seeking federal funds under the authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566), which is administered by the Natural Resources Conservation Service (NRCS). A draft watershed plan-environmental assessment document has been prepared by Farmers Conservation Alliance (FCA) in accordance with the National Environmental Policy Act (NEPA) of 1969, Public Law 91-190, as amended (42 United States Code [U.S.C.] 43221 et seq.) and Public Law 83-566 planning processes to meet NRCS requirements. A copy may be found at https://oregonwatershedplans.org/

The Proposed Action would include updating District infrastructure, including piping 27.5 miles of laterals, updating 153 turnouts, and constructing four 1,000-cubic-yard retention ponds. The Proposed Action would occur within the Project Area, which includes 27.5 miles of open laterals along laterals 31, 32, 34, and 43 with the associated right-of-way (ROW) and easements. The Project Area consists of only a portion of the district's total conveyance system. Construction of the Proposed Action would include mobilization and staging of construction equipment, delivery of pipe to construction areas, excavation of trenches when necessary, fusing of pipelines, placement of pipe, compaction of backfill, and restoration and reseeding of the disturbed areas. Pipe would be placed within the existing canal alignment, the pipe would be buried, and the depth of cover would adhere to NRCS practice standards, and backfill would be graded to meet the surrounding landscape. All proposed infrastructure modifications related to piping would occur directly in the district's laterals and within the district's existing ROW and easements. Construction of the retention ponds would occur within District acquired easements. Because construction would occur outside of the Deschutes and Crooked rivers Ordinary High Water (OHW) mark, none of the proposed construction would impact surrounding waterbodies. The district proposes to implement the Proposed Action over the course of six years in two project groups beginning as soon as fall 2023 during the non-irrigation season. See Section 8.7.2 in the Plan-EA for more details about the estimated timeline of the construction phases.

Implementation of the Proposed Action would result in water savings by the district during the irrigation season. Upon completion of the infrastructure modernization covered under the Proposed Action, the District would save up to 6,089 acre-feet of water annually. Of this, NUID would allocate 25 percent of the saved water (up to 1,522 acre-feet/year) to instream purposes. NUID would file a water right transfer application to change the purpose for which 1,522 acre-feet/year of water could be stored to include instream purposes. NUID would then apply for a secondary water right to use up to 1,522 acre-feet/year of the stored water for instream purposes below Wickiup Reservoir. The secondary water right would authorize the use of stored water in Wickiup Reservoir for release into the Deschutes River during the non-irrigation season (i.e., in the late fall, winter, and early spring). The water allocated to instream purposes would retain the same priority date as the originating storage water right.

Construction activities associated with converting an open irrigation canal to irrigation pipeline, would have no direct, indirect, or cumulative effects to gray wolf, bull trout, MRC steelhead, OSF, or associated critical habitats.

During the non-irrigation season, the decrease in Wickiup Reservoir water level (DR1) is expected to have a short-term negligible, adverse effect on OSF overwintering and breeding, consistent with the effects described in the HCP (NMFS and USFWS, 2020). Increase in non-irrigation season streamflow in the Deschutes River (DR2-3), as a result of the Proposed Action, is expected to slightly improve overwintering habitat conditions, however, because the increase in streamflow during the non-irrigation season would be insufficient to reach emergent wetlands, OSF would continue to be relegated to overwintering in unvegetated backwater areas and side channels of the river (NMFS and USFWS 2020). Also, as a result of the Proposed Action, OSF breeding conditions are expected to variably improve in DR2-3 during the non-irrigation season due to the increased streamflow and reduced fluctuation in flow during the breeding season (NMFS and USFWS 2020). All effects are consistent with those described in the HCP.

NRCS has determined that, as a result of the Proposed Action, the decreased water levels in Wickiup Reservoir and increased streamflow in DR2-3 during the non-irrigation season may affect but is not likely to adversely affect the Oregon spotted frog and its federally designated critical habitat.

If you have any questions or require additional information to complete this request, please contact Gary Diridoni at gary.diridoni@usda.gov or 503-414-3092.

Sincerely,

JASON JEANS Digitally signed by JASON JEANS Date: 2022.12.09 13:27:32 -08'00'

JASON JEANS
Acting State Conservationist

Enclosures: 3

ECC:
Bridget Moran, U.S. Fish and Wildlife Service
Anna Soens, U.S. Fish and Wildlife Service

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bend Field Office
63095 Deschutes Market Road
Bend, Oregon 97701

In Reply Refer To:
2023-0027746-S7

Jason Jeans, Acting State Conservationist
Natural Resources Conservation Service
1201 NE Lloyd Blvd., Suite 900
Portland, Oregon 97232

Subject: North Unit Irrigation District Infrastructure Modernization Project – Jefferson County, Oregon – Concurrence

Dear Mr. Jeans:

This letter responds to the Natural Resources Conservation Service's (NRCS) request for the U.S. Fish and Wildlife Service's (Service) concurrence on effects of the subject action to species and habitats listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; [Act]). The NRCS's request dated December 9, 2022, and received by the Service on December 9, 2022, included a biological assessment entitled *North Unit Irrigation District Infrastructure Modernization Project - Biological Assessment* (Assessment) dated November 28, 2022. Information contained in the Assessment is incorporated here by reference.

Through the Assessment, the NRCS determined that the proposed action may affect, but is not likely to adversely affect Oregon spotted frog (*Rana pretiosa*) or designated Oregon spotted frog critical habitat. The Service concurs with the NRCS' determinations and presents our rationale below.

The NRCS also determined that the proposed project will have no effect on bull trout (*Salvelinus confluentus*), gray wolf (*Canis lupus*), or bull trout critical habitat. The regulations implementing section 7 of the Act do not require the Service to review or concur with no effect determinations. However, the Service does appreciate being informed of your determinations for these species.

Proposed Action

The Watershed Protection and Flood Prevention Act (PL-566) authorizes the NRCS to assist local organizations and units of government to plan and implement watershed projects. North Unit Irrigation District (NUID) will be constructing and implementing the proposed action as described in the Assessment, but Federal funding will facilitate the project's successful completion. This funding is administered by NRCS; as such, NRCS is the lead Federal agency responsible for ensuring the project meets Federal requirements.

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*PARTIAL

The proposed action seeks to improve water conservation and water supply management, delivery reliability, water quality, and instream flow for aquatic habitat within the Upper Deschutes River watershed of the Deschutes River Basin. The project includes installing 27.5 miles of buried pipe; constructing four, 1,000-cubic-yard retention reservoirs at the end of specific laterals; and updating 154 turnouts. The irrigation modernization activities will be implemented over a period of 6 years in two project groups by NUID. Each group will take 2-3 years to complete and are planned to start fall 2023 in the non-irrigation season (i.e., late fall, winter, and early spring).

All proposed infrastructure modifications will occur directly in NUID's main canal and within the NUID's existing rights-of-way and easements. Construction of the retention ponds will occur within District acquired easements. Because construction will occur outside of the Deschutes and Crooked Rivers' ordinary high-water marks, none of the proposed construction will impact surrounding waterbodies. Piping NUID's infrastructure will also reduce water loss to seepage and evaporation. Water loss with the current infrastructure is approximately 18.78 cubic feet per second (cfs) of water (6,089 acre-feet annually) to seepage through the porous underlying geology and evaporation.

The infrastructure modernization project implemented within the district is expected to result in indirect streamflow changes in other portions of the Deschutes River Basin. The piping effort is anticipated to save up to 6,089 acre-feet (AF) of water annually from seepage and evaporative loss. Of the conserved water, NUID will allocate 25 percent of the saved water (up to 1,522 AF/year) to instream purposes. To accomplish this, NUID will file a water right transfer application to change the purpose for which 1,522 AF/year of water could be stored to include instream purposes. NUID will then apply for a secondary water right to use up to 1,522 AF/year of the stored water for instream purposes below Wickiup Reservoir. The secondary water right will authorize the use of this stored water in Wickiup Reservoir for release into the Deschutes River during the non-irrigation season.

Live flow availability and the District's storage use would determine how much water would be saved during a given irrigation season and released during the subsequent non-irrigation season. Water released by NUID during the non-irrigation season will be in addition to the Deschutes Basin Habitat Conservation Plan (HCP) minimum winter flow target of 100 cfs in the Deschutes River downstream from Wickiup Reservoir until year 8 of the HCP (January 2028), when this conserved water can be used to meet the increased minimum winter flow target of 300 cfs.

The action area encompasses the project area for NUID infrastructure proposed to be modernized, areas where new infrastructure is proposed to be built, associated NUID-operated rights-of-way and/or easements where construction will take place and/or be staged, as well as portions of waterbodies that might be directly or indirectly affected by the proposed action. This area extends from the Deschutes River inflow at Wickiup Reservoir (river mile 233.5) to the mouth of Lake Billy Chinook along the Deschutes River arm (river mile 120.0), the mouth of Lake Billy Chinook at the Crooked River arm to Round Butte Dam (river mile 112.4), Willow Creek (river mile 1.0) to the mouth of Lake Simtustus, an unnamed ephemeral creek (river mile 5.4) to the mouth of Lake Billy Chinook, and Crooked River (river mile 18.5) to the mouth of

Lake Billy Chinook (Assessment, Figure 3, Table 3). The proposed action is fully described in the Assessment (pp. 6-11).

The following is a conceptual water summary associated with the Proposed Action.

- As a result of piping, NUID will save water during the irrigation season (6,089 AF annually).
- NUID will release a portion of the saved water (1,522 AF annually) from Wickiup Reservoir during the non-irrigation season as conserved water. This equates to NUID releasing approximately 5.1 cfs from Wickiup Reservoir into the upper Deschutes River if the water is released at a flat rate over the entire non-irrigation season.
- Until Year 8 of the HCP, the conserved water released during the non-irrigation season will be in addition to the 100 cfs minimum winter flow rate required by the HCP in the Deschutes River downstream of Wickiup Reservoir.
- After Year 8 of the HCP, the conserved water released during the non-irrigation season will help to meet the 300 cfs minimum winter flow rate required by the HCP in the Deschutes River downstream of Wickiup Reservoir.

The Assessment contains detailed descriptions of each summary statement (pp. 10-12).

Species and Habitat Presence in the Action Area

The action area lies within critical habitat unit 8 (Upper Deschutes River) for Oregon spotted frog, which encompasses 24,032 acres from headwater streams, lakes, and wetlands that drain to Crane Prairie and Wickiup Reservoirs and to the mainstem of the Deschutes River to Bend, Oregon. The Deschutes Basin remains a primary population center for the species. Within the Deschutes River Basin, Oregon spotted frogs are present in wetlands from headwaters lakes and streams to Bend. There are 34 known occupied sites within the action area. All areas occupied by frogs are within designated critical habitat. Within this area, Oregon spotted frog habitat has been significantly altered by water management activity in the basin and continues to be influenced by operations of Crane Prairie and Wickiup Reservoirs. Low streamflow during the non-irrigation season as well as rapid changes in streamflow and reservoir levels during the irrigation season have contributed to poor condition of Oregon spotted frog in the Deschutes River Basin.

Potential Impacts and Effects from the Proposed Action

Construction activities associated with the proposed action will not directly affect Oregon spotted frog or its critical habitat since neither are found within the network of NUID irrigation infrastructure (Assessment, p. 21). The improved system will result in conserved water and transferred instream flows, indirectly impacting Oregon spotted frog and its habitat by decreasing Wickiup Reservoir storage levels (up to 1,522 AF annually) and increasing non-irrigation season streamflow in the Upper Deschutes River below the reservoir (approximately 5.1 cfs). Over the long-term, the proposed action will result in incremental progress towards improved conditions for Oregon spotted frog and its critical habitat by providing more stable overwintering conditions in the Upper Deschutes River Basin. The increase in non-irrigation season streamflow in the Deschutes River from Wickiup Dam to the North Canal Dam is expected to slightly improve overwintering habitat conditions due to the increased streamflow and reduced fluctuation in flow during the breeding season.

Concurrence

Based on the Service's review of the Assessment, we concur with the NRCS's determination that the action outlined in the Assessment and this letter, may affect, but is not likely to adversely affect Oregon spotted frog or designated Oregon spotted frog critical habitat. This concurrence is based on improved conditions for Oregon spotted frog and its critical habitat by providing more stable overwintering conditions in the upper Deschutes River Basin, and location of activities that avoid or reduce impacts of the proposed action to listed species and their critical habitat to insignificant or discountable levels.

This concludes informal consultation. Further consultation pursuant to section 7(a)(2) of the Act is not required. Reinitiation of consultation on this action may be necessary if: (1) new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not considered in the assessment; (2) the action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the analysis; or (3) a new species is listed or critical habitat designated that may be affected by the proposed action.

Thank you for your continued interest in the conservation of threatened and endangered species. If you have any questions regarding this consultation, please contact Emily Weidner of this office at (541) 383-7146.

Sincerely,

BRIDGET MORAN Digitally signed by BRIDGET MORAN
Date: 2022.12.22 16:04:13 -08'00'

Bridget Moran
Field Supervisor

cc:
National Marine Fisheries Service, Portland (Carlon)
National Resources Conservation Service, Portland (Diridoni)
U.S. Bureau of Reclamation, Bend (Garnett)
U.S. Fish and Wildlife Service, Bend (O'Reilly)
U.S. Fish and Wildlife Service, Bend (Soens)