Appendix A

Comments and Responses

Table A-1. Topics and associated codes

Topic	Topic Code	Topic	Topic Code
Alternative Analysis	ALT	Project Cost	COST
Construction Practices	CONS	Project Profits	PROF
Energy Production	ENRG	Public Process	PROC
Fish and Aquatic	FISH	Purpose and Need	PURP
General	GEN	Resource Concerns	RES
Irrigated Acres	IRA	System Design	SYS
Maps	MAP	Vegetation	VEG
Patron Delivery	PATD	Water	WAT
Permitting	PRMT	Wild and Scenic	WAS
		Wildlife	WILD

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

Comment ID	Topic Code	Comment	Response
1.01	VEG	You should come see what has happened to four seasons mobile home park since they piped it. Trees are falling over from NO water.	Thank you for your comment. See Section 6.8.3 for Best Management Practices regarding vegetation during and after construction.
1.02	WILD	All the animals have left our park. Not a good thing. Not at all for anyone.	Thank you for your comment.
2.01	GEN	I am supportive of the Draft Watershed Plan-Environmental Assessment (Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project that will pipe 16.6 miles of canals and laterals over a seven-year period.	Thank you for your comment.

2.02	WAT	The Plan-EA will help alleviate my concerns over the wasteful use of water by the agricultural industry/irrigation districts, and the negative effect our policies are having on the Deschutes River Basin. The current irrigation system of leaky, unlined canals built in the early 1900's, combined with an antiquated set of water use policies have put the health of the Basin and its economic viability at grave risk. Agriculture receives >80% of the water through diversion from the river to irrigate our local desert. Of that, approximately 50% of irrigation water is lost by the leaky canal system, combined with wasteful practices such as flood irrigation. Piping the water to the farmers, metering its use, coupled with keeping conserved water in the river are key elements that are in the best interests of the farmers, the tourism and recreation industry and all of the Bend business that benefit directly or indirectly from our precious river. By law, the water belongs to ALL the people of Oregon. We need to improve our irrigation infrastructure and modernize our policies to reflect 21st Century economics. Most importantly, the River needs our help and our voice. I would also like to take this opportunity of thanking Sen. Jeff Merkley for his role in securing funds in support of modernizing irrigation (specifically piping) as an essential means to conserving water and helping restore healthy flows to the Deschutes River.	Thank you for your comment.
3.01	WAT	I am glad to see 75% of the water conserved would be dedicated to instream flow in the Deschutes River. Where in the river and during what times of the year would that additional flow from conservation occur?	See Section 6.10.2.1 and Table 5-2 for information about location and allocation of conserved water under the preferred alternative.
3.02	PROC	Page 17 lists public comments. I missed seeing direct responses to those comments. It would be useful if the document had a direct point-by-point response to those comments, issues or concerns. If the answer is complex, the response could cite the page(s) where that answer is found.	The scoping comments on page 17 of the Plan-EA were gathered in July 2017 and were used to develop the Draft Plan-EA in accordance with Section 610.68 of the National Environmental Compliance Handbook. Table 3-1 of the Plan-EA summarizes those comments and references the sections in the Plan-EA addressing the summary comments. Responses to each public comment received during the public comment period for the Draft Plan-EA (September 21 - October 24) are included in the Final Watershed Plan-EA. Please see NRCS eDirective National Environmental Compliance Handbook for more detail at https://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=29769.
3.03	WILD	I would like to see more on site-specific information on changes to wildlife habitat.	The Plan-EA is a programmatic document used to comply with the National Environmental Policy Act (NEPA). It is a Tier 2 document that analyzes a particular setting and impacts with specificity in mitigation measures and performance criteria. Please see the National Environmental Compliance Handbook Section 610.81 for information about tiering (https://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=29769). Based on NEPA guidance, site-specific evaluations are completed at the implementation stage of each on-the-ground project. Please see Office of Management and Budget Fact Sheet and Section 6.12.2 for further discussion regarding changes to wildlife habitat.
3.04	WAT	I would like to see more on site-specific information on potential effects on private wells.	See the response to comment 3.03. Information about groundwater and effects to private wells can be located in Sections 4.10.4 and 6.10.2.4.

4.01	COST	Several questions/comments arising out of the latest meeting hosted by Swalley and Oregon Watershed: 1) What is the change in cost projected for our per acre yearly charge for water? Since funding has been secured, does that mean there will be no cost passed on to recipients? Or since water flow is projected to be better, will costs go down for recipients?	The District expects that the proposed project would be fully funded through grants. The District does not anticipate changing per acre annual rates or the overall base assessment fee as a result of any capital improvement project that is fully funded through grants. See updated text in Section 8.8.6.
4.02	PROC	2) If the meeting is held for the public's benefit, all questions/comments from the public should be heard by all. Breaking into small groups with particular interests doesn't allow for general knowledge to be shared and the impact understood. Thank you for allowing the input.	The format of the public meeting complied with Natural Resources Conservation Service Directive 610.68 in the National Environmental Compliance Handbook (https://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=29769). However, the NRCS and FCA appreciates your feedback and will consider it when planning future public meetings.
5.01	PROF	In regards to the Swalley Irrigation Plan meeting on October 10th, we have the following questions and concerns to be addressed: Who will profit off this plan specifically? Company, entity, whether it be monetary or other form of consideration.	Providers of materials and services that would be procured for the construction of the proposed project may profit from project construction. Additionally, patrons may see an increase in on-farm profits following project construction as a result of access to secure and pressurized water. See Appendix D, Section 2 in the Plan-EA appendices for a discussion about the costs of the project and Appendix D, Section 3 for the anticipated benefits of the project.
5.02	CONS	Piping is being trucked up from Henderson, AZ, isn't there a closer option? Has it been explored?	The District has not procured pipe for the proposed project.
5.03	CONS	Have there been multiple bids performed? If not, why? I request at least 2 other bids to be performed including one from a company that is local and gets local supplies (within 500 miles).	The District has not yet solicited bids or proposals for materials or services for the proposed project because the Final Plan-EA has not been approved, a Finding of No Significant Impact (FONSI) has not been issued, and funding has not been authorized by the Chief of NRCS. If the Final Plan-EA receives approval, a FONSI is issued, and funding authorized by the Chief of NRCS, the District will follow the appropriate state and federal procurement rules when procuring goods and services.
5.04	FISH	It was told to me at the meeting Swalley must take steps to conserve water or else face a lawsuit from the spotted frog group and potentially lose our water rights, is this true?	The eight irrigation districts in Central Oregon and the City of Prineville (Partners), in association with the U.S. Fish and Wildlife Service, are voluntarily developing a Habitat Conservation Plan for threatened, endangered, and other species, including the Oregon spotted frog. The Habitat Conservation Plan could affect the districts' operations, which were already affected under the 2016 Settlement Agreement with the Center of Biological Diversity and maintained in compliance with the 2017 Biological Opinion for Bureau of Reclamation dam operations (Reclamation 2017). The Partners are voluntarily developing this Habitat Conservation Plan to minimize or mitigate for the effects of their operations on the included species, a requirement of an application for an incidental take permit under the Endangered Species Act of 1973. Measures and outcomes such as those resulting from the proposed project may be included in the Habitat Conservation Plan. In the absence of a Habitat Conservation Plan and associated Incidental Take Permit, district operation activities may result in the unlawful take of a listed species. U.S. Bureau of Reclamation (Reclamation). (2017). *Biological Opinion: Approval of Contract Changes to the 1938 Inter-District Agreement for Operation of Crane Prairie and Wickiup Dams and Implementation of Review of Operations and Maintenance and Safety Evaluation of Existing Dams Programs at Crane Prairie and Wickiup Dams*. U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Bend, Oregon.

5.05	WAT	Will Swalley's water conservation go directly to the farmers in Culver and Madras that regularly have shortages?	The water saved by the project would not be made directly available for diversion and delivery to famers in Culver and Madras through this program. Please see Table 5-2 in Section 5.3.2 of the Plan-EA for a summary of how water saved through the project will be allocated between the Deschutes River and Swalley Irrigation District through Oregon's Allocation of Conserved Water Program. See Sections 1.1 and 1.2 for a description of the watershed and project area that would be impacted by the project.
5.06	WAT	If we conserve water and spend in excess of $14 million dollars, will our efforts actually benefit Swalley patrons and will the conserved water reach the farmers in Culver and Madras?	See Sections 3.2.2 and 3.3.1 of Appendix D of the Plan-EA for discussions about the benefits to Swalley Irrigation District's patrons. Please see the response to comment 5.05 regarding water deliveries to farmers in Culver and Madras.
5.07	SYS	Why don't we pipe the Main canal first as it (please address each point): 1. has the most positive cost benefit 2. has the potential to save the most water 3. has the potential to save the most energy costs 4. serves the most people that will benefit 5. will remedy pressurization problems which from my understanding is an issue on that section and not so much on other sections. 6. remedy the safety issues as the Main canal as it is clearly the most dangerous 7. Remedy the canal that has the largest percentage of seepage? 8. Will have the greatest affect to appease the conservationist	The District intends to pipe and pressurize its entire conveyance system generally using a top-down approach as funding becomes available. Nearly half of the Main Canal is already piped from the diversion down. Following this general top-down approach, and also considering heavy urbanization and development demands near the City of Bend, the District developed an appropriate project phasing schedule that worked within engineering and funding constraints to meet District, patron, and community development demand needs. Although the lower half of the Main Canal Piping Project would not be the first project piped under this proposed project, the District would fully pipe and pressurize this canal under the proposed project to achieve the outcomes identified in the comment.
5.08	WAT	The 2016 report suggests more studies on seepage still need to be performed to get an accurate measurement of how much water is actually being lost, this study says main canal has the largest loss. Have more studies on seepage been performed?	The seepage studies performed in 2016 by Black Rock Consulting were performed in accordance with industry-standard protocols and using state-of-the-art equipment. These measurements accurately assessed the water loss due to seepage and estimated water conservation in the system (SID 2017, Table 3.3.1). The System Improvement Plan (SID 2017) includes language regarding further loss assessments. This language states that, "*In instances where grants are to be allocated in direct exchange for conserved irrigation water to be dedicated by revised water rights certificates to instream flow, the grantor may be compelled to confirm these seepage loss results by conducting a subsequent loss measurement program performed by the USGS and/or the Oregon Water Resources Department prior to project implementation*" (SID 2017, pp. 17). This language acknowledges that funding partners may complete additional loss measurements prior to project implementation.
5.09	WILD	I don't see any in-depth studies on effects on wildlife habitat, has there been a study? If not, why? I request a professional study to be completed by a neutral third party, accredited entity.	Please see the response to comment 3.03.
5.10	WAT	Why do the discharge and turn outflows in the report go up at certain points in the graph instead of down? It suggests to me there are some inaccuracies.	The comment does not identify which graph or report it refers to, so NRCS and FCA are unable to provide additional clarity to the commenter.
5.11	WAT	Does the percentage of water loss include the water sprayed off or leaked out purposely by Swalley? Why are we wasting any water anyway? It should not be included as seepage as Swalley voluntary wastes it.	The water losses discussed in the Plan-EA include seepage and evaporation losses. Swalley Irrigation District does not purposefully spray off, leak out, or otherwise intentionally waste water.
5.12	ALT	Why isn't conserving water on a voluntary basis not being considered or better management before spending $14,000,000?	Please see Section 5.2 and its subsections for discussions of alternatives eliminated from detailed study. Conversion to dryland farming, fallowing farm fields, voluntary duty reductions, on-farm efficiency upgrades, and piping private laterals would all be voluntary actions to better manage or conserve water.

5.13	COST	What are the unknown costs?	See Section 2 of Appendix D for the costs of the proposed project. The Plan-EA does not refer to or identify any unknown costs.
5.14	VEG	Specially, how will the piping be covered up, particularly if it runs through a yard? Will landscape be repaired, trees removed, grass repaired, will project leave no trace? I would appreciate an in-depth answer and explanation to the above concerns before any part of the Swalley Irritation project moves forward. Above Report being referenced is https://www.swalley.com/files/b5e295bcb/SID+SIP+020317+FINAL+v2.pdf.	See Sections 6.8.2 and 6.8.3 of the Plan-EA for discussions about how the landscape would be used and affected during construction and how the landscape would be repaired after construction using Best Management Practices. Also, see Section 8.4 for details regarding minimization, avoidance, and compensatory mitigation measures throughout the entire construction process.
6.01	WAT	The overall description and effects with alternatives lay out a very comprehensive and extensive analysis of the project with resultant effects to the environment. The Swalley Irrigation District has been a leader in stream restoration through conservation efforts and has returned more water instream in the Middle Deschutes River than any other district has. More stunning is the fact that the percentage of water returned in stream compared to the original water right is approximately 30%. I know of no other irrigation district in Oregon that has reduced their diversion by this amount for the purpose of instream flow restoration. Swalley should be applauded for their continuing efforts. The diversion works description on page 8 gives the impression that Swalley, COID and NUID irrigation districts all share a common point of diversion. It is true for COID and Swalley but NUID's diversion is no less than 75 feet away from Swalley and COID's diversion and is entirely separate. They utilize the same pond that is created behind North Canal Dam but other than that, they are separate.	Thank you for your comment. The diversion works description in Section 1.3 of the Plan-EA has been modified per your comment.
6.02	WAT	Pg 51 3rd paragraph: The comment regarding OWRD and USGS have a meter/gage on SID's canal is incorrect. The OWRD operates this gage and transmitting platform solely. USGS has no role whatsoever.	Thank you for your comment. This correction has been made in Section 4.10 of the Plan-EA.
6.03	WAT	Fig 4-13 pg 55 gives a false impression of the stream flow expected below Bend during the month of April. It is unlikely to be that high for the entire month. The flow will by or should be very similar to historic flows as this measurement point is strongly affected by canal operations and not just Wickiup outflow.	Thank you for your comment. Clarifying language has been added to Figure 4-13.
6.04	WAT	Section 5.2.9 Use of Groundwater The comments about mitigation and rate limitations are accurate and describe the program adequately. However, it is quite possible that with this alternative being implemented in full force to the limit of water available the well depths quoted at 240 feet below land surface would likely have to be on average 200 to 300 feet deeper to reach the regional aquifer to be able to supply an adequate and dependable source. The cost would naturally escalate with increasing depths and pumping costs would also be increased.	Thank you for your comment. Section 5.2.9 of the Plan-EA has been updated to reflect that the discussion about the decline in groundwater and pumping costs representing minimum estimates of these two metrics.
6.05	ALT	5.4 Summary and Comparison of Alternatives The summary tables adequately address the issues.	Thank you for your comment.
6.06	WAT	Section 6.10.2.4 on page 103 does a good job of analyzing the effects of the Swalley canal piping on the regional aquifer. The drop in the groundwater table over 100-year period is 1.64 feet.	Thank you for your comment.
7.01	GEN	I think the proposed plan to pipe more canals by Swalley ID is FANTASTIC! We need more canals piped. The low level in Wickiup is our wake up call that we need to update all aspects of our very important irrigation system to ensure we have the water needed now and in the future. Bravo to Swalley for being proactive.	Thank you for your comment.

8.01	WAT	We wanted to find out what the impact to our well would be from the piping. Since the piping is in essence taking would take the existing water source from our land, it may have the result of making our well go dry. If so, funding (federal or otherwise) should be available to landowners for rework/replacement of these wells, many having been in existence for >50 years.	Please see the response to comment 3.03 regarding the analysis of effects on individual properties. Please see Section 6.10.2.4 for a discussion about the effects of the proposed project on groundwater resources.
9.01	COST	1. With the political views expressed by our current president about the environment, can it be confirmed that the money allocated to this project will actually be available and "funded" to the irrigation companies?	NRCS has obligated funding for the Rogers Lateral, Rogers Sublateral, and Elder Lateral to the Deschutes Basin Board of Control for use by Swalley Irrigation District under the PL 83-566 program. This funding will only be made available when, and if, NRCS authorizes a Final Plan-EA and issues a Finding of No Significant Impact. If an authorized PL 83-566 Plan-EA cannot be developed, existing funding will be deobligated and would be unavailable to SID. Future funding through PL 83-566 is not available to SID until a PL 83-566 approved plan is developed.
9.03	PATD	2. My irrigation is provided by another irrigation company, COID, and delivered via Swalley ditches. I pay COI for my water every year. If they raise their rates (and they said they would) but Swalley doesn't, this doesn't seem like a fair process for all of my association users, 30 of them, since we will not be getting the pressurized water.	Swalley Irrigation District has no authority over the assessments that Central Oregon Irrigation District charges to its patrons.
9.04	WILD	3. This whole project just seems rushed, and I don't think that all of the animals and wildlife that will be potentially affected by the piping have been documented.	Thank you for your comment. Please see Section 6.12.2 for a discussion about the potential effects of the proposed project to wildlife.
10.01	GEN	The State of Oregon appreciates the opportunity to comment on the Environmental Assessment (EA) for the Irrigation Modernization Project proposed by the Swalley Irrigation District (SID). The Regional Solutions Program – consisting of advisory committees, coordinators, and state agency teams – provides a one-stop shop for communities throughout the state. For each region, Governor Brown has appointed an advisory committee to represent the private, public, and philanthropic sectors. The regional boundaries are aligned with the 11 federally designated Economic Development Districts. These committees establish priorities unique to their respective region. The Central Oregon Regional Solutions Advisory Committee has identified "encourage water conservation and restoration and improve water availability" as a high focus priority. This priority recognizes the need to prioritize, develop and implement investments in water conservation that support instream, municipal and agricultural uses. The proposed Swalley Irrigation District modernization project is an investment that moves this priority forward. Below please find comments from individual state agencies who have reviewed the Draft Environmental Assessment. Overall, state agencies appreciate the opportunity to comment on the Draft EA. They found that the document is well written and that it covers a wide range of subject matter related to the Swalley Irrigation District's impact on the central Oregon environment.	Thank you for your comment.

11.01	GEN	As the statutory authority of fish and wildlife in Oregon, ODFW is mandated to protect and enhance Oregon's fish, wildlife and their habitats for the use and enjoyment by present and future generations. Our comments are intended to help the Swalley project contribute to the success of this requirement by supporting actions that permanently increasing flows in the Deschutes River. The Deschutes River from North Canal Dam to Lake Billy Chinook experiences low streamflows and high water temperatures due to storage and diversion of water for agricultural purposes. Reduced habitat associated with low streamflows increases competition for suitable habitat among fish populations, which can concentrate fish populations increasing susceptibility to predators and disease. Elevated water temperatures in the middle Deschutes River negatively affect native fish growth and survival by increasing stress, susceptibility to predators, and negatively influencing growth rates, feeding, metabolism, and development. One of ODFW's goals is to increase instream flows for aquatic species in this reach by meeting and permanently protecting ODFW's instream water right certifications and applications. Improving streamflow, water quality and habitat availability in the Deschutes River downstream of SID's diversion by legally protecting conserved water instream will help us achieve this goal. The Swalley project could help ODFW meet these goals and objectives.	Thank you for your comment.
11.02	WAT	Alternative two would conserve 6,172 acre-feet per year of water, of which 75% will be protected permanently instream, benefiting fish and wildlife. Most of the irrigation piping projects in central Oregon have permanently transferred 100% of their conserved water instream. We recommend the Swalley project and its proponents consider transferring 100% of their conserved water instream.	Thank you for your comment. Under Oregon state law (Oregon Revised Statute 537.470), Swalley Irrigation District is allowed to retain up to 25 percent of the conserved water created through a water conservation project if that project is completed with 100 percent public funding. Allocating 100 percent of the conserved water instream would not alleviate the delivery challenges experienced by the District and would not meet the purpose and need of the project, nor the sponsor's objectives and goals (see Section 2.1.2, Section 2, and pg. xix of the Plan-EA, respectively.)
11.03	WAT	The conserved water will be transferred to the middle Deschutes River from April 1 to October 31. This will result in protected water of 4.8 cfs (April and October, 5.6 cfs (May 1-May 14, September 15-September 30), and 15.2 cfs (May 15-September 14). ODFW recommends the Farmers Conservation Alliance (FCA) and SID work with the Oregon Water Resources Department (OWRD) to explore opportunities to prorate the volume of conserved water over the entire April 1 to October 31 irrigation period. This would assist in eliminating low flows during the shoulder months, which limit both fish and macroinvertebrate productivity in the middle Deschutes.	The District experiences delivery shortages from April 1 to May 14 and September 15 to October 31 and water management challenges throughout the April 1 to October 31 irrigation season (see Section 4.10.1.1). The District proposes using 25 percent of the water saved through the project to alleviate these challenges and meet the purpose and need of the proposed project (see Sections 2.1.2 and 2.2.1). Allocating additional water instream from April 1 to May 14 and September 15 to October 31 would not alleviate these challenges. See Table 5-2 in Section 5.3.2 for the projected allocation of conserved water instream. See Table E-12 and E-13 for how the distribution of the project's total saved water between instream and district use was calculated.

11.04	WAT	Studies have shown there is a direct connection between seepage loss from canals and the regional groundwater supply. This groundwater contributes to spring recharge in the middle Deschutes River below Lower Bridge Road and the lower Crooked River below Highway 97. These areas represent critical cold water refugia for native redband trout and bull trout, an ESA listed species. These reaches are also of significant importance to anadromous summer steelhead and spring Chinook salmon associated with the reintroduction effort. The Department of Environmental Quality has provided comments to the EA noting a thermal infrared survey conducted on 7/6/2001 identified the magnitude of the cooling effect these springs have on the Deschutes River. The value of these cold water inputs are more profound during periods of drought and in response to climate change. The pathway between canal seepage loss and spring recharge is poorly understood. ODFW recommends the FCA and SID partner with OWRD, the U.S. Geologic Survey and other area stakeholders to direct and implement a study further increasing and refining our knowledge of groundwater movement and connectivity within the basin. If it determined that canal piping results in significant loss of cold water to spring recharge areas, we recommend alternatives or mitigation options be considered to offset impacts.	Gaging stations will be monitored as projects are implemented. At the programmatic level, watershed-planning documents are reviewed at regular intervals (approximately five years). This review ensures that conditions remain as described and that any changes in information or conditions that might result in a new or altered finding are identified early on and addressed. During the five-year evaluation, monitoring results will be reviewed along with other applicable resource concerns to identify project effects. If new information presents itself, the Plan-EA will be revised or supplemented as appropriate to account for changing conditions. These revised or supplemented plans may require additional alternatives or that mitigation measures be considered to offset impacts.
11.05	GEN	In summary, ODFW is supportive of the Swalley Irrigation District Irrigation Modernization Project. The conserved water permanently transferred instream to the middle Deschutes River at the point of diversion within the City of Bend will provide benefit to native fish and incrementally move us closer to the target instream water right of 250 cfs. We recommend the FCA view the Swalley Project as part of an integrated holistic approach to managing and conserving water within the Deschutes Basin. Each project influences surface and/or groundwater elsewhere in the basin with corresponding impacts to fish and wildlife.	Thank you for your comment.
12.01	GEN	DEQ appreciates all of the work that went into preparing this comprehensive description of the anticipated natural resource effects of the proposed project. While we believe that project largely supports the state's goals of improving stream flows to meet instream flow targets and improve water quality, we do have several questions or comments that we would like to offer at this time. DEQ appreciate Swalley's agreement to legally protect 75% of the total water saved by the project as an instream flow in the middle Deschutes River from April 1 to October 31. This will result in protected water of 4.8 cfs (April and October), 5.6 cfs (May 1-May 14, September 15-September 30), and 15.2 cfs (May 15-September 14). While this protected water may not represent a significant increase in stream flow between Bend and Lake Billy Chinook in the shoulder seasons, it appears to represent an increase of over 10% of daily average stream flow during the summer months (based on the daily average flows presented in Figure 4-13 in the draft EA).	Thank you for your comment.
12.02	WAT	DEQ has several comments/clarifications relative to information presented in Section 4/10/3 (Surface Water Quality): • In the first paragraph of this section, we suggest adding language to clarify the geographic location of the listings for temperature, pH and dissolved oxygen: "The Deschutes River in the project area is included on Oregon's 303(d) list…".	Thank you for your comment. The suggested clarifying language has been added to the Plan-EA Section 4.10.3.

12.03	WAT	DEQ has several comments/clarifications relative to information presented in Section 4/10/3 (Surface Water Quality): • In the second paragraph of this section, we suggest adding language to indicate that pH levels can also be exacerbated by low flows (in addition to temperature and dissolved oxygen). Low stream flows cause stream temperatures to increase, which in turns stimulates plant/algae growth. Increased plant/algae growth, in turn, can result in increased photosynthetic activity, which can exacerbate pH and dissolved oxygen levels diurnally. The most sensitive beneficial use affected by all three parameters is "Fish and Aquatic Life".	Thank you for your comment. The suggested clarifying language has been added to the Plan-EA Section 4.10.3.
12.04	WAT	DEQ has several comments/clarifications relative to information presented in Section 4/10/3 (Surface Water Quality): • In Section 4.10.3.1, there is a sentence that describes how standards are set to protect a number of different beneficial uses, including water supply, wildlife resources, etc. we recommend moving this sentence to the first paragraph of Section 4.10.3, since this list is a broad list of beneficial uses, not just ones that are affected by temperature.	Thank you for your comment. The suggested modification has been made in Section 4.10.3 and Section 4.10.3.1.
12.05	WAT	DEQ has several comments/clarifications relative to information presented in Section 4/10/3 (Surface Water Quality): • In Section 4.10.3.2, we believe that the statement about pH levels in the Deschutes River exceeding pH standards because of the volcanic geology of the area (attributed to L. Mork) is incorrect. It is correct that there is a different pH criterion for Cascade Lakes above 3000 feet (OAR 340-041-0135(1)(b), with the Cascade Lakes allowed to have a lower pH value: 6.0-8.5, rather than 6.5-8.5 as for the rest of the basin. The lower pH value allowed for the high Cascade lakes is because of the poor buffering capacity in this region. This would not relate to the Deschutes River in the project area, however, where 303(d) listings for pH are because of pH levels that are too high – above the upper threshold of 8.5.	Thank you for clarifying our understanding of the pH in the study area. Section 4.10.3.2 has been modified by removing the statement about pH levels in the Deschutes River exceeding standards because of the volcanic geology of the area. Additional clarifying language related to pH has been added to Section 4.10.3.2.
12.06	WAT	DEQ has several comments/clarifications relative to information presented in Section 4/10/3 (Surface Water Quality): • Please consider adding the last sentence in Section 4.10.3.3, which describes the factors that can contribute to lower dissolved oxygen, to Section 4.10.3.2. The same factors contribute to fluctuations in both dissolved oxygen and pH, with low dissolved oxygen and high pH contributing to impairments.	Thank you for your comment. The clarifying text has been incorporated into the Section 4.10.3.2.

12.07	WAT	As described in the draft EA, the HDPE Piping Alternative could result in a decrease in groundwater recharge (Section 6.10.2.4). Groundwater recharge, in the form of springs entering the Deschutes River downstream of Lower Bridge Road and the Crooked River downstream of Hwy 97, provides an important source of cold water to the rivers. The figure below shows the thermal profile of the Deschutes River from a thermal infrared survey conducted on 7/26/2001 (Aerial Surveys in the Deschutes River Basin, Watershed Sciences, 2002, http://www.oregon.gov/deq/FilterDocs/deschutes.pdf). In this figure, Bend is indicated on the right-hand side of the figure and the confluence with Lake Billy Chinook is on the left-hand side. The little red squares indicate spring inputs and show the magnitude of the cooling effect that these springs have on the Deschutes River. Section 6.10.2.4 in the draft EA suggests that the reduction in recharge from lining or piping TID canals would not have a significant impact on groundwater recharge, referencing earlier reports by Gannett and Lite. From conversations with OWRD staff, it has always been our understanding that canal piping will have an effect on groundwater recharge and flow into the middle Deschutes River, the lower Crooked River, and lower Whychus Creek. The volume and location of the effect is less clear. It should be noted that these groundwater flows have been elevated for some time now, due to the canal leakage. A reduction in groundwater recharge through piping might represent a return to more "natural" groundwater flow conditions; however, river flows are still much lower than they would be under "natural" conditions. With river temperatures being warmer than under natural conditions, the cool water provided by the springs is important for aquatic life.	Section 6.10.2.4 of the Plan-EA identifies that canal and lateral piping would affect groundwater levels. As noted in the Plan-EA, data suggest that the combined effects of climate and groundwater pumping have had a much greater impact than piping, with piping contributing to approximately 10 percent of the observed decline in groundwater levels (Gannett and Lite 2013). The analysis in the Plan-EA assumes that effects of piping on groundwater resources would continue to be minor relative to the effects of climate variation and groundwater pumping. Reference: Gannett, M.W. & Lite, K.E. Jr. (2013). Analysis of 1997–2008 Groundwater Level Changes in the Upper Deschutes Basin, Central Oregon (Scientific Investigations Report 2013-5092). Reston, VA: U.S. Geological Survey.
12.08	WAT	DEQ understands that USGS has been working to revise some of the earlier groundwater models, and we would encourage the incorporation of new groundwater information as it becomes available. If it is determined that piping results in significant loss of cold water to the middle Deschutes River, lower Crooked River or lower Whychus Creek, we recommend that alternatives or mitigation options be considered to offset that impact.	At the programmatic level, watershed planning documents are reviewed at regular intervals (approximately five years). This review ensures that conditions remain as described and that any changes in information or conditions that might result in a new or altered finding are identified early on and addressed. A new groundwater model and associated studies, if developed and published, would be identified and incorporated during this review.
12.09	WAS	While there are likely positive benefits in the reach of the Deschutes River between the North Canal Dam and Lower Bridge, the piping could result in a negative impact on the Deschutes River between Lower Bridge and Lake Billy Chinook. As described in Response #3, above, this reach of the river sees the addition of a significant amount of water in the form of springs. Because of the importance of these springs to the designated values of both the middle Deschutes River and lower Crooked River, the Bureau of Land Management conducted a series of ecological surveys of the springs from 2004-2008. Previous communications with Michelle McSwain (former BLM hydrologist in Prineville), indicated that the BLM did have concerns about the possible effects that piping could have on Wild and Scenic River values for both the middle Deschutes River and the lower Crooked River.	Please see response to comments 12.07 and 12.08. BLM was contacted on November 13, 2018 to discuss any outstanding concerns regarding Wild and Scenic River values. Per the subsequent conversation with BLM, the effects to the Wild and Scenic outstandingly remarkable values have been clarified and are discussed in Section 6.13.2.
12.10	PRMT	Section 8.6.2 describes state permits that might be required for the project, including an NPDES permit from DEQ. To be more accurate, we suggest the following changes to that section, with changes indicated in red text. **Department of Environmental Quality:** The National Pollutant Discharge Elimination System program, implemented by ODEQ, would require a stormwater permit for construction activities including clearing, grading, excavation, materials or equipment staging and stock piling that would disturb one or more acres of land and have the potential to discharge into surface waters or conveyance systems leading to surface waters of the state ~~a public waterbody~~. The two project groups of the Preferred Alternative would each disturb more than 5 acres, but neither of them has the potential to discharge into waters of the state. ~~discharges into a public waterbody.~~	Thank you for your comment. The clarifying text has been incorporated into Section 8.6.2.

12.11	PRMT	Section 8.6.3 describes Federal permits/compliance, including mention of Section 401 of the Clean Water Act. Under Section 401, the document states "Implemented by ODEQ, see above". It is unclear where "above" is referring to.	Thank you for your comment. The language in Section 8.6.3 of the Plan-EA has been modified for clarification.
13.01	RES	Oregon Department of Agriculture appreciates the opportunity to review and offer comment on Draft Watershed Plan-Environmental Assessment for the Swalley Irrigation District (Swalley ID or the District) Irrigation and Modernization Project (the proposed project). The need for Federal action is address the watershed problems and resource concerns: • Water loss in the District conveyance systems; • Periodically unreliable delivery of irrigation water, and inefficient operations; • Periodic low instream flow for fish and degraded aquatic habitat quality; and • Increasing risk to public safety from open irrigation canals. The purpose of the proposed project, which is also the Preferred Alternative, is to improve water conservation, water delivery reliability, and public safety along 16.6 miles of District-owned canals and laterals, and the proposed project is among efforts on the part of Deschutes Basin Board of Control (DBBC) and Swalley ID to substantively improve flow magnitude and quality in the Deschutes River system. Swalley ID and the USDA NRCS (NRCS) identified and considered a broad range of project alternatives that would address the purpose and need in a variety of ways. The selected preferred alternative includes piping 16.6 miles canals and laterals; new pump and pump station; and metered deliveries. The steps to modernize and increase water and energy use efficiencies is estimated to reduce water loss to seepage, evaporation and spills by 6,171.61 acre-feet annually. Swalley ID will use the State of Oregon's Allocation of Conserved Water Program, and transfer 75% of the 6,171.61 acre-feet, or 4,628.71 acre-feet, that is estimated to be saved through project implementation to an instream water right with the same priority date as the original Swalley ID water right; 1899. In contrast to simply reducing the District diversions by 4,628.71 acre-feet, the instream water right is permanent and it legally protects the conserved volume of water instream from appropriation for other beneficial uses. Resource Concerns In general, the Preferred Alternative (i.e., the proposed Swalley ID Modernization Project) potentially provides a wide range of benefits associated with the need and purpose of the project. Potential concerns stem from inherent climate variability and climate change. Climate variability inherent to the climate system, in particular the cyclic characteristics that last multiple decades (e.g., about 30 years) affects timing and magnitude water supply more than what is exhibited in the period of streamflow record, 1958-1987, used to establish the state's water availability system. Climate change has been and will continue to exacerbate differences in timing and quantity available for beneficial use. Different analytic methods and longer periods may be used to better characterize variability in historic observed stream flows, however it is important to recognize that the results are only representative for the period of record used in the analysis; they are not representative of conditions in the future, or even for conditions in history prior to the period of record used in the analysis. Other Western States have also been experiencing challenges, to varying degrees, associated with increasing asynchrony between actual observed water availability and the water availability established for systems of water resources administration and	Thank you for your comment.

		water rights. So the challenge is not unique to Oregon. According to a well-established relationship between increasing temperature and evapotranspiration (i.e., plant water use; ET) that is physically-based, shows that ET increases between 2.5% and 5% for each degree Fahrenheit increase in temperature. The Upper Grande Ronde River Watershed Partnership, one of the Place Based Planning water resources planning pilot projects, a program managed by the Oregon Water Resources Department, conducted estimates of current and future water demands for agriculture and other sectors. Estimating future demands for irrigated agricultural included two components: 1) Improve irrigation systems to the most efficient method appropriate for the location; 2) Estimate future crop water demand, using a Penman-Monteith model and projected temperatures for 2068 (i.e., 50 years in the future) for the RCP 8.5 climate change scenario, the high emission scenario that observed/measured emissions have tracked or exceeded for at least the past 20 years. Results showed that the quantity of water saved by implementing more efficient irrigation methods about equal to increased crop water demand.	
14.01	GEN	I have been a paying patron of SID for close on 50 years. In 1969, I built my house and shop on property adjacent to the Rogers lateral. While I have not lived there continuously since then, all four of my children were born and raised there, and they, my three grandchildren, and my wife and I continue to use and enjoy the property and its surroundings. During those years, we have irrigated several acres of pasture, had horses, raised some cattle, and generally benefitted from SID's role in water delivery. At one point, we also directed a few of our water rights back to in-stream use. So before I go further, I want to acknowledge the value Swalley's commitment to both Deschutes watershed health and efficient water delivery to its patrons.	Thank you for your comment.
14.02	WILD	While I understand that as a utility, Swalley has strong incentives to emphasize values of economy and efficiency, I want to speak to other values which need to be respected, values which more fully define our lives in Central Oregon. These values are tangentially mentioned in the Draft Watershed Plan, but I feel they need to be stated more explicitly. I want what will be lost on the record. I refer to emotional, experiential, and aesthetic values. I believe I speak for many people in stating these values contribute in large part to our choice of Central Oregon as a place to live and raise our children. It's why we're here. Perhaps like others, I have come to think of our lateral not as a ditch, but a stream. It looks like a stream, smells like a stream, and sounds like a stream. Perhaps I have been fooled into that perception, but others have been fooled too: mallards, Canada geese, dragonflies, mink, yellow swallow-tail butterflies, warblers, orioles, mayflies, caddisflies, and swallows. A lot of wildlife has been fooled. These things, these valuable things, are going to be lost to those of us lucky enough to live close to Swalley's open, moving water. This is merely a partial list, and does not even speak to the indefinable experience of peace, balance, and vibrancy that we experience under the influence of the running water. Our 'stream' may not be natural, but it is nonetheless magical. I realize that this perspective is not the normal province of an irrigation company, but I want it on the record.	Thank you for your comment. The required National Economic Development Analysis, included as Appendix D.1 of the Plan-EA, quantifies the costs and benefits of the proposed project. Aesthetic, emotional, and experiential values could not be quantified due to insufficient data. Although the visual change for property owners and recreationists are discussed in Sections 4.9 and 6.9 of the Plan-EA, the value associated with this change could not be monetized. With the exception of nesting bald or golden eagles, the phasing of the project is expected to allow airborne wildlife ample time to adapt to a new water source. See Section 4.12 and 6.12.2 for more detailed information about terrestrial wildlife and best management practices regarding threatened and endangered species.

14.03	CONS	I want you to appreciate that it's a big loss; a significant loss of emotional, experiential, and aesthetic value. So I want to ask you and all those who will be carrying out this project, to respect those values as much as possible before, during, and after construction. Realize that all your patrons are not alike, that they have individual properties and perspectives. I want to emphasize the need to remain good neighbors and stewards of our communal environment, and urge you to work in close cooperation with your patrons as you and your contractors execute this plan. Listen to us and work with us to make this change as agreeable as possible. Thank you.	Thank you for your comment.
15.01	GEN	Thank you for the opportunity to comment on the Draft Watershed Plan-Environmental Assessment (EA) for the Swalley Irrigation District Irrigation Modernization Project. The Deschutes River Conservancy was formed in 1996 with a mission to restore streamflow and water quality in the Deschutes Basin. The DRC works collaboratively with diverse partners to implement projects and programs to achieve this mission. To date, the DRC and its partners have restored upwards of 250 cfs instream in the Deschutes Basin. Conservation projects have contributed significantly to these outcomes, specifically, using the State of Oregon's Allocation of Conserved Water Program to legally protect water permanently instream. Swalley has an impressive track record of aggressive conservation efforts which have restored, to-date, 43 cfs permanently instream in the Middle Deschutes River. The DRC has a long history of partnering with Swalley on projects and will continue to support Swalley's efforts to implement future projects.	Thank you for your comment.
15.02	WAT	The DRC strongly supports Swalley's plan to pipe up to 16.2 miles of canals and laterals, which will save up to 6,172 ac re-feet of water. The DRC understands and acknowledges Swalley's intention to retain 25 percent of this saved water to address delivery shortages for patrons and to maintain a reliable supply of irrigation water for agricultural needs. The DRC strongly supports Swalley's plan to protect 75 percent of the total water saved by the project from April 1 to October 31 as instream flow in the middle Deschutes River using the State of Oregon's Allocation of Conserved Water Program (Oregon Revised Statute [ORS] 537.470). This legally-protected water will improve streamflow, water quality, and habitat availability in the Middle Deschutes River	Thank you for your comment.
15.03	WAT	The DRC would encourage, upon completion of piping, a system review. If the district is able to serve its patrons with less water at that time, or monitoring post projects show greater water conservation than estimated at this time, the DRC would encourage Swalley to consider protecting additional water instream, given the serious water supply needs in the basin. One approach would be to state in the EA that Swalley will keep up to 25% to resolve operational issues and that 100% of the remaining saved water will be protected instream.	The District proposes to allocate 75 percent of the water saved through the project instream through Oregon's Allocation of Conserved Water Program and retain 25 percent of the water saved through the project, as permitted under ORS 537.470, to address water management and delivery challenges in the District. With a completed project and fully piped and pressurized water conveyance infrastructure, the District would only divert precisely the amount of water that its patrons need, when they need it. Any water not needed by patrons at any given time would remain instream and available for other uses and users as a function of the pressurized system.
15.04	GEN	The DRC supports and applauds Swalley's continued commitment to conservation and instream flow restoration. It looks forward to helping support Swalley's implementation of this System Modernization Project.	Thank you for your comment.

16.01	PURP	Thank you for the opportunity to comment on the Draft Environmental Assessment ("EA") for the Swalley Irrigation District Irrigation Modernization Project ("Project"). Central Oregon LandWatch ("LandWatch") is a conservation organization which has advocated for preservation of natural resources in Central Oregon for over 30 years. With over 200 members in Central Oregon, LandWatch has worked on water resource issues in the Deschutes River Basin and in gaining special protection for Whychus Creek and the Metolius River and spring systems. LandWatch has lately been particularly concerned about flows in the Upper Deschutes River, the impacts of the management of the irrigation diversions from the River, and maintenance of flows in the River's key tributaries. We continue to be interested in supporting an efficient irrigation- based farming community throughout Central Oregon. LandWatch is pleased that Swalley Irrigation District ("District") is taking efforts to restore natural flows to the Deschutes River. However, we have several concerns with the EA's preferred alternative, including the actual amount of water that will be conserved, verification of conserved water, amount of water that will be transferred for instream use, and the failure to consider other alternatives. These and other concerns are described below. Purpose and need of Project The Draft EA describes the purpose of the Project as "to improve water conservation, water delivery reliability, and public safety" on District-owned canals and laterals." Draft EA at 12. Public Law 83-566 authorizes federal assistance for only Projects that fit at least one of eight listed purposes: Flood Prevention, Watershed Protection, Public Recreation, Public Fish and Wildlife, Agricultural Water Management, Municipal and Industrial Water Supply, Water Quality Management, and Watershed Structure Rehabilitation. National Watershed Program Manual Title 390, Part 500, Section 500.3(B). In which of these eight purposes does the Project fit? We encourage the District to include Public Fish and Wildlife as a purpose of the Project. Improved streamflows for the benefit of fish and wildlife are widely understood to be a primary motivating factor for water conservation Projects in Central Oregon. Our state's congressional delegation agrees. The life cycle and biological needs of fish and wildlife species that depend on flows in the Deschutes River should be the baseline goal for analyzing the benefits and consequences of the Project. Framing the Draft EA around this purpose would provide the proper analysis to show the public whether the Project will serve the purpose of improving habitat for fish and wildlife.	The Preferred Alternative meets the Agricultural Water Management purpose. See the Office of Management and Budget Fact Sheet p. xix and Section 8.2 in the Plan-EA. Watershed projects are sponsored by one or more local organizations (SLO) who meet certain criteria (National Watershed Program Manual Title 390, Part 500, Section 500.11). Based upon the request for assistance, NRCS assists the SLO in conducting the preliminary investigation and report (PIR) for determining the feasibility of a proposed action and its potential eligibility for the program. The SLO's request for assistance and PIR is used to develop the purpose and need statement, balancing the breadth and specificity of the watershed problems and resource concerns identified in the PIR, while accommodating a range of reasonable alternatives as required by NEPA and the P&Gs. Per 390-NWPH, Part 601, Subpart D, Section 601.34A, it is necessary to include at least one eligible program purpose within the purpose and need, of which "Agricultural Water Management" is identified as one. Agricultural Water Management was selected as the only appropriate authorized purposes due to the type of measures that would be included in the project. The PL 83-566 authorized project purpose of "Public Fish and Wildlife" is defined in the National Watershed Program Manual Title 390-500. Title 390-500 states that, "Fish and wildlife development areas may be included in a watershed project plan when the SLO agrees to operate and maintain a reservoir or other area for public fish and wildlife access. Measures installed for public use of areas developed to improve the habitat or the environment for the breeding, growth, and development of fish and wildlife may be included in a watershed project plan" (USDA 2015). The proposed project does not include the measures described; therefore, "Public Fish and Wildlife" would not be an appropriate authorized project purpose. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). (2009). National Watershed Program Manual Title 390-500. Website: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010704.pdf. Accessed November 2, 2018.
16.02	WAT	Operational losses The Draft EA states that the preferred alternative will conserve 19.2 cfs by preventing "seepage through the porous underlying soils, evaporation, and other conveyance inefficiencies." Draft EA page 12. The District's System Improvement Plan, at Section 3.3 System Loss Assessment, states that measured system losses on all district-owned canals and laterals was 20.1 cfs. The System Loss Assessment "included the main canal and the associated system laterals." What explains the difference between these two numbers?	Clarifying language has been added as footnotes to Section 4.10.4 and Table 5-2 in Section 5.3.2. Additional clarifying language has been added to Appendix E.6.

16.03	WAT	Operational losses Currently, the District diverts more water than required for on-farm duties in order to deliver water through a leaky system. Do either the 19.2 cfs or 20.1 cfs water savings include operational losses, such as carry water, that are currently required to deliver water to all patrons? What are the "other conveyance inefficiencies" mentioned in the draft EA?	The 19.2 cfs water savings (see response to comment 16.02) includes seepage and evaporation losses. Any water not ultimately delivered to patrons may occasionally and rarely be operationally spilled into ponds or onto non-productive lands at the ends of the District's system for very short durations while adjustments at the District's headworks and primary diversion are made in order to avoid flooding and damage to property. These are typically emergency-type scenarios. These spills were not quantified in the Plan-EA, as they are occasional and inconsistent. "Other conveyance inefficiencies" was incorrectly included in this Plan-EA in reference to Swalley Irrigation District, Central Oregon Irrigation District, and Tumalo Irrigation District. This term has been removed from Section 2.1.1 and Section 6.14.2.3.
16.04	WAT	Operational losses A fully piped system would eliminate the need for carry water to achieve full deliveries. We request a commitment that all losses (including seepage, evaporation, and operational losses) that would be prevented by the Project be transferred instream through the Oregon Allocation of Conserved Water statute. We understand that a few cfs (for carry water) might need to be retained in the interim while the system is being piped to assure deliveries, but at Project completion, all water conserved by the Project should be transferred instream.	Please see the responses to comments 11.02, 11.03, and 15.03.
16.05	WAT	Accounting of conserved water The District should not rely on preliminary estimates of the amount of water the Project will conserve in its calculation of the amount of water the District will transfer to the State for instream uses. Rather, the District should measure actual amounts of water diverted before the Project, and actual amounts of water delivered to and used by patrons after the Project. The total amount of water transferred instream should be the difference between these two numbers, as this will be the actual amount of conserved water that should be transferred to the state via the Allocation of Conserved Water program at ORS 537.465. Indeed, the Allocation of Conserved Water statute demands this method. A good example of such water savings that the Draft EA appears to not include in its estimate of 19.2 cfs water savings is carry water, as discussed above. Once the system is fully piped, the difference between the amount of water diverted before the Project and the amount of water used by patrons after the Project should be transferred instream.	The District measured seepage and evaporation losses throughout its open canals and laterals prior to the development of the Plan-EA. The District's seepage loss study, which appears as Appendix A to the Swalley Irrigation District System Improvement Plan (SID 2017), documents these measured losses. The District assumes that incrementally modernizing its canals and laterals would incrementally eliminate these losses, and the District projected the water savings associated with the proposed project based on incrementally eliminating these seepage and evaporation losses. Past water conservation projects throughout the Deschutes Basin have developed conserved water rates and volumes based on seepage and evaporation loss measurements. These projects have completed the Oregon Water Resources Department's administrative process necessary to allocate the conserved water instream through Oregon's Allocation of Conserved Water Program. The District suggests that each phase of the proposed project follow this proven approach. Please see the response to comment 16.03 regarding carry water and operational spills. Reference: Swalley Irrigation District (SID). (2017). Swalley Irrigation District System Improvement Plan. Bend, Oregon: Swalley Irrigation District.
16.06	WAT	Amount of water allocated instream As public money is sought to fund infrastructure improvements for the District and its patrons, the public should realize the maximum benefit from the Project. 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. Rather than increase deliveries of water to private water patrons with 25% of the water conserved by the Project, the District should commit to transferring 100% of water conserved by the Project to instream uses.	Please see response to comments 11.02 and 11.03.

16.07	ALT	Range of alternatives The draft EA only considers two alternatives: the no action alternative and the preferred alternative. 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 alternative preferred by the sponsor. 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. 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. The results from the recently completed Deschutes Basin Study Work Group study show 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 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 ("For alternatives that were eliminated from detailed study, the rationale for this elimination will be provided."). National Watershed Program Manual Title 390, Part 500, Section 501.12(A)(2). For example, the draft EA, at page 69, excludes piping of private laterals from consideration because "SID lacks the statutory authority or responsibility to carry out, operate, and maintain private laterals owned by SID patrons." This is not true. ORS 545.287 specifically allows an irrigation district to upgrade private laterals: "When improvements for the distribution or delivery of water to any tract of land are not owned by the district and the owner or person in control of the improvement fails to maintain, repair or replace the improvement as required for the proper and efficient distribution or delivery of water to any tract. … When the interest or convenience of such tracts requires the construction, repair or maintenance of any ditch, flume, dike, aqueduct or other improvement, the board may construct, repair or maintain the improvement." A Project that proposes benefiting private patrons by increasing water deliveries should not exclude alternatives that would conserve water through upgrades to private patrons' infrastructure.	Per the USDA's Guidance for Conducting Analysis under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water and Resource Investments (USDA 2017), "After preliminary consideration, agencies may remove from detailed study those alternatives that do not achieve the Federal Objective and Guiding Principles. In addition, alternatives that may at first appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, social, or environmental reasons may also be eliminated from further analysis." Alternatives falling under Section 5.2 were not carried forward for further analysis because they became "unreasonable" when evaluated against the four criteria laid out in the guidance. They were also evaluated on whether they met the objectives of the sponsors. The HDPE Alternative carried forward was the only alternative that both met the sponsors' objectives and was not unreasonable after being evaluated against the four criteria. The studies and reports associated with the Deschutes Basin Study are draft-level documents that have not been fully vetted and approved by the Basin Study Work Group and the Bureau of Reclamation. As such, they are not ready for incorporation into or reference in the Plan-EA (Relf, personal communication, 2018). However, the preliminary draft information discussed through the Basin Study process can help to inform public discussion (M. Relf, personal communication, July 12, 2018). Preliminary draft information from the Basin Study also suggests that private ownership creates coordination, authority, and other logistical challenges for actions that would take place on private land. Pursuant to the authority conveyed to Oregon irrigation districts by ORS Chapters 540.420, 540.430, 540.440, 545.221, 545.237, 545.279, 545.287, and 545.293, and the case law interpreting these provisions, the District is empowered to enter onto patrons' properties to improve, maintain, or replace certain irrigation systems and infrastructure beyond the District's point-of-delivery when, in the District's estimation, this involvement in systems and infrastructure beyond the point-of-delivery is necessary to avoid water waste, inefficiency, detrimental practices, conflicts, and/or non-use that threatens the efficient, consistent, and reliable delivery of irrigation water to the District's patrons. The interpretation and implementation of this statute presented in the comment would present political, legal, and logistical private property challenges that would need to be overcome for successful implementation. Over time, statutory authority could be utilized to work toward creating a private delivery system improvement plan such as the District has for its infrastructure, but funding is not currently available to create such a comprehensive plan at this time. If PL 83-566 funds were used to develop and implement this plan, the use of these funds would require the District to obtain landowner permission to complete all the necessary NEPA steps and requirements, including doing a SHPO/NHPO analysis on a private taxlot-by-taxlot basis, as well as permission to then operate and maintain the system, including acquiring easements to do so, once it was piped per PL 83-566 authorities. This approach is not logistically feasible at this time and would increase costs beyond those discussed in the draft information provided through the Deschutes Basin Study. It is these logistical challenges associated with private ownership and the failure to fully meet the sponsors' objective, in addition to the requirements of PL 83-566, that contribute to voluntary duty reductions, private lateral piping, and on-farm improvements not being ripe for further consideration within the Plan-EA. Additionally, language has been added for clarification. Please see Sections 5.2.4, 5.2.5, and 5.2.6 for a further discussion of voluntary duty reductions, private lateral piping, and on-farm improvements, respectively.

17.01	PURP	Trout Unlimited (TU) appreciates the opportunity to provide comments on the draft Watershed Plan-Environmental Assessment (draft EA) for Swalley Irrigation District's (SID) Irrigation Modernization Project (Project). The Project seeks to pipe 16.6 miles of canals and laterals to improve water conservation, water delivery reliability and public safety. The Watershed Plan, when complete, will enable the Natural Resource Conservation Service (NRCS) to access funding for irrigation improvements through the PL-566 program (Watershed and Flood Prevention Program). TU is a non-profit organization with a mission to conserve, protect and restore North America's coldwater fisheries and their watersheds. With more than 300,000 members and supporters nationwide, TU works to restore wild trout, salmon, and steelhead and their watersheds throughout the U.S. TU has over 3,000 members in Oregon and over 550 in its local Deschutes Redbands Chapter. Restoring instream flows to the Deschutes River and its tributaries is a key objective of TU and its members. To that end, TU engaged in the Upper Deschutes Basin Study (Basin Study), a collaborative effort intended to help resolve long-standing water management issues. Irrigation improvements were identified in the Basin Study process as a key part of any long-term solution and TU commends SID for pursuing the planning, funding and implementation of these improvements. TU is also very appreciative of prior SID conservation projects which have restored 43 cfs of flows in season 3 in the middle Deschutes. SID has been a leader in conservation efforts in the middle Deschutes and TU is very encouraged by many elements of the Project. However, to better ensure that the Project proceeds in a transparent and broadly supported manner, TU is providing the following comments and requests for clarification. By addressing each of them, TU believes the final Watershed Plan and Environmental Assessment (final EA) will be a more complete and understandable document. Purpose and Need TU appreciates that the draft EA includes "water conservation" among its stated purposes. (Draft EA, p. xx.) However, to improve clarity, TU recommends that the stated purpose identify that water conservation is for the purpose of permanently restoring flows to the Upper Deschutes River for the benefit of instream resources. Additionally, to better align the draft EA's purpose and need statement with the PL-566 "Authorized Project Purpose", we recommend that "Public Fish and Wildlife" be added as a PL-566 "Authorized Project Purpose."	Please see the response to comment 16.01.

17.02	WAT	Project Description Conserved Water The draft EA notes that a key element of the Project is the dedication of a portion of the conserved water to instream uses. Specifically, the Project intends to protect 75% of the total amount of water conserved to instream flow in the Middle Deschutes River. The draft EA notes that the remaining 25% of water conserved will be utilized to address delivery shortages and maintain a reliable supply of irrigation water for agricultural needs. TU appreciates that the draft EA has assured that (1) 75% of the water conserved as a result of proposed modernization actions will be returned to the river for instream uses and (2) the State of Oregon's Allocation of Conserved Water Program (CWP) will be utilized to ensure the water returned to the river is permanently and legally protected. Generally, to ensure conservation actions effectively and efficiently contribute to a broad-based water management solution in the Deschutes Basin, TU supports the permanent and legal protection of 100% of conserved water to instream use. The water supply needs in the Basin are significant and all districts should be maximizing the amount of water that can be dedicated instream from conservation actions given the level of biological need and the extensive amount of public funding support expected to be contributed to these projects. However, TU recognizes SID's specific need to ensure it has sufficient supply to reliably meet its existing delivery needs consistent with current water rights authorizations. Accordingly, TU supports up to 25% of conserved water being utilized for this purpose but we request that SID consider the clarifications and modifications described below. First, TU requests that SID commit to dedicating a higher percentage of conserved water instream if it determines in the future that it is able to meet its delivery supply shortages with less water than projected in the draft EA. This would necessitate a review by SID of its system and projections following the completion of the Project.	Please see the response to comment 15.03.
17.03	WAT	Second, TU requests that the draft EA clarify that SID will not seek to expand or enlarge its existing water rights to utilize the conserved water consistent with its assurance that no water saved by the Project will be used to irrigate new acreage. These additions will help ensure that the maximum amount of conserved water is dedicated instream and SID's water delivery needs are met.	The District will not seek to expand or enlarge its water right to use the water saved by the Project to irrigate new acreage. Please see Section 2.2.1 of the Plan-EA.

17.04	WAT	Calculation of Conserved Water It is broadly-accepted that conservation actions are a key part of a long-term water management solution for the Deschutes Basin. Accordingly, a wide-range of stakeholders support the allocation of public funding for their development and implementation. This diverse support is, in large part, fueled by the fact that this significant investment will permanently return "wet" water instream to an over-allocated river system. Given that the instream component of these projects is so central to their wide-ranging support, it is critical that the watershed plans contain a clear and defensible methodology for determining the conserved water amount. Additionally, such information should be presented in a way that is understandable to the average stakeholder given that the watershed plans and draft EAs are the main (and most recent) public disclosure document regarding these projects. Unfortunately, the draft EA for the Project contains several inconsistencies and omissions that make it extremely difficult to understand how the projected conserved water volume was determined. TU recommends that the final EA itself (without requiring reference to other documents) include a clear and concise explanation that supports its projected conserved water volumes. Pursuant to the Oregon Allocation of Conserved Water program, a determination of conserved water volume requires an understanding of relevant water rights, existing system capacity and the water required to satisfy existing beneficial uses both before and after Project completion.	Please see the response to comment 17.07.
17.05	WAT	See Oregon Revised Statutes section 537.455. As the loss calculation is significant part of this analysis, TU recommends that the SID commit to verify the loss calculation prior to Project implementation.	Thank you for your comment. The District does not plan to re-measure seepage and evaporation losses prior to the construction of each phase of the proposed project. However, if TU wishes to invest in additional water loss measurements, the District would welcome the opportunity to work with TU to do so.
17.06	WAT	As part of the explanation regarding how the projected conserved water volumes were determined, various inconsistencies should be explained in the final EA including the elements described below. The 2016 Systems Improvement Plan (SIP) notes that "measured losses" is 20.1 cfs. However, 19.2 cfs is noted as the direct loss calculation in Appendix E of the draft EA. This discrepancy should be explained.	Please see the response to comment 16.02 regarding the difference between the 20.1 cfs and 19.2 cfs referenced in the comment. Clarifying language has been added to Table 5-2 and to Appendix D.6.
17.07	WAT	Various methodologies are utilized for determining direct loss measurements across different years and different seasons. The final EA must clarify which methodology is being used to determine direct loss measurements in all seasons. If different methodologies are used for different seasons, the document must explain why. If one loss value is being utilized for all seasons, the document must explain why it is appropriate to extrapolate that value across all seasons (despite different characteristics of the different seasons including seasonal seepage rates, canal flow rates etc.).	Please see additional language in Appendix D.6 regarding the calculation of water savings.

17.08	IRA	The draft EA includes several different irrigated acreage calculations ranging from 3204 to 4333 acres and many of these acreages differ from those presented in the SIP. Additionally, it appears that neither the draft EA or the SIP contains the most current information on the acreage values associated with certificated water rights. The final EA should clarify the acreage value being utilized for the purposes of calculating the conserved water volume. Current water rights information should also be provided in the final EA.	The 3,204 acres included in Section 5.3.2 was incorrect and has been updated. Acreage values included elsewhere in the document have been verified. These values vary depending on the year the data were gathered and what the data represent in the Plan-EA. Data included in the Plan-EA were selected to most accurately characterize resources and the potential effects of the proposed project on those resources. Additional footnotes have been added to Table 4-4, Table 4-5, Section 1, and Section 4.10.1 to clarify the differences between acreage values. The 4,333 irrigated acres presented in the Plan-EA was the same number presented in the District's System Improvement Plan (SID 2017) and is based on information provided by the District. Acreage values were not used for the purposes of calculating the volume of water that would be conserved by the project. See the responses to comments 16.02, 17.04, and 17.07 and language added to Appendix D.6 for additional discussion about loss measurements, water savings, and conserved water. Reference: Swalley Irrigation District (SID). (2017). Swalley Irrigation District System Improvement Plan. Bend, Oregon: Swalley Irrigation District.
17.09	MAP	Project Map To improve clarity regarding the proposed Project, TU recommends that the final EA include a map that identifies all the piping project segments and includes their name. Such a map was provided in the 2016 Final System Improvement Plan and TU believes this would allow stakeholders to more easily cross-reference maps with the tables that are currently in the draft EA and appendices. Additionally, it would be helpful for the final EA to include a map of "prime farmland" acres to help stakeholders more fully understand the value of piping different segments.	Thank you for your comment. The suggested project maps have been added to Appendix C of the Plan-EA.
17.10	WAT	Groundwater Mitigation The draft EA notes that the Project will not "use" groundwater mitigation credits. TU recommends that the final EA clarify that the Project will not "create" groundwater mitigation credits.	Thank you for your comment. The clarification has been made in Sections 3.4 and 6.10.2.4 of the Plan-EA.

17.11	ALT	Alternatives The final EA should include a broader range of alternative measures to meet the objectives of the Project. Specifically, we recommend that the final EA more fully develop an alternative that includes additional conservation actions identified by the Deschutes Basin Study Workgroup (BSWG) including measures to improve the efficiency of farm operations. These actions can be further analyzed as part of another alternative or as a stand-alone alternative. The justification provided in the draft EA for not considering these alternative measures is inadequate. TU believes a more thorough review of these alternative measures is warranted. Pursuant to NEPA, all "reasonable alternatives" that meet the purpose and need must be analyzed. Alternatives are not limited to actions that the Project proponent can control. In fact, that National Watershed Program Manual notes that "all 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." See section 501.12 (A)(1), National Watershed Program Manual, 4th edition, 1st Amendment (January 1, 2015). The conservation actions identified by the BSWG will help meet the Project purpose and need. Thorough consideration of their effects in the final EA will help ensure that they can be incorporated into the Project now or in the future if it makes sense.	Please see the response to comment 16.07.
18.01	WAT	There are many concerns that should be had with this project, including: 1) If all irrigation canals in the area are piped, the ground water will most likely take a huge hit, which could further cause problems with domestic wells in the area. The study for the projects show that most of the water loss is through seepage into the ground, which is most likely impacting the water table throughout Central Oregon. If that seepage into the ground water is eliminated, local wells could run dry, which would have drastic economic impacts to the local economy. If wells are no longer able to supply domestic water to the people of Central Oregon, where is drinking water going to come from?	Please see the response to comment 3.04.
18.02	WILD	2) The wildlife patterns in the area are going to change drastically. The canals are used by migratory birds, raccoons, deer, and every other animal in the Central Oregon ecosystem for water, food, and transportation means. I have even found Western Pond Turtles swimming in the canals. Piping the canals will result in all of the animals relying solely on the river and patron stock ponds, which puts a higher impact on the Swalley Irrigation members. It will also cause a change in animal patterns, which could increase public safety concerns if animals are moving along roadways to reach water more often.	Please see Sections 4.12 and 6.12 for a discussion of wildlife resources and the potential effects of the proposed project on those resources.
18.03	CONS	3) The direct impact to the local patrons during the construction time can highly impact more than solely the canal. The impact will affect cisterns, houses, fences, pumping stations, ponds, and other structures along the canal. Are there are measures being taken to ensure that, although there is a large easement, that the construction is kept to the least impact possible? If the construction is not kept to a minimum, the project's cost for patrons having to clean up after the project would increase dramatically if patrons have to fix or rebuild anything destroyed by the contractor. The company hired to complete the project needs to be held accountable for every aspect of the project to ensure the project does not end up costing more than what is accounted for in the projects budget.	Please see the response to comment 5.14.
18.04	ENRG	4) How will piping project effect the usability of the hydroelectric plant during construction timing?	SID operates its hydroelectric plant only when the District diverts and delivers water for irrigation and stock use. Project construction would occur outside of the irrigation season, limiting the effects of construction on hydroelectric power production. The effects to hydroelectric power production after the construction of each project group are discussed in Appendix D in the NED Section 2.1.4.

19.01	PURP	The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Watershed Plan Environmental Assessment (EA) for the Swalley Irrigation District - Irrigation Modernization Project (Project) within Oregon's Deschutes Basin. Thank you for the opportunity to provide comments during your National Environmental Policy Act (NEPA) process for the Project. The Service supports piping the canals and laterals, and is eager to see the resulting conserved water returned to the Deschutes River. The Service has been leading a large scale, conservation planning effort for water management that will benefit threatened and endangered species in the Deschutes River Basin in Central Oregon. The goal of this planning effort is to develop an Endangered Species Act (ESA) Habitat Conservation Plan (HCP) under section l0(a)(l)(B) of the ESA that provides non-Federal parties the opportunity to conserve the ecosystems upon which listed species depend, ultimately contributing to their recovery. The Deschutes Bain HCP (DBHCP) has been in development for a number of years and includes eight Central Oregon irrigation districts (constituting the Deschutes Basin Board of Control), the City of Prineville (collectively the Applicants), as well as other stakeholders and interested parties. The Applicants' goal is to complete the planning process in 2019. The goal of the DBHCP is to manage water in the Deschutes River Basin in a manner that addresses the long-term certainty for water users but provides necessary water for species covered by the plan [(Oregon spotted frog (Rana pretiosa), bull trout (Salvelinus confluentus), and steelhead (Oncorhynchus mykiss), sockeye salmon (Oncorhynchus nerka) and spring Chinook salmon (O ncorhynchus tshawytscha)]. One of the various tools available for the Applicants' conservation approach is to modernize their existing irrigation infrastructure, and return the conserved water instream to support the conservation of the covered species. The Deschutes Basin HCP does not prescribe which conservation tool the Applicants must use, rather it is designed to set a series of flow milestones in the future that the Applicants must meet using all available tools. Currently, low flows in the Deschutes River Basin result in myriad impacts to fish and wildlife resources. Water management that alters water levels has reduced habitat suitability for the covered species, specifically the Oregon spotted frog. Increased flows are necessary to meet the life history demands of this and other covered species. Further, low flows impact water quality in the Deschutes River by increasing temperature and decreasing dissolved oxygen. Less than optimal water quality often contributes to the spread and extent of invasive aquatic species (plants and wildlife), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River. The Service is providing you with the following comments in the context and spirit of our mutual ongoing efforts and responsibilities to conserve listed and unlisted species. Purpose and Need Section 2 of the EA, Purpose and Need for Action, highlights the primary considerations for the Project. "The purpose of this project is to improve water conservation, water delivery reliability, and public safety on up to 16.6 miles of District-owned canals and laterals." While the Service is supportive of these objectives, given the long-term potential use of this Project, we believe the Purpose and Need may limit the scope of the Project. The limited scope may preclude the use of other available conservation tools. Broadening the Purpose and Need statement to include benefits to agriculture as well as conservation benefits for fish and wildlife will provide greater opportunity to use all available tools for conservation.	Please see the response to comment 16.01.

19.02	ALT	Alternatives The alternatives each evaluate specific approaches to modernization that will yield conservation. Since the conservation need is so great, the Service supports use of all tools available for conservation. We recommended considering an approach which allows for the greatest flexibility over time to conserve water and return it to the Deschutes River. The Service supports the Preferred Alternative (Alternative 2); however, given the long-term nature of the Project and the high conservation need, we suggest using a more integrated approach. While the Service wants to see the piping commence, the funding opportunity that PL 83-566 provides may also be used to achieve conservation through the use of other tools. If needed, the Service is happy to provide more substantive feedback about specific conservation tools that would complement the Project.	The proposed project would, when completed, eliminate existing water management challenges associated with open canals and laterals within the District (see Section 2.1.2 of the Plan-EA). A fully piped and pressurized system would facilitate the use of additional tools for conservation, and the District appreciates the offer of feedback regarding tools that would complement the proposed project. See the response to comment 5.12 for additional information on investing in other tools through PL 83-566.
19.03	WAT	Comments and Questions The Service has the following specific comments and questions about information presented in the draft EA that could be clarified in the final EA: The Service strongly supports Swalley's plan to pipe 16.6 miles of canals and laterals. Given volumes of water conserved and previous conservation projects, the Service understands the rationale to protect 75 percent of the total water saved by this particular Project from April 1 to October 31 as instream flow in the middle Deschutes River. However, the Service typically supports fully protecting all conserved water. If the operational needs of the district are met, the Service recommends that Swalley consider protecting the remaining 25% of the conserved water should that option become available.	Please see the response to comment 15.03.
19.04	WAT	Again, the Service is very supportive of piping canals and laterals, and appreciates NRCS' endeavors to facilitate those efforts through PL 83-566. In addition, we want to ensure that all tools remain available to achieve the great conservation gains we need to see in the Deschutes River.	Thank you for your comment. The proposed project would, when completed, facilitate the use of additional tools to meet water supplies and demands in the Deschutes Basin. The District expects that the proposed project would complement, rather than preclude, other efforts to apply other tools.

20.01	WAT	Re: Swalley Irrigation District's Draft Watershed Plan To: Whom it may concern The Coalition for the Deschutes fully supports the Swalley Irrigation District Draft Watershed Plan. While we strongly prefer that 100% of conserved water go back in-stream we understand the unique situation in the Swalley District and support their 75% in-stream/25% on-farm proposal. The mission of the Coalition for the Deschutes is to restore the Deschutes River to a healthy ecological condition. We are a river advocacy group that works in partnership with and supports the work of irrigation districts in Central Oregon so that we can have: • A healthy, restored Deschutes River • Thriving farms and sustainable agriculture • Robust and vibrant communities We understand that 75% of the conserved water will be permanently protected in the Deschutes River for the benefit of fish, wildlife and other aquatic resources. We feel this commitment should be independently monitored to ensure that the protected water remains in-stream. The Coalition for the Deschutes recognizes the direct link between the Deschutes and robust farms, fish and communities. Fish, families, and farms are all beneficiaries of irrigation modernization projects. We deeply appreciate the water conservation work that Swalley has already done and look forward to the many benefits of this project and to many more such projects in the future.	Thank you for your comment. Please see Section 2.2.1 of the Plan-EA regarding the measurement and protection of conserved water instream.
21.01	WAT	The Coalition for the Deschutes would like to add a supplement to our previous comment on the Swalley District Draft Watershed Plan. Two of our sister river advocacy organizations, DRC and Trout Unlimited, have suggested that Swalley assess the actual amount of water saved once their projects are complete and if, at that time, water needs decrease or water conserved exceeds the projections in the Watershed Plan that Swalley consider protecting that surplus water instream. This idea further supports the Coalition's desire to conserve as much water as possible instream and adds significantly to our comfort level in supporting Swalley's proposed 25% on-farm/75% instream water conservation proposal.	Please see response to comment 15.03.

Appendix B

Project Map

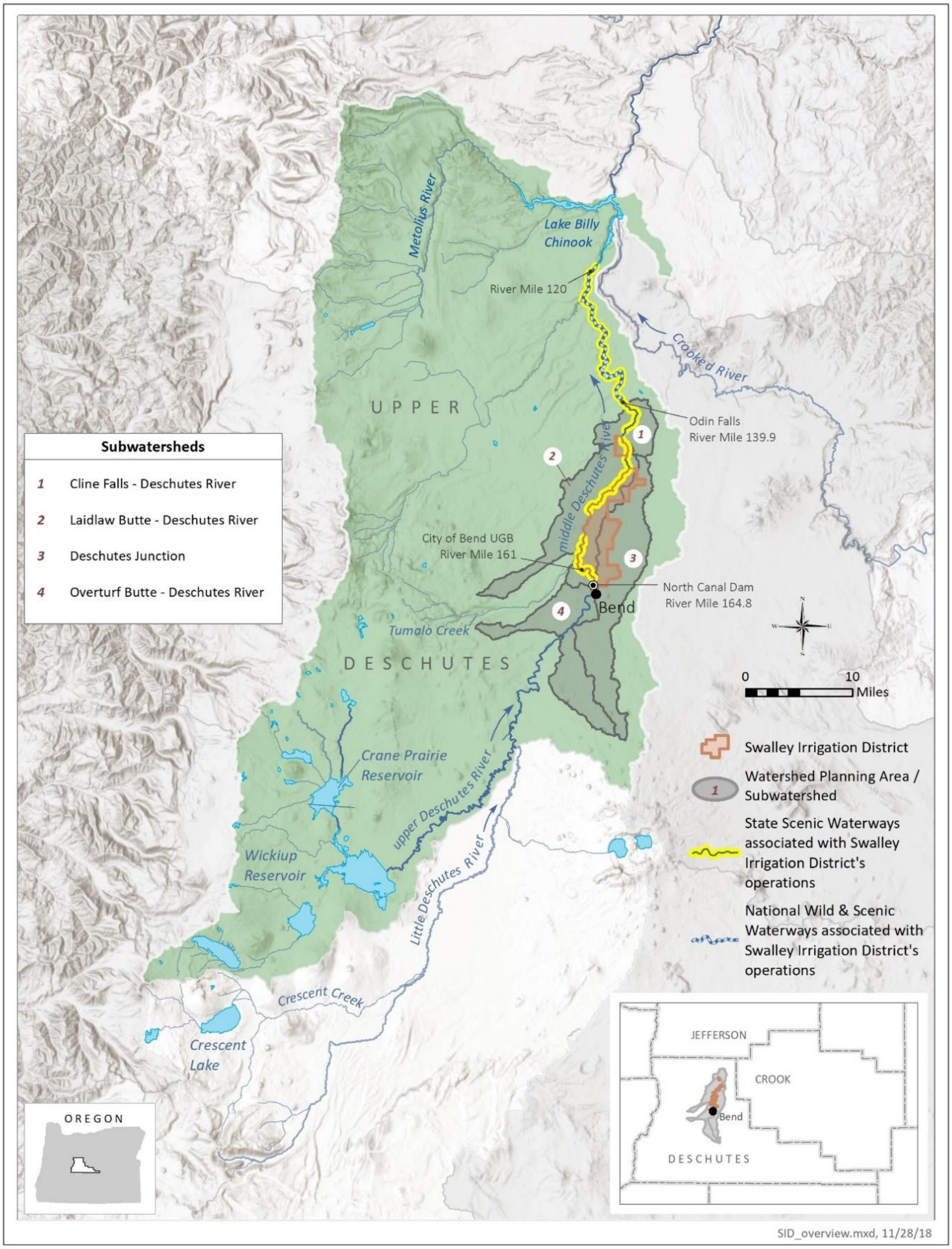

Figure B-1. The four watersheds within the Swalley Irrigation District watershed planning area.

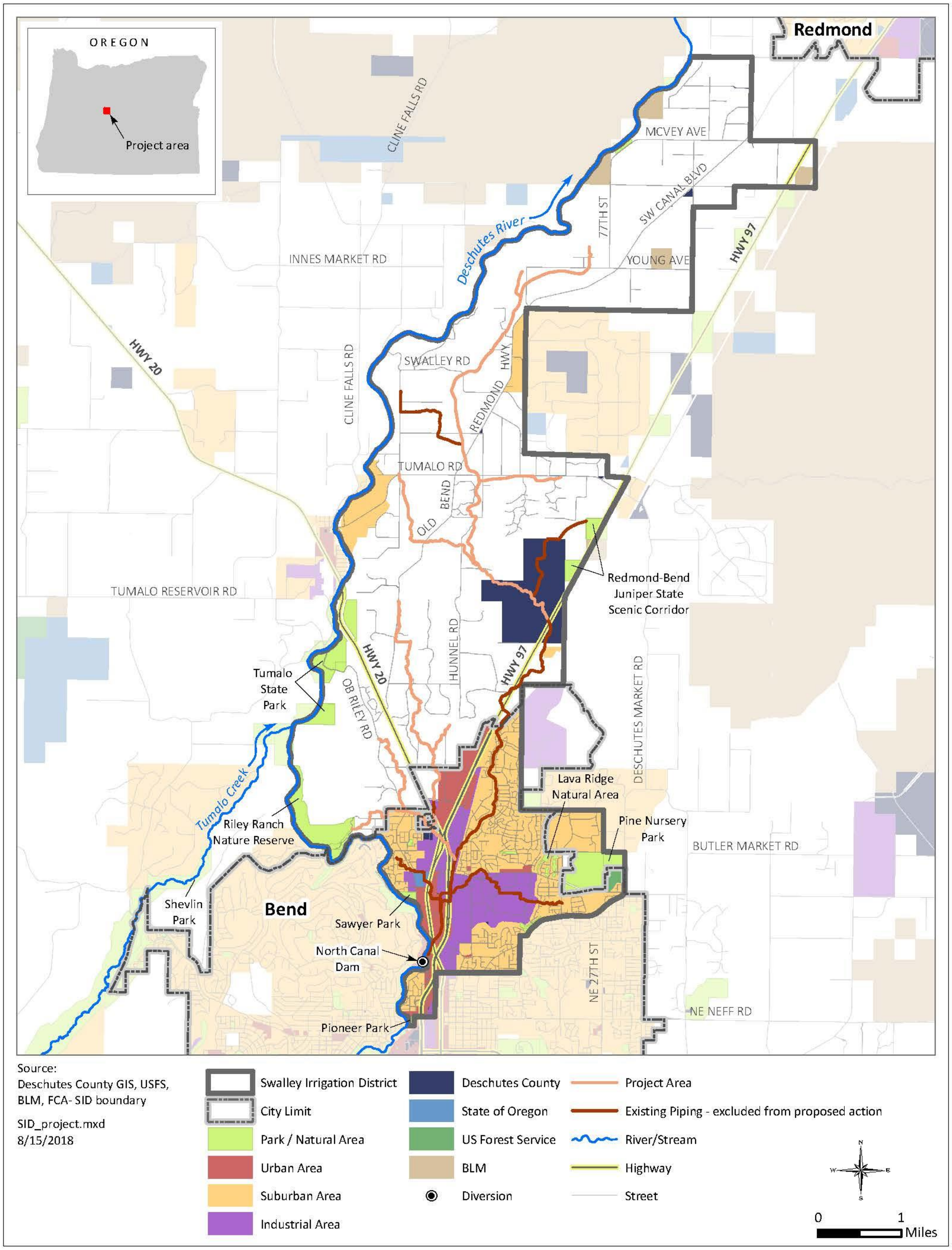

Figure B-2. Location of the Swalley Irrigation District Irrigation Modernization Project.

Appendix C

Supporting Maps

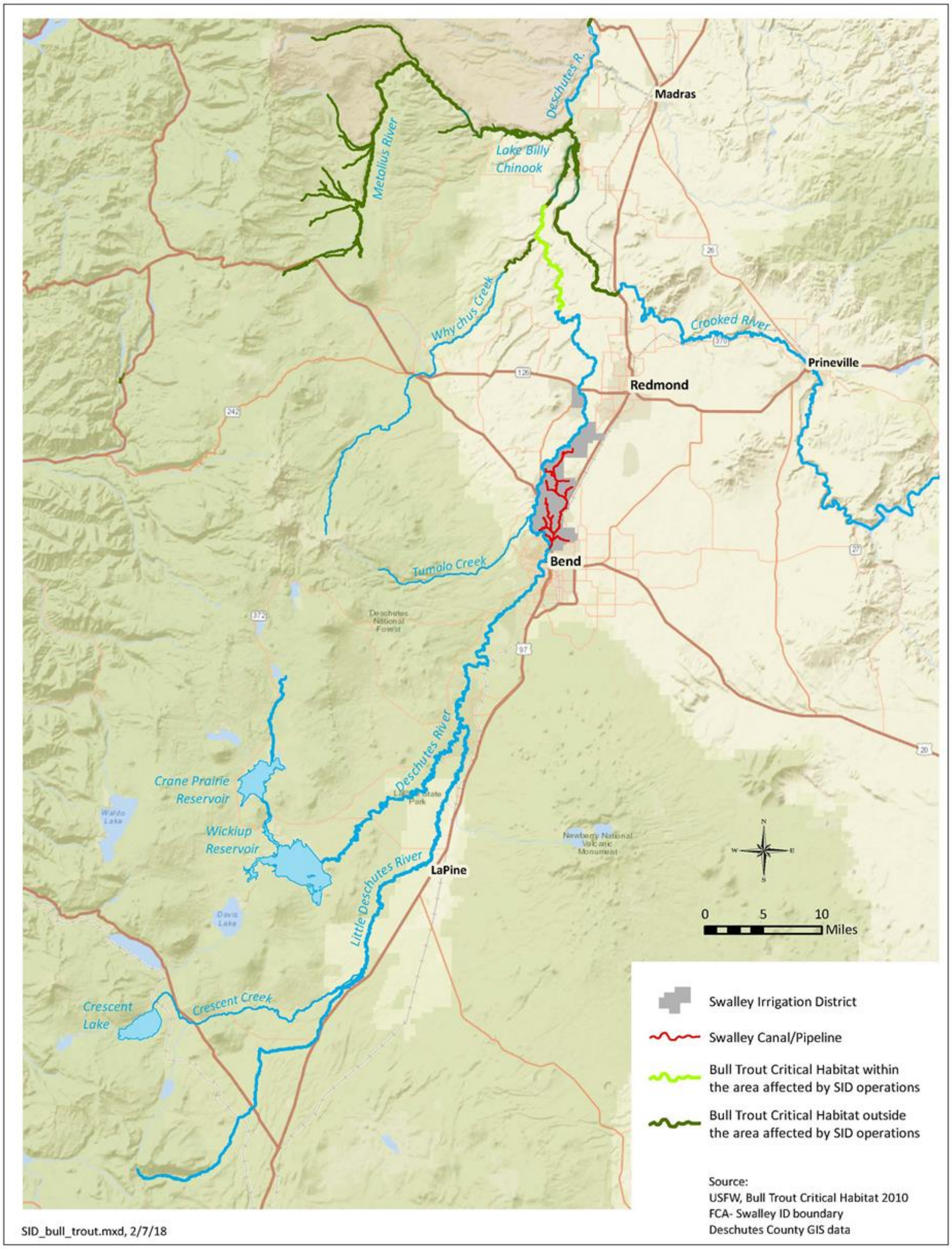

Figure C-1. Bull trout critical habitat near Swalley Irrigation District.

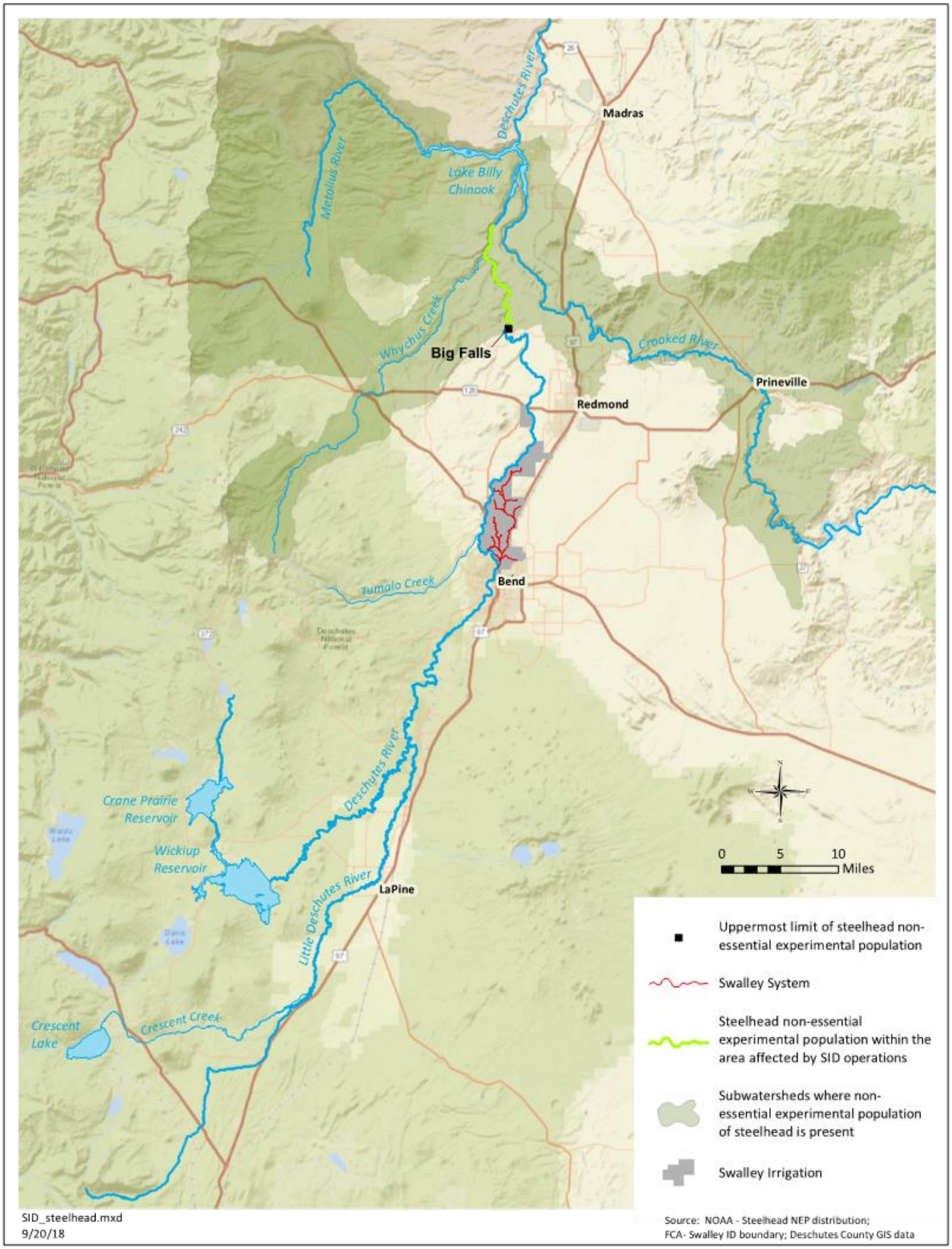

Figure C-2. Middle Columbia River steelhead population boundaries near Swalley Irrigation District.

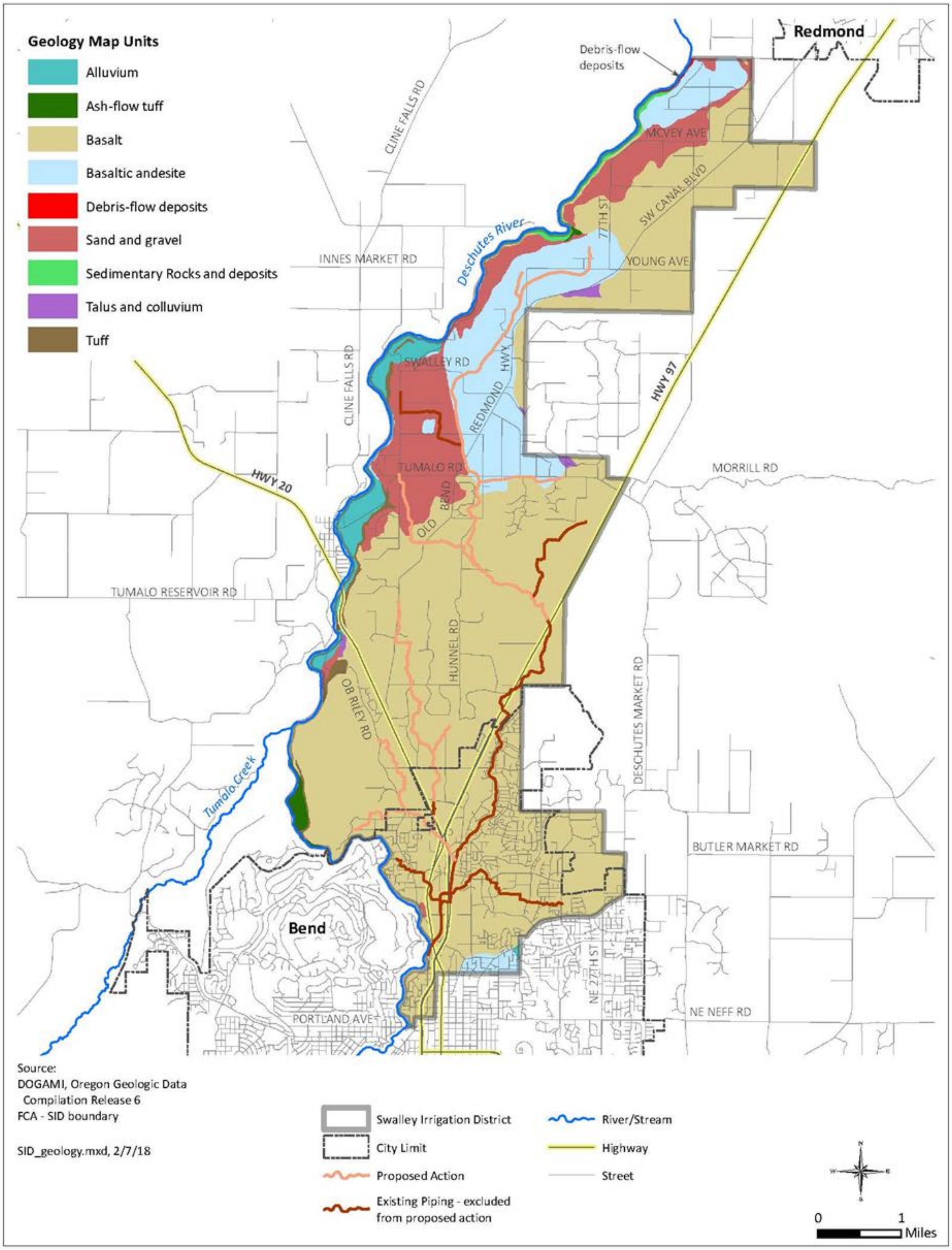

Figure C-3. Geologic formations in Swalley Irrigation District.

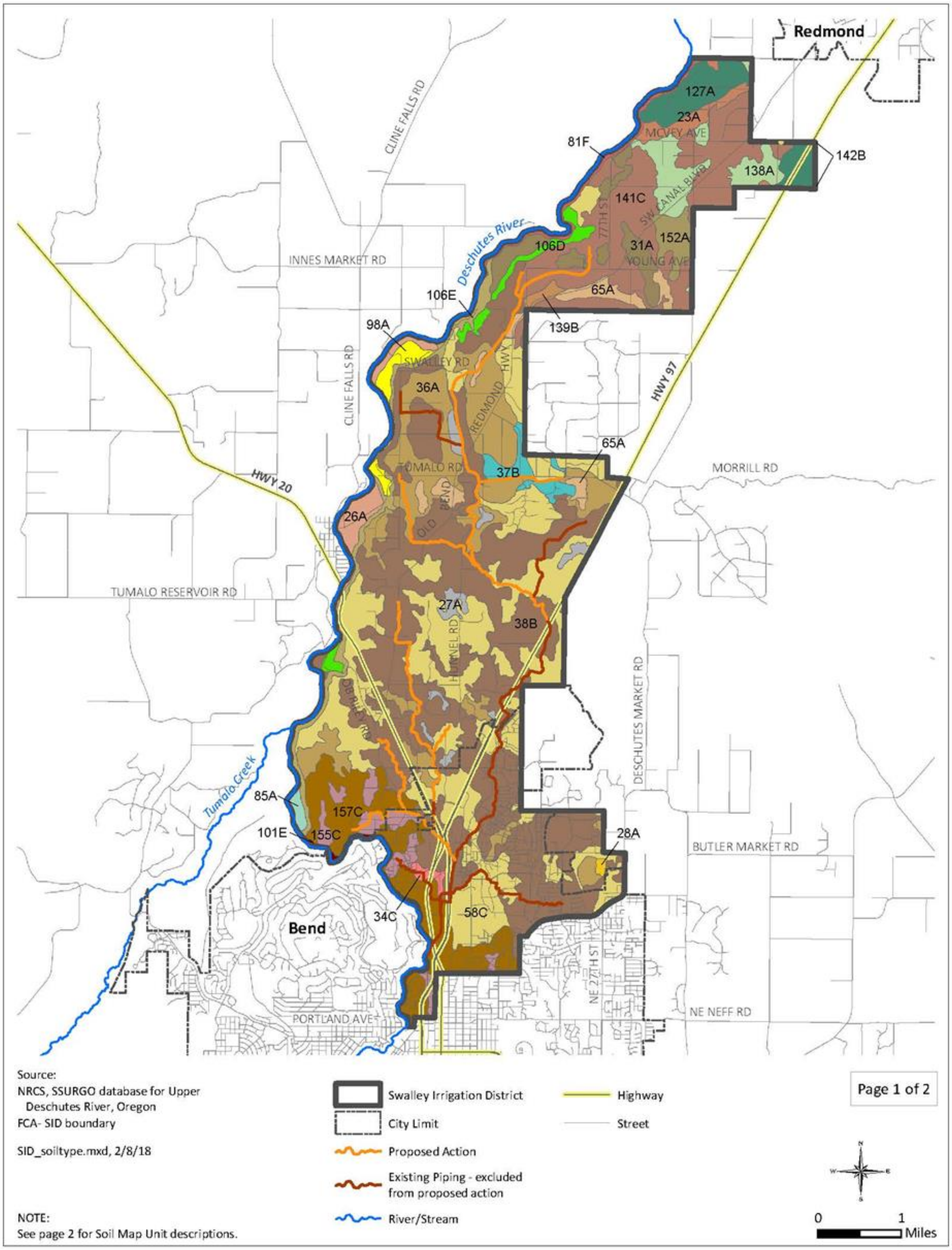

Figure C-4. General soil types in Swalley Irrigation District.

NRCS Map Unit Descriptions

Map Unit Symbol		Map Unit Name
23A		Buckbert sandy loam, 0 to 3 percent slopes
26A		Clinefalls sandy loam, 0 to 3 percent slopes
27A		Clovkamp loamy sand, 0 to 3 percent slopes
28A		Clovkamp loamy sand, bedrock substratum, 0 to 3 percent slopes
31A		Deschutes sandy loam, 0 to 3 percent slopes
34C		Deschutes-Stukel complex, 0 to 15 percent slopes
36A		Deskamp loamy sand, 0 to 3 percent slopes
37B		Deskamp sandy loam, 3 to 8 percent slopes
38B		Deskamp-Gosney complex, 0 to 8 percent slopes
58C		Gosney-Rock outcrop-Deskamp complex, 0 to 15 percent slopes
65A		Houstake sandy loam, 0 to 3 percent slopes
81F		Lickskillet-Rock outcrop complex, 45 to 80 percent slopes
85A		Lundgren sandy loam, 0 to 3 percent slopes
98A		Plainview sandy loam, 0 to 3 percent slopes
101E		Redcliff-Lickskillet-Rock outcrop complex, 30 to 50 percent south slopes
106D		Redslide-Lickskillet complex, 15 to 30 percent north slopes
106E		Redslide-Lickskillet complex, 30 to 50 percent north slopes
127A		Statz sandy loam, 0 to 3 percent slopes
138A		Stukel sandy loam, 0 to 3 percent slopes
139B		Stukel sandy loam, dry, 3 to 8 percent slopes
141C		Stukel-Deschutes-Rock outcrop complex, 0 to 15 percent slopes
142B		Stukel-Rock outcrop-Deschutes complex, dry, 0 to 8 percent slopes
152A		Tumalo sandy loam, 0 to 3 percent slopes
155C		Wanoga sandy loam, 0 to 15 percent slopes
157C		Wanoga-Fremkle-Rock outcrop complex, 0 to 15 percent slopes
W		Water

Page 2 of 2

Source:
NRCS, SSURGO database for Upper Deschutes River, Oregon

SID_soiltypelegend.mxd,2/8/18

Figure C-5. Legend for general soil types in Swalley Irrigation District.

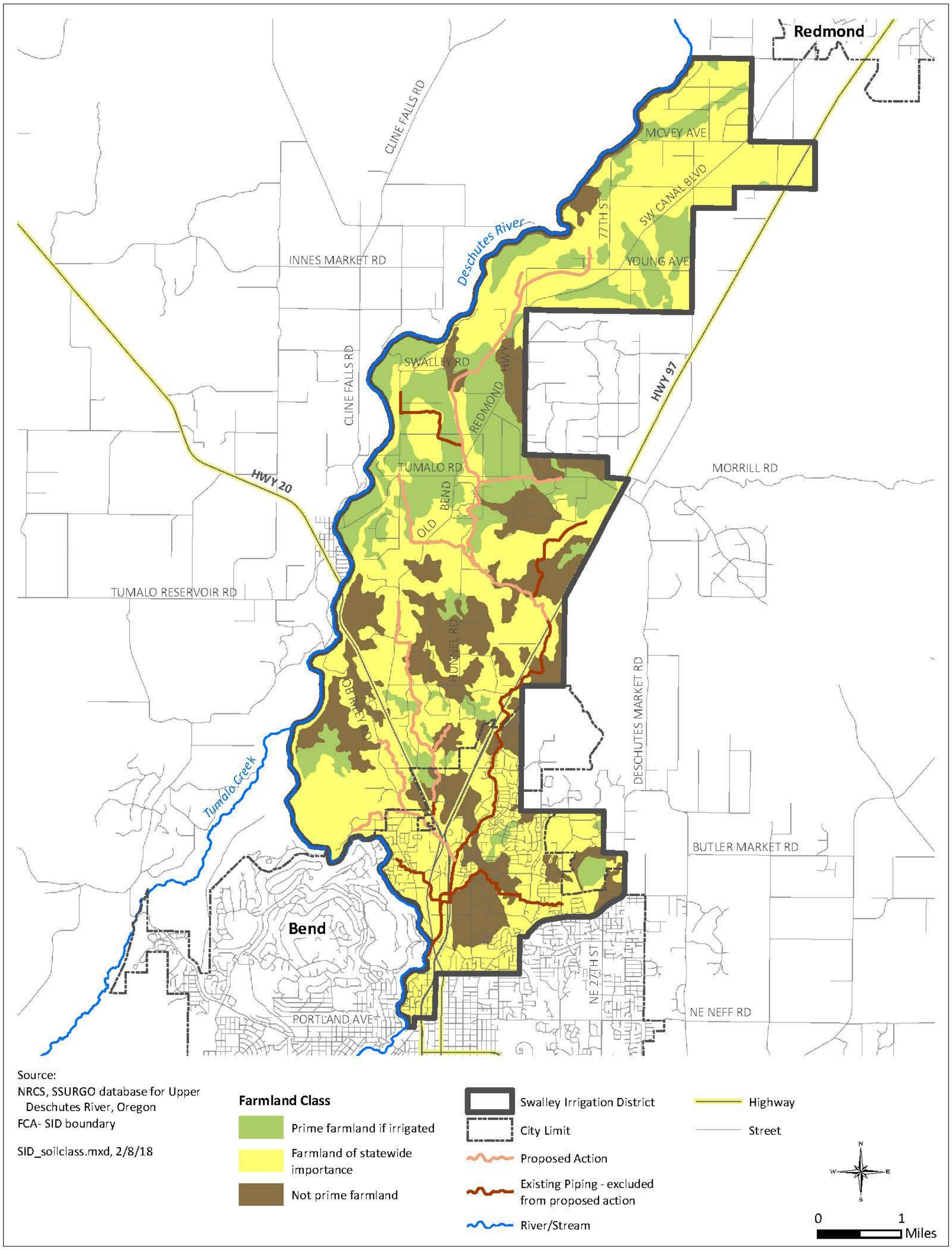

Figure C-6. NRCS classification of farmlands in Swalley Irrigation District.

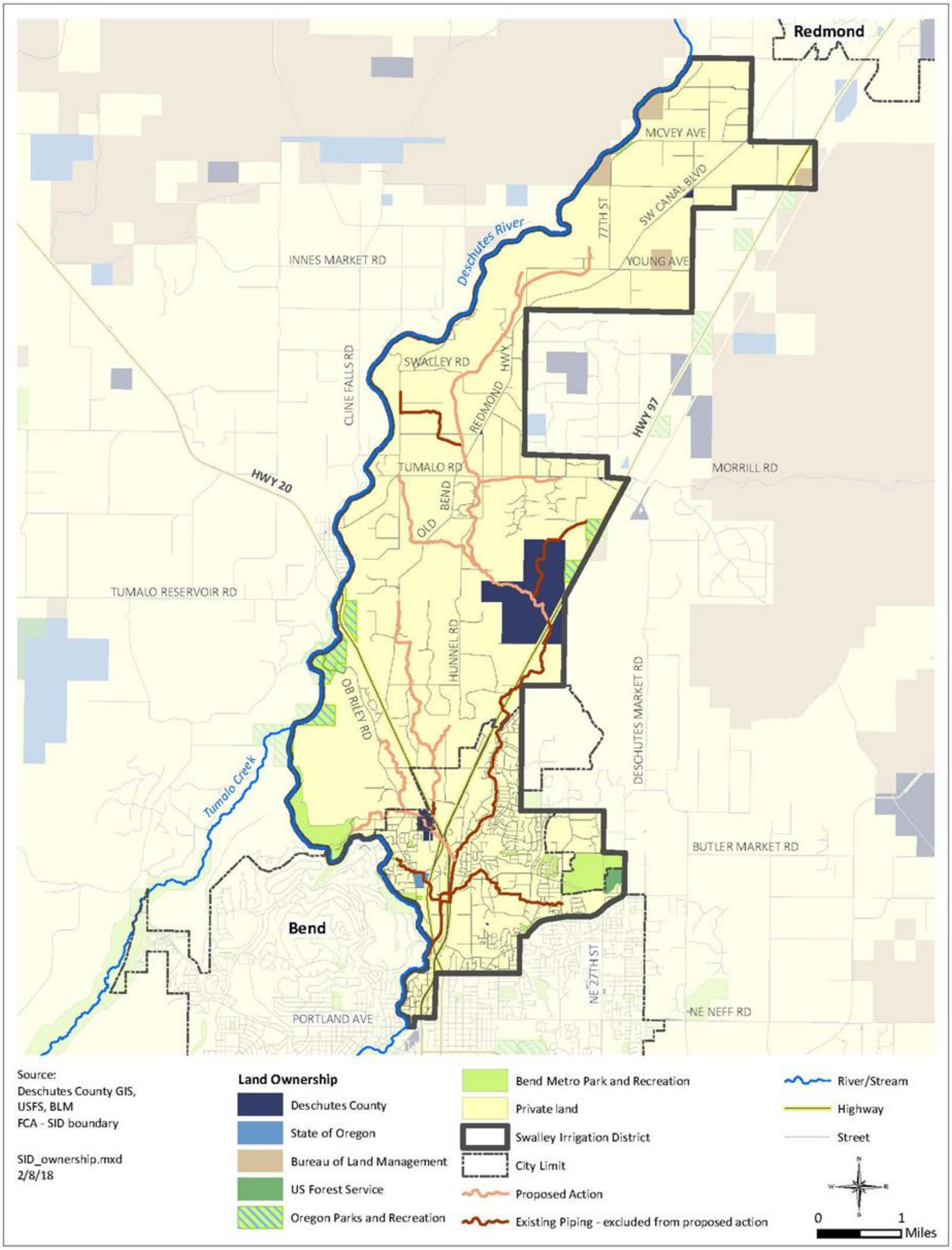

Figure C-7. Land ownership within Swalley Irrigation District.

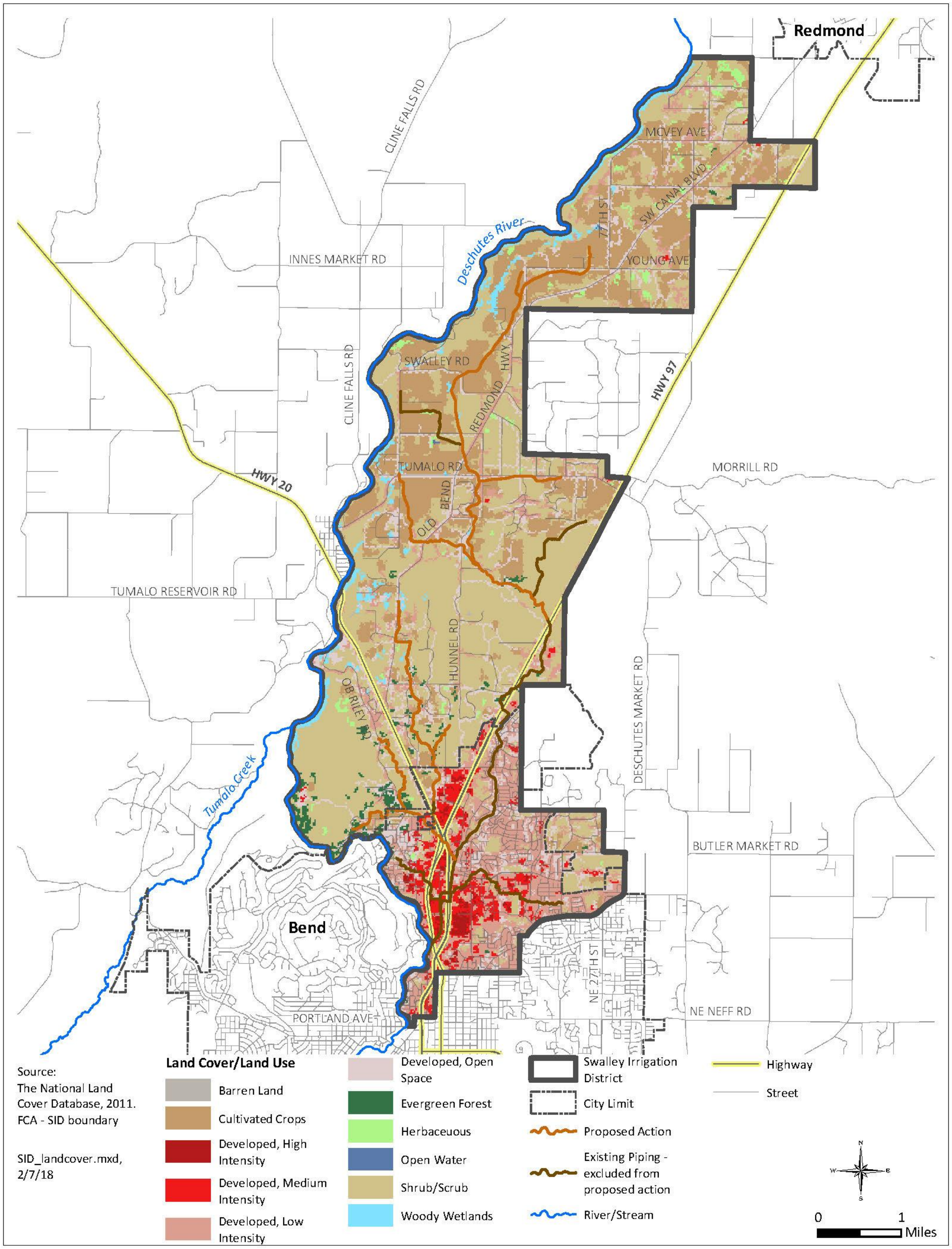

Figure C-8. Land cover/use within Swalley Irrigation District.

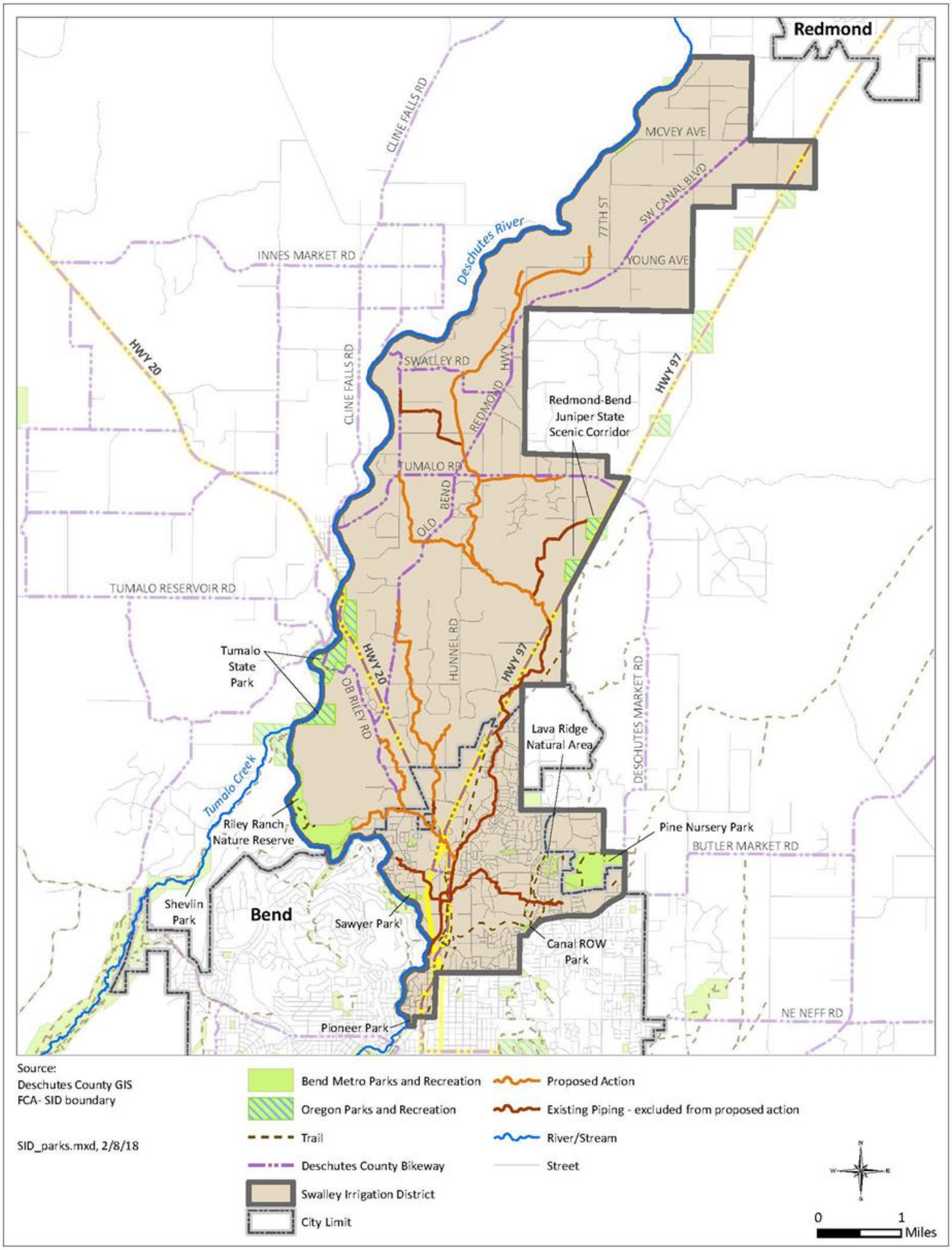

Figure C-9. Recreation map of parks, trails, and bikeways in Swalley Irrigation District.

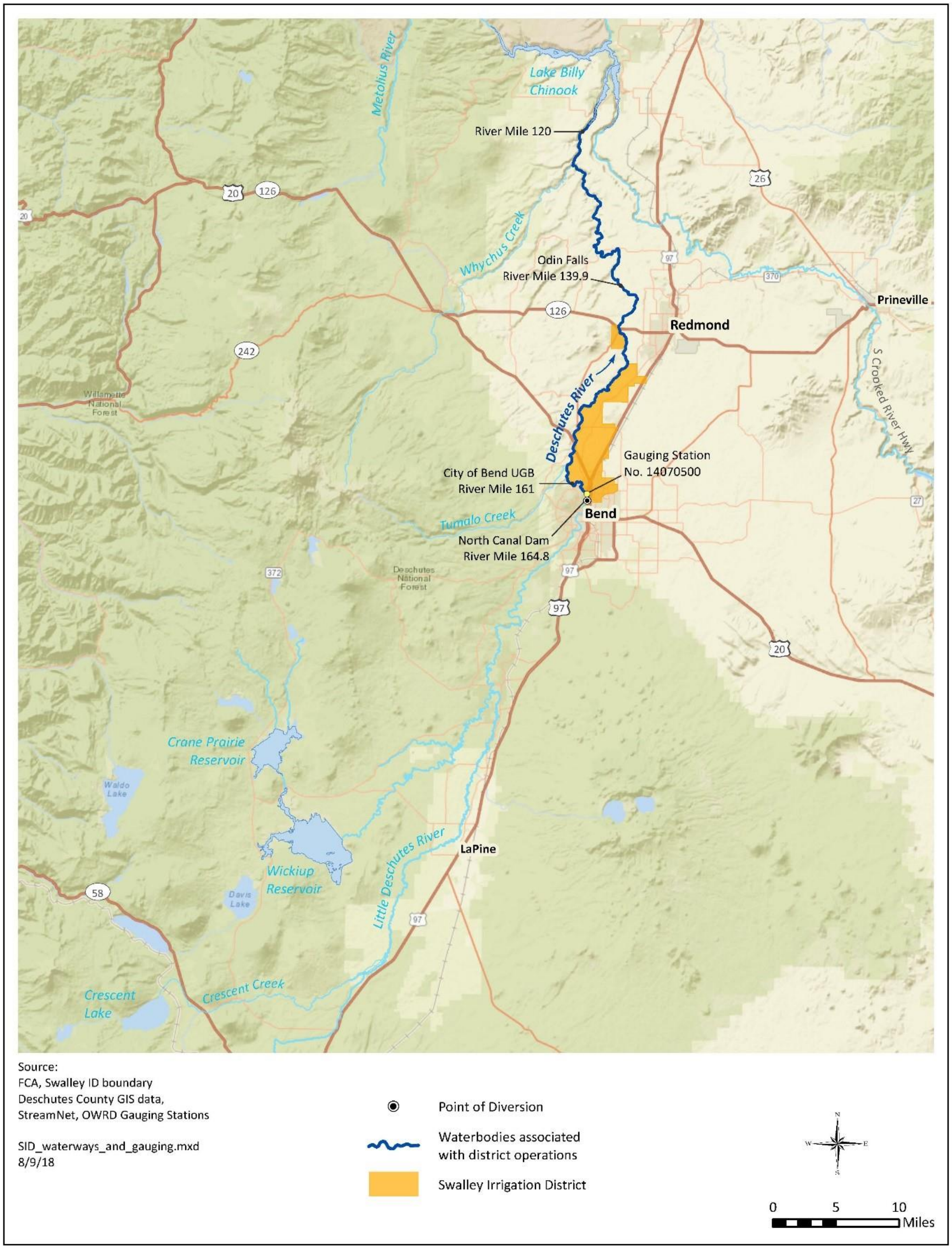

Figure C-10. Waterbodies and location of the OWRD streamflow gaging station associated with district operations.

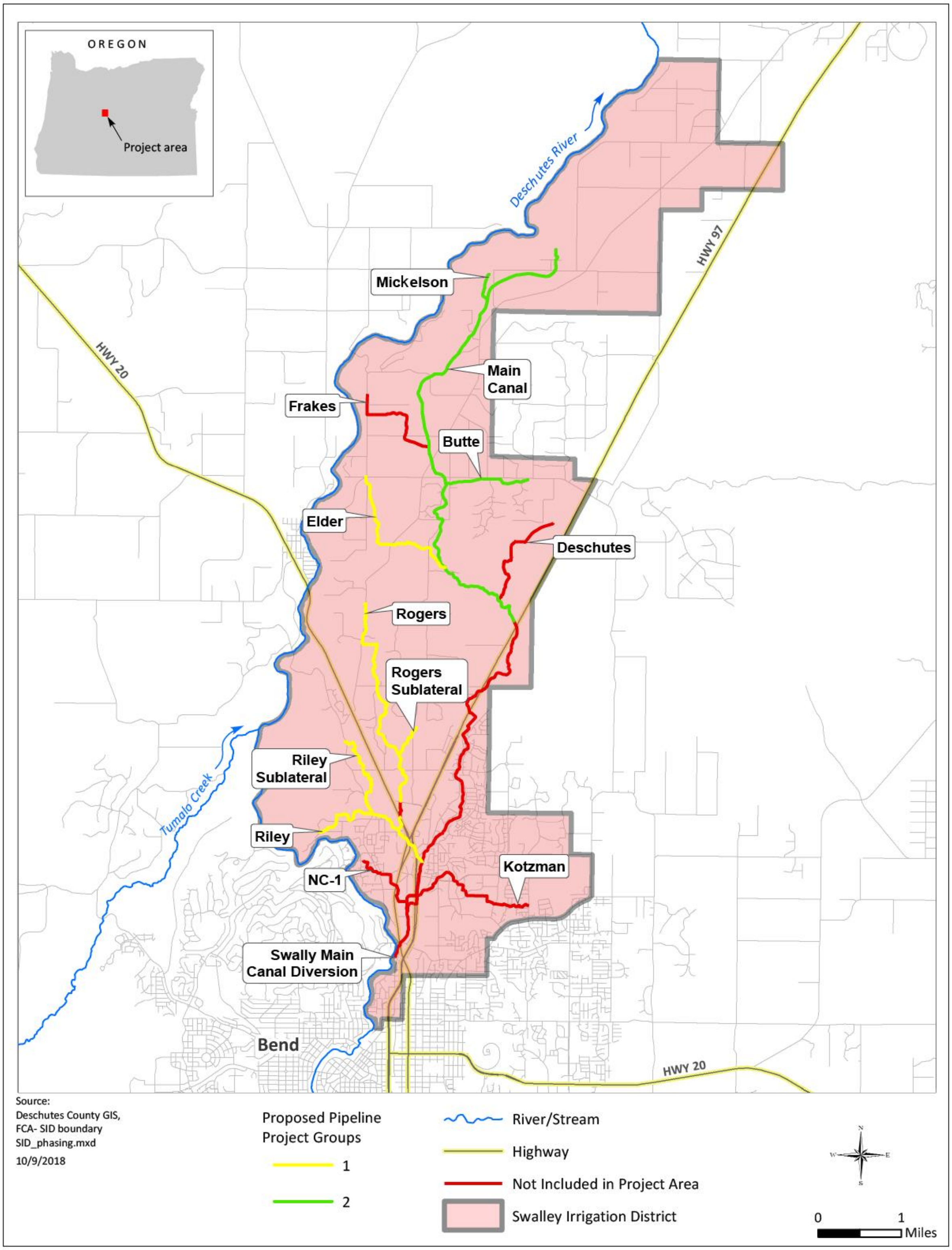

Figure C-11. The HDPE Piping Alternative project groups for the Swalley Irrigation District Irrigation Modernization Project.

Appendix D

Investigations and Analysis Reports

D.1 National Economic Development Analysis

Highland Economics LLC

National Economic Development Analysis

Barbara Wyse and Winston Oakley
9/5/2018

1 Benefits and Costs

This section provides a National Economic Development (NED) analysis that evaluates the costs and benefits of the high-density polyethylene (HDPE) Piping Alternative compared to the No Action Alternative (referred to as No Action). The analysis uses Natural Resources Conservation Service (NRCS) guidelines for the evaluation of NED benefits as outlined in the NRCS Natural Resources Economics Handbook and the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.

All economic benefits and costs are provided in 2018 dollars, and have been discounted and amortized to average annualized values using the 2018 federal water resources planning rate of 2.875 percent.

1.1 Analysis Parameters

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

1.1.1 Funding

Funding is expected to be provided through a combination of loans, such as the Clean Water State Revolving Fund, and grants through organizations such as the Oregon Watershed Enhancement Board and Oregon Water Resource Department. All funding sources other than the Watershed Protection and Flood Prevention Program, Public Law 83-566 are from non-federal funds.

1.1.2 Evaluation Unit

There are two proposed Project Groups[1] in the HDPE Piping Alternative. Each of the Project Groups could be completed as a stand-alone project and accrue the same benefits. As such, the Project Groups are defined as the evaluation unit, in which benefits and costs of implementation are assessed. Note that for the incremental analysis, costs for constructing any given Project Group would not change if it were the only Project Group constructed.

1.1.3 Project Implementation Timeline

At present, the timing of implementation of the HDPE Piping Alternative, or whether implementation will occur in Project Groups, is unknown, as this depends on the level and timing of project funding. Assuming SID is granted the funds, construction could be started as early as 2020 (Table 1-1). Based on conversations with the District manager, it is likely that construction will be completed over approximately 7 years. Both Project Group 1 and Project Group 2 are likely to be constructed over several years. In most cases, the analysis assumes that full benefits are realized the year after the lateral or canal construction is completed (e.g., for the Rogers Sublateral Work of Improvement in Project Group 1, which is completed in Construction Year 1, full benefits are realized in Year 2). Exceptions to this are further described below. The analysis also assumes that Project Groups are completed in numeric order (i.e., Project Group 1 is completed first, followed by Project Group 2). This approach is expected to slightly understate the net present value of the HDPE Piping Alternative because benefits are slightly over-discounted compared to costs since it is expected that only 6 months (rather than 1 year) will lapse between incurring construction costs

[1] "Project Group" refers to canals and laterals that undergo construction during the same period.

for each Work of Improvement[2] and realizing benefits from each Work of Improvement (as construction is expected to occur during the winter months, with benefits accruing the following summer). Table 1-2 below outlines the year each benefit or cost begins to accrue by lateral.

1.1.4 Period of Analysis

The period of analysis for each Work of Improvement identified in Table 1-1 is defined as 101 years since the installation period is 1 year and 100 years is the expected project life of buried HDPE pipes. Across the two Project Groups, the period of analysis is 107 years (Year 1 to Year 107). Project construction timing is shown in Table 1-2. Project life of other key project infrastructure, such as pumps, are 15 to 25 years; as such, they do not affect the period of analysis.

1.1.5 Project Purpose

The piping infrastructure is multipurpose, providing habitat benefits, agricultural production benefits, patron energy cost saving benefits, and potentially recreation benefits. As there are no project cost items that separately serve a single purpose, this analysis does not allocate costs or benefits by purpose.

Table 1-1. Construction Timeline and Construction Costs by Funding Source, Deschutes Watershed, Oregon, 2018$. [1]

Construction Year	Works of Improvement	Public Law 83-566 Funds	Other, Non-Federal Funds	Total Construction Costs
1	Project Group 1: Rogers Lateral	$2,099,000	$646,000	$2,745,000
1	Project Group 1: Rogers Sub-lateral	$95,000	$32,000	$127,000
2	Project Group 1: Elder Lateral	$694,000	$215,000	$909,000
3	Project Group 1: Riley Lateral	$730,000	$227,000	$957,000
3	Project Group 1: Riley Sub-lateral	$187,000	$60,000	$247,000
3	Project Group 1: Riley Turnout	$124,000	$37,000	$161,000
4	Project Group 2: Butte Lateral	$192,000	$62,000	$254,000
5	Project Group 2: Mickelson Lateral	$79,000	$27,000	$106,000
6	Project Group 2: Main Canal	$3,407,000	$1,045,000	$4,452,000
7	Project Group 2: Main Canal Pump	$3,624,000	$1,393,000	$5,017,000
	Total project	**$11,231,000**	**$3,744,000**	**$14,975,000**

1/ Price Base: 2018 dollars — Prepared October 2018

[2] "Work of Improvement" refers to the specific Project Group, lateral, canal, or pump station that would be installed as part of the HDPE Piping Alternative.

Table 1-2. The Timing of Project Costs and Benefits, Deschutes Watershed, Oregon.

Works of Improvement	Year Benefits and Costs Begin								
	Project Group	Operation & Maintenance	Pump Station Energy Costs[1]	Groundwater Pumping Costs	Hydropower Loss Costs [2]	Irrigation Energy Savings	Carbon Emissions [3]	Instream Flow	Maintaining Irrigation Pumps
Rogers Lateral	1	2	N/A	2	N/A	2	Varies	2	2
Rogers Sublateral	1	2	N/A	2	N/A	2	Varies	2	2
Elder Lateral	1	3	8	3	3	8	Varies	3	8
Riley Lateral	1	4	N/A	4	N/A	4	Varies	4	4
Riley Sublateral	1	4	N/A	4	N/A	4	Varies	4	4
Mickelson Lateral	2	6	8	6	N/A	8	Varies	6	8
Butte Lateral	2	5	8	5	5	8	Varies	5	8
Main Canal	2	7	8	7	7	8	Varies	7	8
Main Canal Pump Station	2	8	8	8	8	8	Varies	8	8

1/ Rogers and Riley do not receive pressurization from the pump station. Prepared October 2018

2/ Only Elder, Butte, Main Canal, and Main Canal Pump Station impact hydropower production. Hydropower production is fully restored in Year 9 once a new runner has been installed.

3/ The timing of changes in carbon emissions differs depending on the source of emissions. Avoided emissions from energy use begin to change according to the timeline under Irrigation Energy Savings (column 7). Increased emissions from reduced groundwater recharge begin to change according to the timeline under Groundwater Pumping Costs (column 5). Increased emissions from reduced hydropower change according to the timeline under Hydropower Loss Costs (column 6). Increased emissions from District Pumping begin to change according to the timeline under Pump Station Energy Costs (column 4).

2 Proposed Project Costs

2.1 Costs Considered and Quantified

Table 2-1 (NWPM 506.18, Economic Table 4) below summarizes installation costs, distribution of costs, and total annual average costs for the HDPE Piping Alternative. Table 2-2 and Table 2-3 present other direct costs associated with changes in operation, maintenance, and replacement (OM&R) costs. Table 2-4 and Table 2-5 show other direct costs associated with reduced groundwater recharge resulting from piping, while Table 2-6 shows other direct costs associated with short-term reduced hydropower generation. The subsections below provide details on the derivation of the values in the tables. Average annual costs include those associated with installation, OM&R costs, and other direct costs. OM&R costs include general SID operational expenses, operational energy costs of the proposed pump station, replacement costs for pump infrastructure, and replacement costs for hydropower infrastructure called a "runner." There are three primary types of other direct costs: increased pumping costs from increased depth to groundwater due to reduced recharge, reduced energy sales resulting from a temporary loss of hydropower production, and potential reduction in aesthetic values to area residents due to the removal of canals. As the aesthetic costs are not quantifiable with the available information, they are not quantified in this NED. Table 2-1 summarizes the other quantified direct costs.

2.1.1 Project Installation Costs

According to Farmers Conservation Alliance estimates, the cost of installing piping, associated district-owned turnouts, and the pump station is $13,468,000 (2018 dollars). See Appendix D.3 for detailed cost derivation by pipe size, cost category, etc. All values in this analysis are presented in 2018 dollar values and rounded to the nearest $1,000 value. Of total estimated costs, Farmers Conservation Alliance estimates that construction accounts for 75 percent and engineering accounts for 25 percent.

Adding 3 percent for in-kind project administration from SID, 8 percent for technical assistance from NRCS, and $27,000 for permitting costs results in an estimated total cost of $14,975,000 for the HDPE Piping Alternative in 2018 dollars. The average annual cost by Project Group is shown in Table 2-1, with total average annual project outlays (amortized installation costs) in 2018 dollars totaling to $401,000 for the HDPE Piping Alternative (assuming works of improvement are completed according to the timeline shown in Table 1-1).

Table 2-1. Economic Table 4—Estimated Average Annual NED Costs for HDPE Piping Alternative, Deschutes Watershed, Oregon, 2018$. [1]

Works of Improvement[2]	Project Outlays (Amortization of Installation Cost) [2]	Project Outlays (Operation, Maintenance, and Replacement cost) [3]	Other Direct Costs [4]	Total
Project Group 1	$150,000	$17,000	$5,000	$172,000
Project Group 2	$251,000	$72,000	$8,000	$331,000
Total	**$401,000**	**$89,000**	**$13,000**	**$503,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ This assumes project construction timing as shown in Table 1-1.
3/ This includes the expense of running SID and maintaining District infrastructure, increased energy costs associated with a proposed pump station, and the costs of replacing the pump station pump and the runner.
4/ Other direct costs include the uncompensated economic losses due to changes in resource use or associated with installation, operation, or replacement of project structures. These include: increased pumping costs elsewhere in the basin from reduced groundwater recharge (i.e., seepage from unlined canals), any increased carbon emissions, and a temporary reduction in hydropower generation.

2.1.2 Project Outlays for OM&R Costs

The current annual OM&R costs for SID are roughly $370,000.[3] The District expects that these costs will remain constant (in real dollar terms) in the future under the No Action Alternative, and that implementing the HDPE Piping Alternative will reduce operation and maintenance (O&M) costs of the canals and laterals, but increase energy costs and replacement costs due to the installation of the pump station (for a net decrease in OM&R costs for Project Group 1 and a net increase in OM&R costs for Project Group 2). The decreases in O&M of canals and laterals are discussed in Section 3.2.1.

In order to pressurize the piped conveyance system, the District plans to install a pump station downstream of the hydropower plant as part of the HDPE Piping Alternative. This station will require additional energy, estimated at 1,308,960 kWh per year (Black Rock Consulting, 2017). The pump station would provide pressure to pipelines located downstream of the hydropower plant, all of which are in Project Group 2 except for the Elder Lateral (part of Project Group 1). The energy use is valued at the same rate as the hydropower sales rate: $0.0765 per kWh (as increased District energy usage translates into lower District hydropower sales). Because the pump station would not be constructed unless the canals were piped, under the No Action Alternative, there would be no energy costs associated with the pump station. Table 2-2 outlines the energy costs for the pump station by Project Group. When discounted and amortized, the costs to power the pump station are roughly $82,000 per year.

[3] This value has been adjusted for inflation to 2018 using the Consumer Price Index.

Table 2-2. Annual Pump Station Energy Costs of HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$. [1]

Works of Improvement	Total Annual Energy Costs Under No Action (kWh)	Annual Pump Station Energy Use Under HDPE Piping (kWh)	Increased Annual Energy Use (kWh)	Undiscounted Annual Cost of Pump Station Energy	Average Annual NED Cost (Discounted and Amortized)
Project Group 1	0	255,407	255,407	$20,000	$16,000
Project Group 2	0	1,053,553	1,053,553	$81,000	$66,000
Total	**0**	**1,308,960**	**1,308,960**	**$101,000**	**$82,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent Prepared October 2018

While the OM&R expenses for existing infrastructure will decrease (as shown in Table 3-4), the HDPE Piping Alternative will result in additional replacement costs for two pieces of new infrastructure. Namely, the pump for the pump station has a 25-year life and carries a replacement cost of $55,113, and the runner for the hydropower plant has a 15-year life and a replacement cost of $95,166 (Farmers Conservation Alliance, 2018a).[4] The initial costs to install the pump in the pump station (which is projected to be installed in Year 8) is included under the installation cost for Project Group 2 as presented in the first column of Table 2-1. The initial installation of the runner (also projected to occur in Year 8) is not part of the funding applied for through the Watershed Protection and Flood Prevention Program, Public Law 83-566, and is therefore included as an OM&R cost in Table 2-3 rather than an installation cost in Table 2-1. The replacement costs after Year 8 have been incorporated at their respective intervals during the 107-year study period; the resulting average annual NED replacements cost is presented under the Project Group 2 OM&R costs in the third column of Table 2-3.[5]

Table 2-3. Annual Operations, Maintenance, and Replacement Costs of HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$ [1]

Works of Improvement	Average Annual NED Replacement Cost (Discounted and Amortized)[2]	Average Annual NED Energy Operations Cost (Discounted and Amortized)	Average Annual NED OM&R Cost (Discounted and Amortized)[3]
Project Group 1	$1,000	$16,000	$17,000
Project Group 2	$6,000	$66,000	$72,000
Total	**$7,000**	**$82,000**	**$89,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent Prepared October 2018
2/Maintenance costs are presented as negative costs (benefits) as maintenance costs are expected to decrease due to the HDPE Piping Alternative.
3/OM&R is presented as a cost for Project Group 2 above in Table 2-1. However, as OM&R costs are expected to decrease (i.e., be a benefit) for Project Group 1, OM&R cost savings are shown as a benefit in Table 3-1.

2.1.3 Other Direct Costs: Groundwater Recharge Costs

Seepage of water 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

[4] These values have been adjusted for inflation to 2018 dollars using the Consumer Price Index.
[5] Both the pump and the runner are assumed to last their full expected lives, providing 25 and 15 years of full benefits respectively before needing replacement.

costs for all groundwater users in the basin. This section estimates this potential project cost. A 2013 study by the U.S. Geological Survey (USGS) estimated the effects on groundwater recharge due to changes in climate (reduced precipitation), groundwater pumping, and canal lining and piping. The study used data for 1997 to 2008; an important caveat to using the data and findings from this study is that the localized effects of piping SID canals may be different from previous lining or piping projects that have occurred throughout the central basin. These disparities could arise from differences in local geology that change the rate of seepage from surface water.

The study indicates that since the mid-1990s, groundwater levels have dropped by approximately 5 to 14 feet in the central part of the Deschutes Basin that extends north from near Benham Falls to Lower Bridge, and east from Sisters to the community of Powell Butte. It also finds that approximately 10 percent of this decline in groundwater level is due to canal lining/piping during this period, or approximately 0.5 to 1.4 feet. This is modeled because of a reduction of recharge from irrigation canal leakage of 58,000 acre-feet (AF) annually. This NED analysis uses these data to first estimate the effect of reduced irrigation canal seepage on groundwater levels, and second to roughly approximate the change in the cost of pumping for all groundwater users in the Deschutes Basin due to the HDPE Piping Alternative.

By 2008, the cumulative effect of piping over the 12-year period of study (1997 to 2008) reached 58,000 AF per year of reduced recharge. Assuming a uniform increase in canal lining/piping over this timeframe, in 1997 there was a decreased canal seepage of 4,833 AF, rising each year by another 4,833 AF until there was a reduced canal seepage in 2008 of 58,000 AF. Cumulatively then, this report estimate that this represents 377,000 AF of reduced recharge from canals during this period. The USGS study finds that this level of reduced recharge caused an overall groundwater decline in the central part of the Deschutes Basin of 0.5 to 1.4 feet. These data suggest that the average relationship between canal recharge and groundwater levels in this part of the basin is approximately 1 foot of groundwater elevation drop per 377,000 AF of reduced canal recharge, though local effects may be much higher or lower.

The HDPE Piping Alternative would reduce canal seepage and associated groundwater recharge by up to approximately 6,172 AF annually in this central part of the Deschutes Basin once all Project Groups are complete (Farmers Conservation Alliance, 2018b). On average, this translates into a decreased groundwater elevation of approximately 0.016 feet annually (based on information presented above that a 1-foot groundwater elevation drop is expected to result from reduced recharge of approximately 377,000, so the corresponding drop from 6,172 AF is 0.016 feet (where 6,172 AF divided by 377,000 AF is 0.016). Over the course of approximately 100 years, this annual drop results in a cumulative decreased average groundwater elevation in the central part of the Deschutes Basin of approximately 1.64 feet (note that this slight drop in pumping elevation would have small effects on pumping costs, but would not be expected to result in the need for drilling deeper wells or replacing pumps at a faster rate).

This analysis combines the estimated decreased groundwater elevation for each year in the 100-year analysis period with the estimated annual volume of groundwater pumping in the central part of the Deschutes Basin during this period to estimate the total increased cost of groundwater pumping in the Basin over time due to decreased recharge from the HDPE Piping Alternative. The USGS report identified approximately 25,000 AF per year of groundwater pumping for public supply and about 25,000 AF per year of groundwater pumping for irrigation use. A 2006 report for the Deschutes Water Alliance on future groundwater use indicates that public supply use may increase by an average of 2.5 percent annually (the report projected in increase of consumptive groundwater use from 35,895 to 58,594 over the 20-year period from 2005 to 2025) (Newton Consultants, 2006). Generously assuming this growth rate in pumping for public supply stays constant over the analysis period (and assuming no growth in irrigation pumping), total groundwater pumping by analysis year 107 may rise to 376,000 AF annually.

In terms of power rates, according to the 2010 *Water System Master Plan Update Optimization Study*, most of the City of Bend's 25 groundwater wells fall under Pacific Power's Rate Schedule 28, while 3 wells fall under Rate Schedule 30 (Optimatics, 2010). The current marginal cost for the City to pump groundwater is expected to be approximately $0.05970 per kWh under Schedule 28 (Pacific Power, 2017). Farmers who use electricity to pump irrigation water pay according to the rates established under Schedule 41, which applies the same price to all electricity used during the summer (April 1 to November 30). This rate is $0.09624 per kWh, which this analysis assumes is the marginal cost to farmers for electricity used to pump groundwater.[6]

Under the No Action Alternative, groundwater levels would still decline but at a slower rate than with the project. The USGS study cited above notes that groundwater levels in the area between Clines Butte and Redmond (the closest area in the study to the HDPD Piping Alternative) fell approximately 12 to 14 feet from 1994 to 2008 from a combination of climate, increases in groundwater pumping, and reduced groundwater recharge from canal lining (Gannett & Lite, 2013). This is an average drop of roughly one foot per year, which we assume will continue under the No Action Alternative. Data from the Oregon Water Resources Department indicate that depths to groundwater vary widely within the areas around Bend and Redmond; depths in Bend are around 740 feet, while depths near Redmond are about 265 feet (Oregon Water Resources Department, 2016). For the No Action Alternative, we assume an average groundwater pumping depth within SID of 501 feet; assuming a 1-foot drop in groundwater depth in each year, during analysis year 100, under the No Action Alternative, groundwater depths will be approximately 600 feet. During analysis year 100, the HDPE Piping Alternative results in a pumping depth of approximately 602 feet, or an increased depth to groundwater of 2 feet compared to the No Action Alternative.

[6] The costs to power a pump represent the vast majority of variable costs of irrigation pumping. Maintenance costs on electric pumps are minimal. One study estimated that maintenance costs represented only 1 to 4 percent of the variable costs of pumping, with electricity costs comprising the other 96 to 99 percent (Robinson, 2002). The costs of diesel pumps show a similar pattern. Because maintenance costs are such a small part of the variable costs of irrigation pumping and would have a small effect on expected average annual values, only energy costs are included in this analysis.

Table 2-4. Approximate Depth to Groundwater in Central Deschutes Basin, Deschutes Watershed, Oregon.

Year	Volume Pumped (AF/year)	Average Depth to Groundwater (feet)	
		No Action	HDPE Piping Alternative (NED Alternative)
2[1]	51,000	502	502
10	57,000	510	510
20	66,000	520	520
30	77,000	530	530
40	92,000	540	541
50	111,000	550	551
60	135,000	560	561
70	166,000	570	571
80	205,000	580	581
90	256,000	590	591
100	320,000	600	602
107	376,000	607	609

Prepared October 2018

1/ Year 2 has been shown as this would be after the first year when construction would be completed and there would be a potential change in pumping do to a reduction in canal seepage.

Applying the electricity prices, assuming a pump irrigation efficiency of 70 percent[7], and using the volume of pumping and pumping depths shown in Table 2-4, the total cost of groundwater pumping under No Action is projected to grow from around $2.9 million in Year 1 to $21.3 million in Year 106.

The increased depth to groundwater due to reduced recharge results in higher pumping costs in the HDPE Piping Alternative. The increased cost to groundwater pumpers over the 100-year evaluation period rises in each year as the cumulative effect of reduced recharge may cause the groundwater elevation to continue to decline. For example, because of reduced recharge due to installation of the Rogers Lateral component of Project Group 1, the groundwater elevation may decline 0.0016 foot in Year 2, increasing to a 0.16-foot decline over 100 years (0.0016 multiplied by 100). In total, after discounting and amortizing these costs across all Project Groups, the estimated total annual average NED cost across the 107 years of analysis is $6,000 per year for the HDPE Piping Alternative (see Table 2-5).

[7] As assumed in the Swalley Irrigation District System Improvement Plan completed by Black Rock Consulting in 2017.

Table 2-5. Other Direct Cost of Reduced Recharge under HDPE Piping Alternative, Deschutes Watershed, Oregon, 2018$. 1

Works of Improvement	Water Conservation (cfs)	Water Conservation (AF/year)	Change in Groundwater Depth (ft/year)	Annual Average NED Cost
Project Group 1	7.0	2,250.1	0.006	$2,000
Project Group 2	12.2	3,922	0.010	$4,000
Total	**19.2**	**6,172**	**0.016**	**$6,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

2.1.4 Other Direct Costs: Decreased Hydropower Revenue

In the short-term, installing Project Group 2 of the HDPE Piping Alternative would decrease energy generation at the Ponderosa Hydroelectric Plant. Specifically, the construction of Project Group 2 would reduce water flows through the plant, such that power generation would fall by 384,910 kWh per year (Farmers Conservation Alliance, 2017). However, this would be a temporary loss as the District plans to install a new turbine runner that would increase power production efficiency over a wider range of flows such that energy generation would return to its pre-project level. This runner would be installed in Year 9 and become operational in Year 10 (Camarata, Swalley Irrigation District General Manager & Board Secretary, 2018). Under the No Action Alternative, the hydropower plant produces an estimated 2,539,372 kWh per year (Swalley Irrigation District, 2017). Once the Elder Lateral (part of Project Group 1 but downstream of the hydro plant) and all of Project Group 2 (Table 2-6) were installed the decrease in hydropower generation would cost the District roughly $29,000 in hydroelectric sales (the District sells the electricity for $.07650 per kWh). However, once the new runner was installed in Year 9, the hydropower production and energy sales loss would decrease (hydropower production would nearly return to the same levels prior to piping) for the remaining time included in the 107 years of analysis. Because the higher energy losses only effect a small proportion of time compared to the full period of analysis, the average annual NED costs (taking both energy losses prior and post runner installation into consideration) would be $2,000 per year over the 107-year analysis. The District would not be compensated for this lost revenue through the Watershed Protection and Flood Prevention Program, Public Law 83-566 funds.

Table 2-6. Annual Hydropower Generation Costs of HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$ 1

Works of Improvement	Total Annual Energy Generation Under No Action (kWh)	Annual Energy Generation Under HDPE Piping (prior to runner installation)	Reduced Annual Energy Generation (prior to runner installation) (kWh)	Undiscounted Annual Cost of Lost Hydropower Generation (prior to runner installation)	Average Annual NED Cost (includes the cost of the runner) (Discounted and Amortized)
Project Group 1	240,534	172,609	67,925	$5,000	$1,000
Project Group 2	2,298,838	1,981,853	316,985	$24,000	$1,000
Total	**2,539,372**	**2,154,462**	**384,910**	**$29,000**	**$2,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

2.2 Costs Considered but Not Quantified

2.2.1 Other Direct Costs: Change in Aesthetics and Associated Property/Recreation Values

A potential direct cost is that some local residents may experience adverse effects on property values and quality of life due to the change in aesthetics from piping the canals (as many people enjoy the aesthetics of the open canals). According to real estate agents in the area, many people interested in purchasing property in the area are willing to pay more for properties that have a view of a canal. On the other hand, some property owners or potential property owners may not want to have a canal adjacent to their property because of the safety hazard an open canal poses, potentially limiting the effect on property values. There should not be any impacts to recreation as there is currently no recreation on or near the canals (Camarata J. , Swalley Irrigation District General Manager & Board Secretary, 2017).

The potential aesthetic cost to residential landowners is not quantified due to a lack of available data. Interviewed real estate agents were not able to quantify the potential effect of a view of the canal. Furthermore, quantification is difficult due to scarce information in the economic literature. While the economic value of many natural views has been studied (such as for ocean front property or other scenic natural areas), the value of irrigation canals has been studied little, if at all. There are no hedonic studies looking at the water attribute for loss of irrigation canal aesthetics on residential properties. As such, while this effect is recognized as a likely cost[8], this analysis does not quantify the potential change in aesthetic values of the HDPD Piping Alternative.

3 Proposed Project Benefits

Table 3-1 (NWPM 506.20, Economic Table 5a) summarizes annual average NED project benefits, while Table 3-2 (NWPM 506.21, Economic Table 6) compares them to the annual average project costs presented in Table 2-1. Onsite damage reduction benefits that will accrue to agriculture and the local rural community include increased agricultural production (increased net returns), reduced OM&R costs (only in the case of Project Group 1), and reduced power and maintenance costs for patron pumping; off-site quantified benefits include the value of reduced carbon emissions and the value of enhanced fish and wildlife habitat. Other benefits not included in the analysis that may result indirectly from the HDPE Piping Alternative include the potential for increased on-farm investment in increased irrigation efficiency (as patrons have more funds to increase investment in irrigation from increased yields and reduced pumping costs). The analysis recognizes that instream flows may affect recreation, both in-river and adjacent land-based recreation. However, aside from positive impacts on fish and wildlife-related recreation (both wildlife viewing and fishing) from improved species populations, it is not clear how recreation may be impacted. Numerous interviews with recreation planners and recreation industry professionals in the area indicate that effects on boating and in-water recreation of enhanced instream flows resulting from the HDPE Piping Alternative may be both positive and adverse (depending on the timing and magnitude of the flows), with no indication of whether there may be net benefits or net costs to recreation. As such, this

[8] Note that increased agricultural production value due to a more reliable water supply to SID patrons may tend to increase property values (all else equal), which could offset the effect on property values. The value of increased water supply reliability is quantified and captured below in the discussion on the benefits of increased agricultural production value. While the aesthetic value and the agricultural production value are not necessarily similar in magnitude, the population affected (patrons of SID) is largely the same (however, there may be some residents in the area who benefit from canal views who are not patrons of SID).

analysis assumes no net impact on recreation. Table 3-1 presents total annual NED benefits, and Table 3-2 compares annual NED benefits and costs.

Table 3-1. Economic Table 5a—Estimated Average Annual Watershed Protection Damage Reduction Benefits of HDPE Piping Alternative for Swalley Irrigation District 2018 Watershed Plan, Deschutes Watershed, Oregon, 2018$. [1]

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-related	Non-Agricultural-related
Project Group 1		
On-Site Damage Reduction Benefits		
Other - Reduced O&M	$5,000	
Other - Patron Pump Cost Savings[2]	$166,000	
Subtotal	$171,000	
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon [3]		$18,000
Water Conservation		$121,000
Subtotal		$139,000
Total Quantified Benefits	**$171,000**	**$139,000**
Project Group 2		
On-Site Damage Reduction Benefits		
Other - Reduced O&M	$5,000	
Other - Patron Pump Cost Savings[3]	$231,000	
Subtotal	$236,000	
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon [3]		$17,000
Water Conservation		$184,000
Subtotal		$201,000
Total Quantified Benefits	**$236,000**	**$201,000**
Project Total Quantified Benefits		**$747,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ This benefit includes both the benefits from decreased patron pumping energy use as well as decreased patron maintenance of pumps.
3/ Indicates the benefit of avoided carbon emissions. These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

Table 3-2. Economic Table 6—Comparison of Average Annual NED Benefits and Costs Under the HDPE Piping Alternative, Deschutes Watershed, Oregon, 2018$ [1]

Works of Improvement	Agriculture-related		Nonagricultural		Average Annual Benefits	Average Annual Cost[2]	Benefit Cost Ratio
	Reduced O&M	Patron Pump Savings	Carbon Value	Instream Flow Value			
Project Group 1	$5,000	$166,000	$18,000	$121,000	$310,000	$172,000	1.80
Project Group 2	$5,000	$231,000	$17,000	$184,000	$437,000	$331,000	1.32
Total	**$10,000**	**$397,000**	**$35,000**	**$305,000**	**$747,000**	**$503,000**	**1.49**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent Prepared October 2018
2/ From Table 2-1 Economic Table 4

3.1 Incremental Analysis

The HDPE Piping Alternative is also evaluated using an incremental analysis, which identifies how total costs and benefits change as Project Groups are added. In the incremental analysis, Project Group pipe sizes and costs remain the same for each Project Group assessed.

The engineering pipeline design (e.g., pipe diameters and pressure ratings) is independent of the number of Project Groups and the order that the Project Groups are installed. The District's System Improvement Plan (Swalley Irrigation District, 2017) describes how the District designed modern pipelines to replace its open canals and laterals. The District mapped and collected digital elevation data along its entire delivery system. The District determined that the system needed to be able to deliver 7 gallons per minute per acre served. The system also needed to be able to handle an upper limit of 9 gallons per minute per acre served.

As the pipeline is installed from the "top down" (from the diversion at higher elevations to the lowest elevations in the District), the design had to account for the entire irrigation demand in the system. That is, the system had to be designed for the future full demand rather than the current Project Group demand.

For example, assume that there are two planned Project Groups for a 2-mile pipeline to replace a leaky canal. Project Group A, construction is the upper 1 mile of pipeline starting at the diversion gate. Project Group B construction is the lower 1 mile. The irrigation demand (water right) for the Project Group A construction is 5 cubic feet per second (cfs). The irrigation demand for the Project Group B construction is 15 cfs. Total irrigation demand for the pipeline equals 20 cfs.

If the engineer designs a pipeline for 5 cfs for Project Group A, this will be a relatively small pipeline. This pipeline will then be connected to the larger Project Group B pipe. Therefore, the Project Group A pipeline will have to convey 20 cfs of flow through a pipeline designed for 5 cfs. This will result in a pipeline that does not meet NRCS design standards, and will likely not function and meet the goals of the project.

Pipelines typically decrease in size as the irrigation demand decreases with the number of acres served at lower elevations in the system. Project Groups are not considered when determining when to reduce from a larger to smaller pipe.

The District used the information and assumptions above to create a hydraulic model that determined pipe sizes for each pipeline (canal or lateral to be piped) in the system. The District designed each pipeline to deliver water under its existing water rights, and these pipelines are not designed to deliver water under any additional water rights. The District does not discharge to any waterbodies or connect with any other district's canals, laterals, or pipelines.

Table 3-3 shows the incremental analysis by lateral. The costs are the same for each Project Group in the incremental analysis as presented in Table 2-1 above, and the benefits are the same as in Table 3-1 above.

Table 3-3. Incremental Analysis of Annual NED Costs and Benefits under the HDPE Piping Alternative for Swalley Irrigation District 2018 Watershed Plan, Deschutes Watershed, Oregon, 2018$.[1]

Lateral	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1	$82,000	---	$167,000	---	$85,000
1,2	$86,000	$4,000	$179,000	$12,000	$93,000
1-3	$133,000	$47,000	$277,000	$98,000	$144,000
1-4	$152,000	$19,000	$294,000	$17,000	$142,000
1-5	$179,000	$27,000	$315,000	$21,000	$136,000
1-6	$186,000	$7,000	$327,000	$12,000	$141,000
1-7	$191,000	$5,000	$327,000	$0	$136,000
1-8	$197,000	$6,000	$346,000	$19,000	$149,000
1-9	$345,000	$148,000	$557,000	$211,000	$212,000
1-10	$503,000	$158,000	$747,000	$190,000	$244,000

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

3.2 Benefits Considered and Quantified for Analysis

3.2.1 Canal and Lateral O&M Cost Savings

The District estimates that O&M costs of canals and laterals will fall by roughly $10,000 per year as a result of reduced maintenance and overtime expenses (Camarata, Swalley Irrigation District General Manager & Board Secretary, 2018).[9] This analysis assumes that these cost savings are proportional to the mileage piped, and accordingly allocates the cost savings to each Project Group based on relative mileage (i.e., Project Group 1 with 8.7 miles of pipe represents 53 percent of the 16.6 miles of proposed pipe, and is therefore assumed to provide 53 percent of the cost savings, or approximately $5,000 annually). Table 3-4 allocates these savings to each Project Group.

[9] Estimated O&M savings for the HDPE Piping Alternative include a reduction in equipment usage, fuel, repairs, and labor. For example, to ensure the irrigation ditch operates properly, open ditch canals require cleaning to allow unobstructed water delivery, and infrastructure requires repair when there is a blowout. Labor includes both administration and field time.

Table 3-4. Annual Reduced Maintenance Costs to SID from the HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$. [1]

Works of Improvement	Mileage	Undiscounted Annualized Cost of No Action	Undiscounted Annualized Cost under HDPE Piping Alternative	Undiscounted Annual Benefit	Average Annual NED Benefits (Discounted and Amortized)
Project Group 1	8.7	$194,000	$189,000	$5,000	$5,000
Project Group 2	7.9	$176,000	$171,000	$5,000	$5,000
Total	**16.6**	**$370,000**	**$360,000**	**$10,000**	**$10,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

3.2.2 Patron Irrigation Pump Cost Savings and Carbon Benefits

The System Improvement Plan for SID estimates that, compared to No Action Alternative, the HDPE Piping Alternative would result in a net energy savings of 2,365,438 kWh per year since it is much more efficient for patrons to receive pressurized water than to pressurize it themselves (Farmers Conservation Alliance, 2018c). This cost savings from this energy savings is evaluated based on a cost of summer irrigation pumping of $0.09624 per kWh (the marginal cost for summer irrigation pumping, as noted above). Table 3-5 presents the energy use under the No Action Alternative, and displays the savings to SID patrons for each Project Group under the HDPE Piping Alternative. Once all Project Groups are complete, the savings to SID patrons would be approximately $228,000 each year; the average annual NED benefits (after discounting and amortizing) are estimated at $194,000.

Table 3-5. Annual Increased Average Energy Cost Savings to SID Patrons of HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$. [1]

Works of Improvement	Total Annual Energy Use Under No Action (kWh)	Annual Energy Use Under HDPE Piping Alternative	Reduced Annual Energy Use (kWh)[2]	Undiscounted Annual Energy Cost Savings	Average Annual NED Benefits (Avoided Energy Costs, Discounted and Amortized)
Project Group 1	1,307,500	539,392	768,107	$74,000	$69,000
Project Group 2	1,838,566	241,235	1,597,331	$154,000	$125,000
Total	**3,146,066**	**780,628**	**2,365,438**	**$228,000**	**$194,000**

Note: Prepared October 2018
1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent.
2/ As estimated by Black Rock Consulting in the SID System Improvement Plan, 2017.

Because the HDPE Piping Alternative will create a pressurized conveyance system, it will eliminate the need for some District patrons to maintain irrigation pumps. Of the estimated 555 pumps being used by SID patrons, 369 are projected to be eliminated as a result of the HDPE Piping Alternative (Farmers Conservation Alliance, 2018d). Pumps incur annual maintenance costs and service charges from power providers. Avoiding these costs would represent a benefit to District patrons.

Under Schedule 41, Pacific Power charges a minimum of $55 per year to service a single phase pump (Pacific Power, 2017). Annual maintenance on a pump is roughly 4 percent of the pump's initial cost (around $13,000), for a total of approximately $520 per year (Martin, Dorn, Melvin, Corr, & Kranz, 2011).[10] Annual maintenance on an electric motor is roughly one percent of the initial cost of the motor (around $6,200), totaling approximately $60 per year (National Resources Conservation Service, 2016).[11] Totaling the maintenance costs and service charge, the annual costs of maintaining an irrigation pump are around $635, which this analysis used to estimate the annual benefit of each pump eliminated in the study area as a result of the HDPE Piping Alternative. The table below outlines these benefits. On average during the study period, District patrons save a total of roughly $203,000 each year by avoiding the costs of maintaining irrigation pumps.

Table 3-6. Estimated Cost Savings from Eliminated Irrigation Pumps under the HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$. [1]

Works of Improvement	Pumps in Use Under No Action	Pumps Eliminated Under Piping Alternative	Annual Service Charges Avoided by Piping Alternative	Average Annual NED Benefit (Avoided Service Cost, Discounted and Amortized)
Project Group 1	322	168	$107,000	$97,000
Project Group 2	233	201	$128,000	$106,000
Total	**555**	**369**	**$235,000**	**$203,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

Energy changes from reduced pumping, temporarily reduced hydropower generation, and increased energy use from the pump station will also cause changes in carbon dioxide (CO_2) emissions. Every megawatt hour (MWh) of decreased energy use is estimated to translate into an estimated reduction of 0.75251 metric ton of carbon emissions.[12] However, because hydropower does not emit CO_2, any reduction of hydropower will have to be replaced with carbon-emitting sources. As shown in Table 3-7, reduced pumping due to pressurization decreases CO_2 emissions by approximately 1,780 metric tons per year. Increased pumping energy due to lowered groundwater depth increases CO_2 emissions by 285 tons per year on average over the 100-year period. Before the runner is installed, replacing lost hydropower will increase CO_2 emissions by roughly 290 tons per year. The energy needed to power the pump station will generate about 985 tons of CO_2 per year. The net decrease in CO_2 emissions is estimated to be 220 tons per year prior to the runner's installation, which will increase to 509 tons of CO_2 avoided after the runner is installed. The emissions avoided by reduced pumping outweigh the increased emissions from hydropower loss and powering the pump station; for this reason, the avoided emissions are included as a benefit in Table 3-1.

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10 The original source cited a cost of $11,163 in 2009 dollars, which was adjusted for inflation to 2018 dollars using the Consumer Price Index.

11 The original source cited $6,000 in 2016 dollars, which was adjusted for inflation to 2018 dollars using the Consumer Price Index.

12 This assumes that marginal changes in energy demand are met with fossil fuel-based production (renewable energy is typically used first and then fossil fuel powered generation is used), such that 100 percent of energy use reduction and green energy production results in reduced fossil fuel-powered generation. Furthermore, this estimate assumes 0.75251 metric tons of carbon emitted from 1 MWh of fossil fuel powered electricity generation based on 1) the current proportion of fuel source - oil, natural gas, and coal – for fossil fuel-powered electrical power generation in the West, and 2) the associated metric tons of CO_2 produced per MWh powered by each fossil fuel source, as reported by the Energy Information Administration.

Under the No Action Alternative, District carbon emissions are estimated to be 2,367 tons per year, which is generated by using 3,146,066 kWh per year to power irrigation pumps. As a result of the changes described above, these emissions will fall to roughly 2,148 tons per year prior to the runner's installation, and fall further to 1,858 tons per year after the runner has been installed. To value the reduced carbon emissions, this analysis uses an estimate of the social cost of carbon (which is the estimated total cost to society of emitting carbon related to the expected damages associated with future climate change). The Environmental Protection Agency and other federal agencies use a social cost of carbon estimate recommended by the federal Interagency Working Group on the Social Costs of Greenhouse Gases of approximately $43 per metric ton (2018 dollars) (Interagency Working Group on Social Cost of Greenhouse Gases, 2013). At this value, the avoided carbon emissions from the HDPE Piping Alternative provide an estimated average annual benefit of approximately $35,000, as shown in Table 3-8.

Table 3-7. Annual Average Carbon Emission Changes (Metric Tons) by Project Group, Deschutes Watershed, Oregon.

Works of Improvement	Annual *Avoided* Emissions from Reduced SID Patron Energy Use	Average Annual *Increased* Emissions from Reduced Groundwater Recharge [1]	Average Annual *Increased* Emissions from Reduced Hydropower (prior to runner installation)	Average Annual *Increased* Emissions from District Pumping	Net Average Annual Emissions *Reduction* (prior to runner installation)	Net Average Annual Emissions *Reduction* (after runner installation)
Project Group 1	578	96	51	192	239	289
Project Group 2	1,202	189	239	793	-19	220
Total	**1,780**	**285**	**290**	**985**	**220**	**509**

Prepared October 2018

1/Additional energy use elsewhere rises through time as the effects of reduced recharge accumulate and cause groundwater depths to drop over time. The average annual energy use increase elsewhere in the basin represents the average change in energy use across the 100 project years for each Project Group.

Table 3-8. Annual Average Carbon Emissions (Metric Tons) by Project Group, Deschutes Watershed, Oregon, 2018$.

Works of Improvement	No Action		HDPE Piping Alternative (NED Alternative)			Net Annual Carbon (Compared to No Action Alternative)		Average Annual NED Benefits [2,3]
	Average Annual Carbon Emissions, Basin-wide Energy Use	Annual Carbon Emissions, SID Energy Use	Average Annual Carbon Emissions, Basin-wide Energy Use	Annual Carbon Emissions, SID Energy Use (prior to runner installation)	Annual Carbon Emissions, SID Energy Use (after runner installation)	Prior to Runner Installation	After Runner Installation	
Project Group 1	N/A	984	N/A	746	695	239	289	$18,000
Project Group 2	N/A	1,384	N/A	1,402	1,164	-19	220	$17,000
Total	**94,359** [1]	**2,367**	**96,879**	**2,148**	**1,858**	**220**	**509**	**$35,000**

Prepared October 2018

1/ Note this value rises from 27,920 in Year 1 to 251,288 in Year 107. The average value is 94,359. Carbon emissions rise over time because groundwater pumping volume increases throughout the basin through time, and the depth to groundwater also increases through time due to reduced recharge from canals.
2/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent.
3/Note that the average annual NED benefits differ from the change in tons of carbon emitted multiplied by the $43 value per metric ton of carbon. The increased emissions rise through time (and are thus highest at later time periods when the values are most discounted, while the decreased carbon emissions are the same through time).

3.2.3 Value of Conserved Water

This analysis focuses on the value of instream flow, as the conserved water from the HDPE Piping Alternative will be used to augment instream flows. However, this analysis also presents the value of water to agriculture as the HDPE Piping Alternative also enhances water supply reliability to the District.

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 is 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 and, similar to the data on costs of water conservation projects, may significantly underestimate the full value of instream flow augmentation. This analysis also presents market information on the value of water rights to irrigators in SID, as this indicates that potential cost of purchasing water rights from these irrigators.

Based on the following discussion, this analysis assumes that the economic benefit of instream flow augmentation would be at least $75/AF/year (see Table 3-9), such that this enhanced instream flow is estimated to have a value of approximately $347,000 per year once all Project Groups are complete under the HDPE Piping Alternative (because of the timing, the NED benefit is $305,000 on an average annualized basis, as presented in Table 3-10). This value is expected to be reasonable as a proxy for the value to the public of enhanced fish and wildlife populations (which is the true measure of the economic benefit of enhanced instream flow to benefit fish and wildlife populations). Values published in the economic literature are often quite high for enhancements to trout and other fish and wildlife populations, such as those that would benefit from the instream flows provided by the action alternative.[13] As quantitative information on how instream flows will improve fish and wildlife populations is not available, the analysis is not able to directly measure the economic benefit of enhanced instream flow. As such, the value of conserved water is directly estimated using the value of water transactions in the western United States.

This value of $75 per AF per year is based on the following information:

- **Prices paid for water by environmental buyers throughout the Western United States.** In the period 2000 to 2009, the purchase price of environmental water varied from just over $0 to nearly $1,665 per AF per year, with an average permanent sale transaction price of $165 per AF per year. Amongst the 51 permanent water right purchases with the sales price and volume recorded in the database, the permanent sales price value in 27 transactions (53 percent) was above $75 per AF per year. As discussed at length below, these values paid are expected to provide a low range estimate of instream flow value to society. There are water transactions in the Deschutes Basin purchased through the Deschutes River Conservancy, but these are not used as an estimate of instream flow value in the Basin. While these values

[13] For examples of this literature, see Section 5.2 of the Appendix.

are specific to the study area, they do not represent the value of increased instream flows for two reasons: 1) there are regulatory limitations on the amount paid for leased water, and 2) most of the water is temporarily leased to instream flows by water right holders who temporarily do not need the water (i.e., have little to no opportunity cost of leasing the water) and are leasing it so that they retain the water right for future use. For these reasons, the local basin transaction prices do not reflect the true instream flow value of the water or the cost to irrigators of fallowing land.

- **Value to irrigators in SID of water.** Depending on the method used, this is estimated at $40 to $110 per AF per year (for an average value of water to agriculture of approximately $75 per AF). This value is important, as the value of water to local agriculture is a key factor determining water sales and lease prices to environmental buyers in the project area (i.e., the marginal value of water to agriculture will determine agricultural sellers' willingness to accept a price for water), and because conserved water avoids potential future reductions in SID deliveries.

Table 3-9. Value per AF per Year of Water (Market Prices and Value to Agriculture), Deschutes Watershed, Oregon, 2018$.

Type of Value	Low Value	High Value	Median Value	Average Value
Permanent Water Right Transaction in Western US, 2000 to 2009 *(Converted to Annual Values)*	~$0	$1,665	~$75	$165
Value of Water to Deschutes County Irrigators *(Income Capitalization Approach and Sales Price of Water in Ag to Ag Transfers, Converted to Annual Values)*	$40	$110	N/A	~$75

Table 3-10 shows the estimated average annual benefits of enhanced instream flow for the HDPE Piping Alternative.

Table 3-10. Annual Estimated Instream Flow Value of HDPE Piping Alternative by Project Group, Deschutes Watershed, Oregon, 2018$ [1]

Project Group	Water Conservation Under HDPE Piping Alternative (AF/year)	Instream Flow Value Under No Action	Annualized Average Net Benefits of HDPE Piping Alternative
Project Group 1	1,688	$0	$121,000
Project Group 2	2,941	$0	$184,000
Total	**4,629**	**$0**	**$305,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

Past Costs Paid as a Proxy for Value

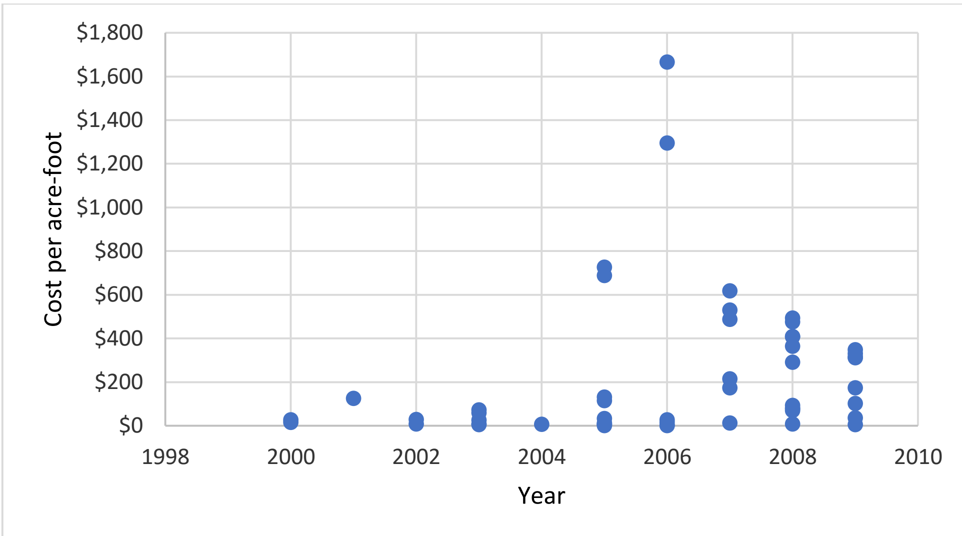
Past piping projects in the Deschutes Basin highlight the willingness of funding entities to pay for instream flow augmentation. These values are evidence of the *minimum* benefit of the instream flows purchased, as perceived and experienced by these entities. Project costs paid are indicative of the *minimum* perceived benefit as (barring very unusual circumstances) entities only pay for projects for which they believe 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 for instream flow restoration, 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). Based on data from the Deschutes River Conservancy, costs of instream flow augmentation from piping projects have ranged from approximately $104,000 to approximately $342,000 per cfs conserved; this may equate to roughly $300 to $1,000 per AF conserved.

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. As described below, this analysis relies on water rights leased and purchased for instream flow augmentation throughout the Western United States. Water right transactions typically reflect the cost to irrigated agriculture of reduced water use, rather than the full economic benefit of increased instream flow. The value of instream flow is also location-specific, but given the high level of interest and focus on ecosystem restoration in the Deschutes, it is expected that the value of instream flow in the Deschutes may be similar to other basins in the west where water rights are being acquired to restore instream flows (i.e., the willingness to pay for instream flow water may be similar in the Deschutes Basin).

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 timeframe between 1995 and 1999, six transactions of water right purchases averaged $360 per AF in Oregon, while five water right leases averaged $114 per AF per year on average. The paper also shows lease and purchase price by environmental use, including for riparian areas, for wetlands, for recreation, and for instream flow. For instream flows, the average purchase price across 18 transactions was $1,114, while across 35 lease transactions the annual price per AF was $68.

The Bren School of Environmental Science & 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 sector of the buyer and seller (e.g., agricultural or environmental) (Bren School of Environmental Science & Management, University of California, Santa Barbara, 2017). Figure 3-1 and Figure 3-2 below show more recent sales and leases of water rights by environmental buyers from 2000 to 2009 on a price per AF per year basis. The figures show how water right transaction values vary widely, but sale prices (amortized to an annual price) typically are less than $200 per year while 1-year leases typically fall below $800 per AF per year (with several transactions showing prices rising over a $1,000 per AF per year). Amongst the 51 permanent water right purchases with the sales price and volume recorded in the database, the sales price value in 27 transactions (53 percent) was above $75 per AF per year. However, it is also important to note that the amount paid per AF tends to decline with an increase in water volume traded: weighting the purchase price by the volume of water sold decreases the average permanent sale transaction price to $20 per AF per year.



1/Note that dollar per AF purchase prices were amortized using a 2.875 percent interest rate and a 100-year time period to derive dollar per AF per year values.

Figure 3-1. Western Water Right Purchases for Environmental Purposes, 2000 to 2009, Price Paid per AF per Year.[1]

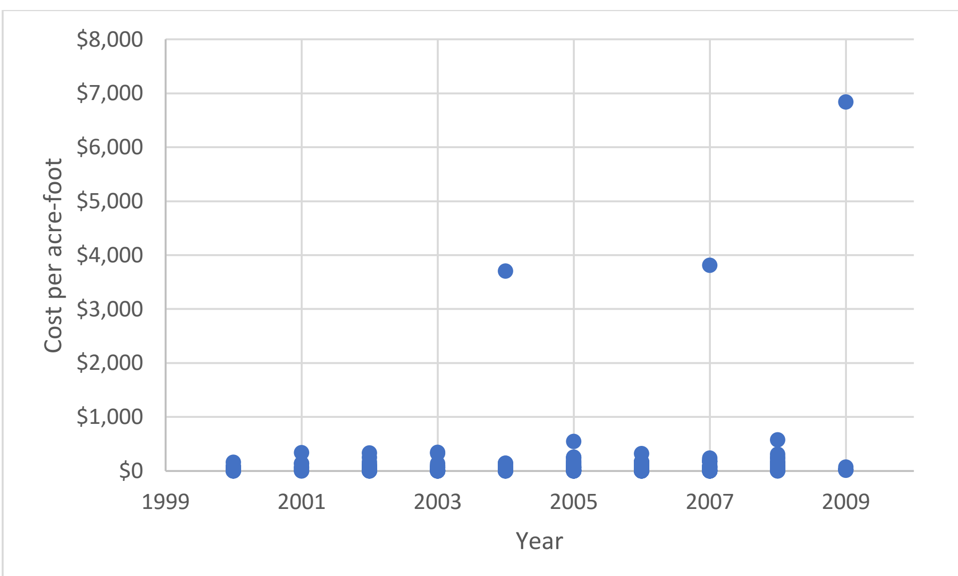


Figure 3-2: 1-Year Water Leases for Environmental Purposes, Price Paid Per AF in Western United States.

Current and Potential Future Water Right Purchase Values in SID

In a neighboring irrigation district, water rights sold from one irrigator to another have typically had a purchase price between $5,000 to $7,500 per acre (Rieck, Tumalo Irrigation District Manager, 2017). These values are very similar to values provided by area real estate agents regarding the increased value of property with irrigation water rights, all else equal. Assuming approximately 4 AF per year delivered on average to acreage, this equates to approximately $1,250 to $1,875 per AF ($5,000 to $7,500 per acre divided by 4 AF per acre delivery), or a value of approximately $40 to $60 per AF per year.

Prices paid for the limited number of agricultural water right sales may not reflect the average value of water to irrigators in SID and the cost of acquiring water in the future. The value of water to irrigators in SID (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). The price paid per AF in the limited number of current SID water transactions is lower than the value derived from the effect on farm income of more reliable access to irrigation water (income capitalization approach), which indicates that if additional water were available it would raise farm income by approximately $100 per AF per year.[14]

Current water right transactions in the area trade for a lower value than derived through the income capitalization approach; this may be because some farms in the area are not commercial farms or are not farming all of their lands, and therefore derive less income from some of their water rights than commercial farms producing grass hay or other crops. This indicates that while some water may trade for the lower value of approximately $40 to $60 per AF, if instream flow buyers were to purchase water rights, then as more water rights were acquired, the cost per AF would likely rise to the level as derived through the income capitalization approach.

3.3 Benefits Considered but not Quantified for Analysis

3.3.1 Agricultural Intensification Benefit

The District's antiquated canal and laterals make it difficult to deliver the correct amount of water to patrons at the correct time, particularly early and late in the irrigation season. During these periods, the District's water rights require it to divert water at a reduced rate. At these reduced flow rates, the canals and laterals are more sensitive to small changes in streamflow at the diversion or deliveries at each point-of-delivery. The reduced flow rates in the open canal and laterals make it much more challenging for the District to deliver the sufficient amount of water that patrons need when they need it. For example, a point-of-delivery near the end of a lateral may receive no water in the morning and excess water in the evening. The District also has to pass excess water, known as carry water, to ensure that adequate water reaches all points-of-delivery when required by patrons according to their water rights. When the patrons' demand subsides, this excess water operationally

[14] This estimate is based on an analysis of the net returns to water of grass hay. An agricultural expert in the area estimated that (assuming there is not already a full water supply) an additional AF of water would increase grass hay yields by approximately 0.5 ton per acre (Bohle, 2018). Assuming that each ton of grass hay generates $200 in revenue after harvest costs are subtracted, an AF of water is worth approximately $100 to growers (Painter, 2015; NASS, 2017). However, we do not assume these yield benefits will accrue to District patrons under the HDPE Pressurized Piping Alternative.

spills onto non-productive lands at the ends of the conveyance system. Through enhanced operational flexibility and efficiency, reduced canal breaches, and keeping 25 percent of saved water from the project (approximately 1,544 AF per year) to shore up supplies, the HDPE Pressurized Piping Alternative could increase water supply reliability to District patrons. Given the limited amount of available data on current delivery and delivery capabilities after piping, although this is identified as a potential benefit that could increase agricultural yield on existing irrigated lands, it was not included in the analysis.

3.3.2 Public Safety Avoided Costs

Piping irrigation water removes the hazard of drownings in canals, and eliminates the potential for unlined canals to fail, with potential damages to downstream property and lives. While SID canal failure is very possible, the extent of damage varies depending on the amount of water in the canal, the location of failure, and the value of adjacent property (Camarata, Swalley Irrigation District General Manager & Board Secretary, 2017; Camarata, Swalley Irrigation District General Manager & Board Secretary, 2018). Given the limited amount of available data on the cost of these canal failures, this public safety (and property damage reduction) benefit of piping is not analyzed in this analysis. However, a history of recent drownings and near drowning events 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 (Beechem, 2018) (Matsumoto, 2016). 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 3 drownings over the last 21 years (1996 through 2016), or 0.143 death 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 will increase.

The HDPE Piping Alternative would pipe approximately 16.6 miles of canals in SID. This section qualitatively discusses the potential magnitude of the public safety benefit of piping the remaining exposed canals in SID. The analysis presents some information on the potential public safety hazard of the existing unlined irrigation canals (based on the recent history of drownings and the mileage of exposed canals) at SID proposed for piping.

<u>Level of Public Safety Hazard</u>

This analysis estimates the public safety hazard of unlined canals in SID based on past drownings in unlined canals in Central Oregon. Based on data from Oregon Water Resources Department on canals in Central Oregon, there are 1,072 miles of irrigation canals in Central Oregon districts (see Table 3-11). Starting in the late 1980s and early 1990s, sections of these canals began to be piped, with the result that today the Oregon Water Resources Department (OWRD) database records that approximately 209 miles have been piped. Assuming piping occurred uniformly across the 21-year period of 1996 to 2016, there were approximately 9.9 miles piped each year, leaving approximately 973 miles unpiped on an average annual basis during this period. Given that there was an average of 0.143 drowning death annually during this period (three deaths over 21 years as described above), during that timeframe 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 or so, but may also be an underestimate of risk as the population of

Bend continues to grow and the areas around irrigation canals continues to urbanize (thereby increasing the risks of drownings).

Under No Action, SID would continue to have approximately 16.6 miles of unpiped canal. Assuming that the three drownings over the past 21 years are representative of future drowning risk, and that the 0.000147 death per mile of exposed canal experienced during this period is an appropriate estimate of future risk, the unpiped canals in SID carry a risk of 0.002 death per year.

Table 3-11. Irrigation Canal Mileage by District

District	Canal and Lateral Mileage
Arnold Irrigation District	47.3
Central Oregon Irrigation District	430.0
Lone Pine	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**

Prepared August 2018

Source: Oregon Water Resources Department, database maintained and provided by Jonathon LaMarche on March 9, 2017.

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5 NED Appendix

5.1 Supplementary Tables

Table 5-1. Estimated Average Annual NED Costs for HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$.

Lateral Name	Year Costs Begin [1]	Project Outlays (Installation)	Project Outlays (OM&R) [2]	Other Direct Costs [3]	Total
Rogers Lateral	Varies	$81,000	$0	$1,000	$82,000
Rogers Sublateral	Varies	$4,000	$0	$0	$4,000
Riley Lateral	Varies	$27,000	$0	$0	$27,000
Riley Sublateral	Varies	$12,000	$0	$0	$12,000
Mickelson Lateral	Varies	$3,000	$3,000	$0	$6,000
Elder Lateral	Varies	$26,000	$17,000	$4,000	$47,000
Butte Lateral	Varies	$7,000	$9,000	$3,000	$19,000
Main Canal	Varies	$115,000	$30,000	$3,000	$148,000
Main Canal Pump Station	Varies	$126,000	$30,000	$2,000	$158,000
TOTAL	**N/A**	**$401,000**	**$89,000**	**$13,000**	**$503,000[5]**

Prepared October 2018

1/ The year costs begin to be incurred differs between the type of cost. Refer to individual cost tables for the beginning year of specific costs.
2/ OM&R costs include the expense of running SID and maintaining District infrastructure, increased energy costs associated with a proposed pump station, and the costs of replacing the pump station pump and the runner.
3/ Other direct costs include the uncompensated economic losses due to changes in resource use or associated with installation, operation or replacement of project structures. These include: increased pumping costs elsewhere in the basin from reduced groundwater recharge (i.e. seepage from unlined canals), an increase in carbon emissions for Elder and Mickelson lateral that is not offset by decrease in pumping, and a temporary reduction in hydropower generation.

Table 5-2. Annual Reduced Operation and Maintenance Costs to SID Patrons of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Benefits Begin [2]	Mileage	Undiscounted Annualized Cost of No Action	Undiscounted Annualized Cost under HDPE Pressurized Piping Alternative	Undiscounted Annual Benefit	Average Annual NED Benefits (Discounted and Amortized, 2018$)
Rogers Lateral	2	3.8	$84,000	$82,000	$2,000	$2,000
Rogers Sublateral	2	0.4	$9,000	$9,000	$0	$0
Riley Lateral	4	1.4	$31,000	$30,000	$1,000	$1,000
Riley Sublateral	4	1.3	$28,000	$27,000	$1,000	$1,000
Mickelson Lateral	6	0.4	$8,000	$8,000	$0	$0
Elder Lateral	3	1.9	$42,000	$41,000	$1,000	$1,000
Butte Lateral	5	1.0	$23,000	$22,000	$1,000	$1,000
Main Canal	7	3.2	$72,000	$70,000	$2,000	$2,000
Main Canal Pump Station	8	3.2	$72,000	$70,000	$2,000	$2,000
TOTAL	**N/A**	**16.6**	**$370,000**	**$360,000**	**$10,000**	**$10,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent   Prepared October 2018
2/ Changes to maintenance costs begin the year after each lateral is completed.

Table 5-3. Annual Pump Station Energy Costs of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Costs Begin [2]	Total Annual Energy Costs Under No Action (kWh)	Annual Energy Use Under HDPE Piping (kWh)	Increased Annual Energy Use (kWh)	Undiscounted Annual Cost of Pump Station Energy	Average Annual NED Cost (Discounted and Amortized)
Rogers Lateral	2	0	0	0	$0	$0
Rogers Sublateral	2	0	0	0	$0	$0
Riley Lateral	4	0	0	0	$0	$0
Riley Sublateral	4	0	0	0	$0	$0
Mickelson Lateral	8	0	47,668	47,668	$4,000	$3,000
Elder Lateral	8	0	255,407	255,407	$20,000	$16,000
Butte Lateral	8	0	138,002	138,002	$11,000	$9,000
Main Canal	8	0	433,941	433,941	$33,000	$27,000
Main Canal Pump Station	8	0	433,941	433,941	$33,000	$27,000
TOTAL	**N/A**	**0**	**1,308,960**	**1,308,960**	**$101,000**	**$82,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent.   Prepared October 2018
2/ For the laterals that impact pump station energy costs, energy costs start the year the pump station is completed.

Table 5-4. Annual Operations, Maintenance, and Replacement Costs of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Costs Begin [2]	Average Annual NED Replacement Cost (Discounted and Amortized)*	Average Annual NED Energy Cost (Discounted and Amortized)	Average Annual NED OM&R Cost
Rogers Lateral	Varies	$0	$0	$0
Rogers Sublateral	Varies	$0	$0	$0
Riley Lateral	Varies	$0	$0	$0
Riley Sublateral	Varies	$0	$0	$0
Mickelson Lateral	Varies	$0	$3,000	$3,000
Elder Lateral	Varies	$1,000	$16,000	$17,000
Butte Lateral	Varies	$0	$9,000	$9,000
Main Canal	Varies	$3,000	$27,000	$30,000
Main Canal Pump Station	Varies	$3,000	$27,000	$30,000
TOTAL	**N/A**	**$7,000**	**$82,000**	**$89,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ Maintenance costs changes begin according to the timeline in Table 5-2. Replacement costs (column 3) are incurred according to the schedule described in Appendix D Section 3.2.2. Energy costs (column 4) begin to change according to the timeline in Table 5-3.
* When OM&R costs are expected to decrease due to the HDPE Piping Alternative, they are shown as benefits in Table 5-7 below.

Table 5-5. Other Direct Costs of Reduced Recharge under HDPE Piping Alternative, Deschutes Watershed, Oregon, 2018$ [1]

Lateral Name	Year Costs Begin [2]	Water Conservation (cfs)	Water Conservation (AF/Year)	Change in Groundwater Depth (ft/year)	Annual Average NED Cost
Rogers Lateral	2	3.2	1,028.6	0.003	$1,000
Rogers Sublateral	2	0.2	64.3	0.000	$0
Riley Lateral	4	0.7	225.0	0.001	$0
Riley Sublateral	4	0.3	96.4	0.000	$0
Mickelson Lateral	4	0.0	0.0	0.000	$0
Elder Lateral	6	2.6	835.7	0.002	$1,000
Butte Lateral	3	0.2	64.3	0.000	$0
Main Canal	5	6.0	1,928.6	0.005	$2,000
Main Canal Pump Station	7	6.0	1,928.6	0.005	$2,000
TOTAL	8	**19.2**	**6,172**	**0.016**	**$6,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ Increased energy costs begin to change after each lateral is completed.

Table 5-6. Annual Hydropower Generation Costs of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Costs Begin [2]	Year Costs End [3]	Total Annual Energy Generation Under No Action (kWh)	Annual Energy Generation Under HDPE Piping (prior to runner installation)	Reduced Annual Energy Generation (prior to runner installation) (kWh)	Undiscounted Annual Cost of Lost Hydropower Generation (prior to runner installation) (2018$)	Average Annual NED Cost (Discounted and Amortized, 2018$)
Rogers Lateral	N/A	N/A	0	0	0	$0	$0
Rogers Sublateral	N/A	N/A	0	0	0	$0	$0
Riley Lateral	N/A	N/A	0	0	0	$0	$0
Riley Sublateral	N/A	N/A	161,466	161,466	0	$0	$0
Mickelson Lateral	N/A	N/A	462,452	462,452	0	$0	$0
Elder Lateral	3	9	79,068	11,143	67,925	$5,000	$1,000
Butte Lateral	5	9	205,654	199,185	6,469	$0	$0
Main Canal	7	9	209,475	54,217	155,258	$12,000	$1,000
Main Canal Pump Station	8	9	1,421,257	1,265,999	155,258	$12,000	$0
TOTAL	**N/A**	**N/A**	**2,539,372**	**2,154,462**	**384,910**	**$29,000**	**$2,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ For those laterals that impact hydropower energy use, changes to costs begin after the lateral is constructed.
3/ Changes to hydropower costs end after the runner is constructed and pre-project hydropower production is restored.

Table 5-7. Estimated Average Annual Watershed Protection Damage Reduction Benefits of HDPE Pressurized Piping Alternative for Swalley Irrigation District 2017 Watershed Plan, Deschutes Watershed, Oregon, 2018$. [1]

Damage Reductions Categories	Agricultural Benefit Swalley ID Patrons/ Surrounding Community	Non-Agricultural Benefit	Total
Rogers Lateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$2,000		$2,000
Pumping Cost Savings	$97,000		$97,000
Onsite Subtotal	$99,000		$99,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$12,000	$12,000
Fish and Wildlife Habitat / Instream Flows		$56,000	$56,000
Offsite Quantified Subtotal		$68,000	$68,000
Total Quantified Benefits	**$99,000**	**$68,000**	**$167,000**
Rogers Sublateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$0		$0
Pumping Cost Savings	$6,000		$6,000
Onsite subtotal	$6,000		$6,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$2,000	$2,000
Fish and Wildlife Habitat / Instream Flows		$4,000	$4,000
Offsite Quantified Subtotal		$6,000	$6,000
Total Quantified Benefits	**$6,000**	**$6,000**	**$12,000**
Riley Lateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$1,000		$1,000
Pumping Cost Savings	$6,000		$6,000
Onsite subtotal	$7,000		$7,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$2,000	$2,000
Fish and Wildlife Habitat / Instream Flow		$12,000	$12,000
Offsite Quantified Subtotal		$14,000	$14,000
Total Quantified Benefits	**$7,000**	**$14,000**	**$21,000**

Damage Reductions Categories	Agricultural Benefit Swalley ID Patrons/ Surrounding Community	Non-Agricultural Benefit	Total
Riley Sublateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$1,000		$1,000
Pumping Cost Savings	$4,000		$4,000
Onsite subtotal	$5,000		$5,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$2,000	$2,000
Fish and Wildlife Habitat / Instream Flows		$5,000	$5,000
Offsite Quantified Subtotal		$7,000	$7,000
Total Quantified Benefits	**$5,000**	**$7,000**	**$12,000**
Mickelson Lateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$0		$0
Pumping Cost Savings	$16,000		$16,000
Onsite subtotal	$16,000		$16,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$3,000	$3,000
Fish and Wildlife Habitat / Instream Flows		$0	$0
Offsite Quantified Subtotal		$3,000	$3,000
Total Quantified Benefits	**$16,000**	**$3,000**	**$19,000**
Elder Lateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$1,000		$1,000
Pumping Cost Savings	$53,000		$53,000
Onsite subtotal	$54,000		$54,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$0	$0
Fish and Wildlife Habitat / Instream Flows		$44,000	$44,000
Offsite Quantified Subtotal		$44,000	$44,000
Total Quantified Benefits	**$54,000**	**$44,000**	**$98,000**
Butte Lateral			
On-Site Damage Reduction Benefits			
Reduced OM&R	$1,000		$1,000

Damage Reductions Categories	Agricultural Benefit Swalley ID Patrons/ Surrounding Community	Non-Agricultural Benefit	Total
Pumping Cost Savings	$13,000		$13,000
Onsite subtotal	$14,000		$14,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$0	$0
Fish and Wildlife Habitat / Instream Flows		$3,000	$3,000
Offsite Quantified Subtotal		$3,000	$3,000
Total Quantified Benefits	**$14,000**	**$3,000**	**$17,000**
Main Canal			
On-Site Damage Reduction Benefits			
Reduced OM&R	$2,000		$2,000
Pumping Cost Savings	$116,000		$116,000
Onsite subtotal	$118,000		$118,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$1,000	$1,000
Fish and Wildlife Habitat / Instream Flows		$92,000	$92,000
Offsite Quantified Subtotal		$93,000	$93,000
Total Quantified Benefits	**$118,000**	**$93,000**	**$211,000**
Main Canal Pump Station			
On-Site Damage Reduction Benefits			
Reduced OM&R	$2,000		$2,000
Pumping Cost Savings	$86,000		$86,000
Onsite subtotal	$88,000		$88,000
Off-Site Damage Reduction Benefits			
Social Value of Carbon (Avoided Carbon Emissions)[2]		$13,000	$13,000
Fish and Wildlife Habitat / Instream Flows		$89,000	$89,000
Offsite Quantified Subtotal		$102,000	$102,000
Total Quantified Benefits	**$88,000**	**$102,000**	**$190,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent.
2/ Indicates the benefit of avoided carbon emissions. These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

Table 5-8. Comparison of Average Annual NED Benefits and Costs Under the HDPE Piping Alternative, Deschutes Watershed, Oregon, 2018$. [1]

	Agriculture-related		Nonagricultural				
Works of Improvement	**Reduced OM&R**	**Pumping Cost Savings**	**Carbon Value**	**Instream Flow Value**	**Average Annual Benefits**	**Average Annual Cost**[2]	**Benefit cost ratio**
Rogers Lateral	$2,000	$97,000	$12,000	$56,000	$167,000	$82,000	2.04
Rogers Sublateral	$0	$6,000	$2,000	$4,000	$12,000	$4,000	3.00
Riley Lateral	$1,000	$6,000	$2,000	$12,000	$21,000	$27,000	0.78
Riley Sublateral	$1,000	$4,000	$2,000	$5,000	$12,000	$7,000	1.71
Mickelson Lateral	$0	$16,000	$3,000	$0	$19,000	$6,000	3.17
Elder Lateral	$1,000	$53,000	$0	$44,000	$98,000	$47,000	2.09
Butte Lateral	$1,000	$13,000	$0	$3,000	$17,000	$19,000	0.89
Main Canal	$2,000	$116,000	$1,000	$92,000	$211,000	$148,000	1.43
Main Canal Pump Station	$2,000	$86,000	$13,000	$89,000	$190,000	$158,000	1.20
TOTAL	**$10,000**	**$397,000**	**$35,000**	**$305,000**	**$747,000**	**$503,000**	**1.49**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ From Table 5-1

Table 5-9. Estimated Cost Savings from Eliminated Irrigation Pumps under the HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Project Group	Year Benefit Begins [2]	Pumps in Use Under No Action	Pumps Eliminated Under Piping Alternative	Annual Service Charges Avoided by Piping Alternative	Average Annual Avoided Cost Under Piping Alternative
Rogers Lateral	2	155	109	$69,000	$67,000
Rogers Sublateral	2	30	0	$0	$0
Riley Lateral	4	41	0	$0	$0
Riley Sublateral	4	12	0	$0	$0
Mickelson Lateral	4	9	9	$6,000	$5,000
Elder Lateral	8	84	59	$37,000	$30,000
Butte Lateral	8	17	15	$10,000	$8,000
Main Canal	8	166	141	$90,000	$74,000
Main Canal Pump Station	8	41	36	$23,000	$19,000
Total	**N/A**	**555**	**369**	**$235,000**	**$203,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

2/ Irrigation pumps will be eliminated after each lateral receives pressurization. For Rogers and Riley (and their sublaterals), this begins after each lateral is constructed. For Michelson, Elder, Butte, Main Canal, and Main Canal Pump Station, pressurization occurs after the construction of the pump station is complete.

Table 5-10. Annual Increased Average Energy Cost Savings to SID Patrons of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Benefits Begin [3]	Total Annual Energy Use Under No Action (kWh)	Annual Energy Use Under HDPE Piping (kWh)	Reduced Annual Energy Use (kWh)[2]	Undiscounted Annual Energy Cost Savings (2018$)
Rogers Lateral	2	458,037	137,411	320,626	$31,000
Rogers Sublateral	2	96,794	38,718	58,076	$6,000
Riley Lateral	4	229,842	172,382	57,460	$6,000
Riley Sublateral	4	113,447	68,068	45,379	$4,000
Mickelson Lateral	8	142,936	0	142,936	$14,000
Elder Lateral	8	409,380	122,814	286,566	$28,000
Butte Lateral	8	69,994	6,999	62,995	$6,000
Main Canal	8	629,074	94,361	534,713	$51,000
Main Canal Pump Station	8	996,562	139,875	856,687	$82,000
TOTAL	**N/A**	**3,146,066**	**780,628**	**2,365,438**	**$228,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ As estimated by Black Rock Consulting in the SID System Improvement Plan, 2017.
3/ Energy cost savings begin after each lateral receives pressurization. For Rogers and Riley (and their sublaterals), this begins after each lateral is constructed. For Michelson, Elder, Butte, Main Canal, and Main Canal Pump Station, pressurization occurs after the construction of the pump station is complete.

Table 5-11. Annual Average Carbon Emission Changes (Metric Tons) by Lateral, Deschutes Watershed, Oregon.

Lateral Name	Year Benefits or Cost Begin [2]	Annual Avoided Emissions from Reduced SID Patron Energy Use (Metric Tons Carbon)	Average Annual Increased Emissions from Reduced Groundwater Recharge (Metric Tons Carbon) [1]	Average Annual Increased Emissions from Reduced Hydropower (prior to runner installation) (Metric Tons Carbon)	Average Annual Increased Emissions from District Pumping (Metric Tons Carbon)	Net Average Emissions Reduction (prior to runner installation) (Metric Tons Carbon)	Net Average Emissions Reduction (after runner installation) (Metric Tons Carbon)
Rogers Lateral	Varies	241	43	0	0	198	198
Rogers Sublateral	Varies	44	3	0	0	41	41
Riley Lateral	Varies	43	10	0	0	33	33
Riley Sublateral	Varies	34	4	0	0	30	30
Mickelson Lateral	Varies	108	0	0	36	72	72
Elder Lateral	Varies	216	36	51	192	-64	-13
Butte Lateral	Varies	47	3	5	104	-64	-59
Main Canal	Varies	402	92	117	327	-133	-16
Main Canal Pump Station	Varies	645	94	117	327	107	224
TOTAL	**N/A**	**1,780**	**285**	**290**	**985**	**220**	**509**

Prepared October 2018

1/Additional energy use elsewhere rises through time as the effects of reduced recharge accumulate and cause groundwater depths to drop over time. The average annual energy use increase elsewhere in the basin represents the average change in energy use across the 100 project years for each Project Group.

2/ The timing of changes in carbon emissions differs depending on the source of carbon. Avoided emissions from energy use (column 3) begin to change according to the timeline in Table 5-10. Increased emissions from reduced groundwater recharge (column 4) begin to change according to the timeline in Table 5-5. Increased emissions from reduced hydropower (column 5) change according to the timeline in Table 5-6. Increased emissions from District Pumping (column 6) begin to change according to the timeline in Table 5-3.

Table 5-12. Annual Average Carbon Emissions (Metric Tons) by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Benefits or Cost Begin[2]	No Action		HDPE Pressurized Piping Alternative (NED Alternative)			Net Carbon		Average Annual NED Benefits[4]
		Average Annual Carbon Emissions, Basinwide Energy Use	Annual Carbon Emissions, SID Energy Use	Average Annual Carbon Emissions, Basinwide Energy Use	Annual Carbon Emissions, SID Energy Use (prior to runner installation)	Annual Carbon Emissions, SID Energy Use (after runner installation)	Net Annual Carbon Reduction Prior to Runner Installation	Net Annual Carbon Reduction After Runner Installation	
Rogers Lateral	Varies	N/A	345	N/A	147	147	198	198	$12,000
Rogers Sublateral	Varies	N/A	73	N/A	32	32	41	41	$2,000
Riley Lateral	Varies	N/A	173	N/A	140	140	33	33	$2,000
Riley Sublateral	Varies	N/A	85	N/A	55	55	30	30	$2,000
Mickelson Lateral	Varies	N/A	108	N/A	36	36	72	72	$3,000
Elder Lateral	Varies	N/A	308	N/A	372	321	-64	-13	-$2,000
Butte Lateral	Varies	N/A	53	N/A	117	112	-64	-59	-$3,000
Main Canal	Varies	N/A	473	N/A	606	490	-133	-16	$1,000
Main Canal Pump Station	Varies	N/A	750	N/A	643	526	107	224	$13,000
TOTAL	**N/A**	**94,359**[3]	**2,367**	**96,879**	**2,148**	**1,858**	**220**	**509**	**$30,000**[5]

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018

2/ See footnote in Table 5-11 for an explanation of the timing of carbon changes.

3/ Note this values rises from 27,920 in Year 1 to 251,288 in Year 107. The average value is 94,359. Carbon emissions rise over time because groundwater pumping volume increases throughout the basin through time, and the depth to groundwater also rises through time due to reduced recharge from canals.

4/ Note that the average annual NED benefits differs from the change in tons of carbon emitted multiplied by the $43 value per metric ton of carbon. The increased emissions rise through time (and are thus highest at later time periods when the values are most discounted, while the decreased carbon emissions are the same through time).

5/ Note that the $30,000 presented is $5,000 less than the $35,000 presented elsewhere in the document. That is because Elder and Butte laterals have a negative benefit, therefore they were included under costs rather than benefits.

Table 5-13. Annual Estimated Instream Flow Value of HDPE Piping Alternative by Lateral, Deschutes Watershed, Oregon, 2018$. [1]

Lateral Name	Year Benefits or Cost Begin[2]	Water Conservation Under HDPE Pressurized Piping Alternative (AF/year)	Instream Flow Value Under No Action	Annualized Average Net Benefits of HDPE Pressurized Piping Alternative
Rogers Lateral	2	771	$0	$56,000
Rogers Sublateral	2	48	$0	$4,000
Riley Lateral	4	169	$0	$12,000
Riley Sublateral	4	72	$0	$5,000
Mickelson Lateral	6	0	$0	$0
Elder Lateral	3	627	$0	$44,000
Butte Lateral	5	48	$0	$3,000
Main Canal	7	1,446	$0	$92,000
Main Canal Pump Station	8	1,446	$0	$89,000
TOTAL	**N/A**	**4,629**	**$0**	**$305,000**

1/ Price base: 2018 dollars amortized over 100 years at a discount rate of 2.875 percent. Prepared October 2018
2/ Benefits from instream flow begin the year after each lateral is constructed.

5.2 Literature on Fish Values

Table 5-14. Studies Examining Fish Values in the Western U.S.

Study Authors	Year of Data	Type of Analysis	Values	Value (2018$)	Value Description
Bell, Huppert, and Johnson	2003	Contingent Valuation	$24 - $122	$35 - $175	Annual WTP per household to either increase salmon population by 100% or enough that it would be protected from extinction (in WA and OR)
Richardson & Loomis	2006	Meta-analysis	$43 - $121	$53 - $149	Annual WTP per household that never fishes to increase population 100% or to increase population 600% (WA and U.S.)
Layton, Brown, and Plummer	1998	Discrete Choice Conjoint Analysis	$119 - $250	$181 - $380	Marginal value to anglers of an additional steelhead caught in OR
Alexander	1989	Random utility	$10 - $16	$20 - $31	Marginal value to anglers of an additional steelhead caught in OR
Loomis	2004	Contingent Valuation	$36 - $149	$47 - $196	Mean net WTP per angler-day (Snake River in ID and WY)
Johnson & Adams	1987	Contingent Valuation	$2 - $14	$5 - $30	Marginal WTP to increase summer flows by one AF in order to increase steelhead populations, or increase populations by 33 - 100% (OR)
ECONorthwest	2007	Contingent Valuation / Travel Cost	$34 - $320	$40 - $383	Sport angler WTP per fish (OR)
Dalton, Bastian, Jacobs, & Wesche	1998	Contingent Valuation	$64 - $227	$97 - $345	Angler consumer surplus per day for an unidentified increase trout population or doubling the chance of catching a large trout (WY)

D.2 Engineering

This appendix section presents the System Improvement Plan.

Swalley IRRIGATION DISTRICT

System Improvement Plan

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REGISTERED PROFESSIONAL ENGINEER 17425 OREGON SEPT. 28, 1994 KEVIN L. CREW
EXPIRES: 31 DECEMBER, 2017

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Executive Summary

This study was commissioned by Farmers Conservation Alliance with support from Energy Trust of Oregon. The purpose of this System Improvement Plan (SIP) was to develop a well-considered evaluation of the District's primary and secondary canal systems, a mitigation plan for the seepage losses, and consideration of resulting pressurized deliveries. System piping was the primary method proposed for such mitigation.

In August and September of 2016, two meetings were held with District staff to confirm approach on the SIP. Data requests were fulfilled by the District. The District also determined that it planned to provide patron delivery pressurization where possible. The District determined that a value of 7 GPM/Acre should be used for hydraulic modeling and pipe sizing purposes. Lastly, that the cost estimating resulting from the SIP should provide District flexibility, therefore should provide lateral by lateral seepage loss and cost of mitigation (through piping) information.

The District's approximate 4,333 acres (excluding banked acres) are served by one primary diversion and canal and with approximately 328 of those acres being served directly from Deschutes River withdrawals. The primary canal and laterals were evaluated for seepage loss using state-of-the-art measurement equipment and it was found that approximately 20.1 CFS were being lost at the time of measurements. Of the 20.1 CFS, it was determined that approximately 16 CFS (Table 1.1, page 4) might be conserved if the system were completely piped (assuming certificated peak flows of 7.64 GPM/Acre delivered). See Section 3.3 (page 17) and Appendix A (page 54) for further details.

The District chose to consider pressurization to patron deliveries as it rolls-out its System Improvement Plan. To accomplish this in the north area of the District, future hydroelectric power plant modification or the installation of a pump station downstream of the hydroelectric power plant would be required. This was the assumed method for the purposes of this SIP. Given this approach, fully piping the District system will accomplish significant pressurization of the District resulting in the estimated reduction of 2.45gWh in patron pumping costs each season. The addition of pumping will require an estimated 1.3gWh each season for a net potential 1.15gW of savings (see Section 4.2, page 22). No pressure reducing valves except for the existing hydroelectric power plant were found to be necessary.

A Pipe manufacturer/vendor was contacted to provide budgetary pipe cost information for pipe delivered to Central Oregon. This information was used to develop reconnaissance-level cost estimates to design and construct the entire piped system to all patron and private delivery points. The cost estimates were evaluated and broken into lateral-by-lateral cost elements. An At-A-Glance Map and Summary Table are provided below indicating the summary results of this System Improvement Plan.

D.3 Capital Cost for the Preferred Alternative

This appendix section presents dimensions and capital costs for the Preferred Alternative, the HDPE Piping Alternative.

HDPE Piping Alternative

Project Group	Name	Feature	Diameter (in)	Length (ft)	Turnout Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	ROGERS	PIPE	30	2,559	NA	LF	$119	$303,651	8%	12%	30%	$24,292	$36,438	$109,314	$473,695
1	ROGERS	PIPE	24	4,728	NA	LF	$75	$355,356	8%	12%	30%	$28,429	$42,643	$127,928	$554,356
1	ROGERS	PIPE	20	3,902	NA	LF	$54	$209,693	8%	12%	30%	$16,775	$25,163	$75,490	$327,122
1	ROGERS	PIPE	18	1,340	NA	LF	$54	$72,789	8%	12%	30%	$5,823	$8,735	$26,204	$113,551
1	ROGERS	PIPE	16	1,927	NA	LF	$43	$81,898	8%	12%	30%	$6,552	$9,828	$29,483	$127,760
1	ROGERS	PIPE	14	1,120	NA	LF	$34	$38,282	8%	12%	30%	$3,063	$4,594	$13,781	$59,719
1	ROGERS	PIPE	12	435	NA	LF	$33	$14,303	8%	12%	30%	$1,144	$1,716	$5,149	$22,312
1	ROGERS	PIPE	12	2,372	NA	LF	$32	$76,900	8%	12%	30%	$6,152	$9,228	$27,684	$119,964
1	ROGERS	PIPE	10	1,509	NA	LF	$25	$37,514	8%	12%	30%	$3,001	$4,502	$13,505	$58,521
1	ROGERS	TURNOUT	1	NA	49	EA	$8,000	$392,000	8%	12%	30%	$31,360	$47,040	$141,120	$611,520
1	ROGERS-SUB	PIPE	10	1,313	NA	LF	$19	$24,422	10%	15%	30%	$2,442	$3,663	$9,158	$39,685
1	ROGERS-SUB	PIPE	8	922	NA	LF	$13	$12,207	10%	15%	30%	$1,221	$1,831	$4,578	$19,837
1	ROGERS-SUB	TURNOUT	1	NA	4	EA	$8,000	$32,000	10%	15%	30%	$3,200	$4,800	$12,000	$52,000
1	RILEY	PIPE	20	2,449	NA	LF	$55	$135,038	12%	15%	30%	$16,205	$20,256	$51,449	$222,948
1	RILEY	PIPE	16	1,113	NA	LF	$36	$40,313	12%	15%	30%	$4,838	$6,047	$15,359	$66,557
1	RILEY	PIPE	14	2,972	NA	LF	$29	$86,664	12%	15%	30%	$10,400	$13,000	$33,019	$143,081
1	RILEY	PIPE	12	738	NA	LF	$25	$18,302	12%	15%	30%	$2,196	$2,745	$6,973	$30,217

Project Group	Name	Feature	Diameter (in)	Length (ft)	Turnout Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	RILEY	TURNOUT	1	NA	30	EA	$8,000	$240,000	12%	15%	30%	$28,800	$36,000	$91,440	$396,240
1	RILEY-SUB	PIPE	12	4,994	NA	LF	$22	$111,866	12%	15%	30%	$13,424	$16,780	$42,621	$184,690
1	RILEY-SUB	PIPE	8	1,629	NA	LF	$13	$20,916	12%	15%	30%	$2,510	$3,137	$7,969	$34,533
1	RILEY-SUB	TURNOUT	1	NA	11	EA	$8,000	$88,000	12%	15%	30%	$10,560	$13,200	$33,528	$145,288
1	ELDER	PIPE	18	4,305	NA	LF	$43	$186,665	8%	12%	30%	$14,933	$22,400	$67,199	$291,197
1	ELDER	PIPE	16	1,183	NA	LF	$36	$42,446	8%	12%	30%	$3,396	$5,094	$15,281	$66,216
1	ELDER	PIPE	14	1,530	NA	LF	$28	$42,136	8%	12%	30%	$3,371	$5,056	$15,169	$65,732
1	ELDER	PIPE	12	604	NA	LF	$26	$15,716	8%	12%	30%	$1,257	$1,886	$5,658	$24,517
1	ELDER	PIPE	10	882	NA	LF	$18	$16,176	8%	12%	30%	$1,294	$1,941	$5,823	$25,234
1	ELDER	PIPE	8	1,553	NA	LF	$13	$20,251	8%	12%	30%	$1,620	$2,430	$7,290	$31,592
1	ELDER	TURNOUT	1	NA	25	EA	$8,000	$200,000	8%	12%	30%	$16,000	$24,000	$72,000	$312,000
2	MICKELSON	PIPE	10	1,877	NA	LF	$20	$38,403	15%	18%	30%	$5,761	$6,913	$15,323	$66,400
2	MICKELSON	TURNOUT	1	NA	2	EA	$8,000	$16,000	15%	18%	30%	$2,400	$2,880	$6,384	$27,664
2	BUTTE	PIPE	8	4,378	NA	LF	$13	$57,089	12%	15%	30%	$6,851	$8,563	$21,751	$94,254
2	BUTTE	PIPE	8	1,056	NA	LF	$15	$15,650	12%	15%	30%	$1,878	$2,347	$5,963	$25,838
2	BUTTE	TURNOUT	1	NA	8	EA	$8,000	$64,000	12%	15%	30%	$7,680	$9,600	$24,384	$105,664
2	MAIN	PIPE	48	2,094	NA	LF	$307	$643,863	6%	12%	30%	$38,632	$77,264	$227,928	$987,686
2	MAIN	PIPE	42	4,560	NA	LF	$252	$1,148,755	6%	12%	30%	$68,925	$137,851	$406,659	$1,762,190
2	MAIN	PIPE	36	6,709	NA	LF	$170	$1,138,249	6%	12%	30%	$68,295	$136,590	$402,940	$1,746,074

Project Group	Name	Feature	Diameter (in)	Length (ft)	Turnout Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
2	MAIN	PIPE	34	1,933	NA	LF	$151	$291,612	6%	12%	30%	$17,497	$34,993	$103,231	$447,333
2	MAIN	PIPE	32	831	NA	LF	$133	$110,357	6%	12%	30%	$6,621	$13,243	$39,066	$169,287
2	MAIN	PIPE	28	3,086	NA	LF	$104	$319,956	6%	12%	30%	$19,197	$38,395	$113,265	$490,813
2	MAIN	PIPE	28	1,665	NA	LF	$127	$210,722	6%	12%	30%	$12,643	$25,287	$74,596	$323,248
2	MAIN	PIPE	26	2,746	NA	LF	$110	$302,719	6%	12%	30%	$18,163	$36,326	$107,163	$464,371
2	MAIN	PIPE	24	2,534	NA	LF	$93	$235,510	6%	12%	30%	$14,131	$28,261	$83,371	$361,272
2	MAIN	PIPE	20	1,283	NA	LF	$66	$84,858	6%	12%	30%	$5,091	$10,183	$30,040	$130,172
2	MAIN	PIPE	18	344	NA	LF	$59	$20,447	6%	12%	30%	$1,227	$2,454	$7,238	$31,366
2	MAIN	PIPE	18	320	NA	LF	$51	$16,390	6%	12%	30%	$983	$1,967	$5,802	$25,143
2	MAIN	PIPE	16	3,039	NA	LF	$71	$215,951	6%	12%	30%	$12,957	$25,914	$76,447	$331,269
2	MAIN	PIPE	14	1,566	NA	LF	$39	$61,826	6%	12%	30%	$3,710	$7,419	$21,886	$94,841
2	MAIN	PIPE	12	66	NA	LF	$91	$6,021	6%	12%	30%	$361	$722	$2,131	$9,235
2	MAIN	PIPE	10	872	NA	LF	$17	$15,208	6%	12%	30%	$912	$1,825	$5,384	$23,329
2	MAIN	PIPE	8	526	NA	LF	$21	$11,141	6%	12%	30%	$668	$1,337	$3,944	$17,090
2	MAIN	TURNOUT	1	NA	49	EA	$8,000	$392,000	6%	12%	30%	$23,520	$47,040	$138,768	$601,328
2	Pump Station	Mobilization	NA	NA	NA	1	$20,000	$20,655	12%	18%	30%	$2,479	$3,718	$6,196	$33,048
2	Pump Station	Civil Works	NA	NA	NA	1	$100,000	$103,275	12%	18%	30%	$12,393	$18,589	$30,982	$165,240
2	Pump Station	Pump/Motor	NA	NA	NA	1	$54,502	$55,113	12%	18%	15%	$6,614	$9,920	$8,267	$79,914
2	Pump Station	Controls	NA	NA	NA	1	$35,000	$36,146	12%	18%	30%	$4,338	$6,506	$10,844	$57,834

Project Group	Name	Feature	Diameter (in)	Length (ft)	Turnout Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
2	Pump Station	Electrical	NA	NA	NA	1	$75,000	$77,456	12%	18%	30%	$9,295	$13,942	$23,237	$123,930
2	Pump Station	Building	NA	NA	NA	1	$30,000	$30,982	12%	18%	30%	$3,718	$5,577	$9,295	$49,572
Total Capital Cost of All Project Groups															**$13,465,491** [1]

Note: [1] $13,468,000 is presented elsewhere in the document due to rounding.

D.4 Capital Costs for the Eliminated Alternatives

This appendix section presents dimensions and capital costs for the eliminated alternatives, which includes canal lining, PVC piping, steel piping and partial groundwater use.

Canal Lining Alternative

Project Group	Name	Feature	Length (ft)	Turnout Quantity	Channel perimeter (ft)	Turnout Cost	Geotextile Costs	Geotextile overlap costs	Shotcrete Costs	Fence Costs	Ladder Costs	Constr factor	Subtotal Cost	Engineering, CM, Survey	CMGC	Contingency	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	Elder	Channel	10,056	NA	16.00	NA	$239,294	$957	$884,693	$137,964	$0	1.5	$1,894,363	8%	12%	30%	$151,549	$227,324	$681,971	$2,955,206
1	Elder	Turnout	NA	25	NA	$25,000	NA	NA	NA	NA	NA	1.5	$37,500	8%	12%	30%	$3,000	$4,500	$13,500	$58,500
1	Riley	Channel	5,350	NA	17.48	NA	$134,040	$536	$514,211	$73,403	$0	1.5	$1,083,285	12%	15%	30%	$129,994	$162,493	$412,732	$1,788,504
1	Riley Sublateral	Channel	5,598	NA	16.42	NA	$135,230	$541	$505,552	$76,804	$0	1.5	$1,077,190	12%	15%	30%	$129,263	$161,578	$410,409	$1,778,441
1	Riley Sublateral	Turnout	NA	11	NA	$11,000	NA	NA	NA	NA	NA	1.5	$16,500	12%	15%	30%	$1,980	$2,475	$6,287	$27,242
1	Riley turnouts	Turnout	NA	30	NA	$30,000	NA	NA	NA	NA	NA	1.5	$45,000	12%	15%	30%	$5,400	$6,750	$17,145	$74,295
1	Rogers North	Channel	9,372	NA	16.83	NA	$229,694	$919	$867,704	$128,584	$0	1.5	$1,840,351	8%	12%	30%	$147,228	$220,842	$662,526	$2,870,947
1	Rogers South	Channel	6,466	NA	23.43	NA	$194,737	$779	$833,309	$88,714	$4,311	1.5	$1,682,775	8%	12%	30%	$134,622	$201,933	$605,799	$2,625,129
1	Rogers Sublateral	Channel	2,056	NA	11.44	NA	$40,966	$164	$129,366	$28,211	$0	1.5	$298,060	10%	15%	30%	$29,806	$44,709	$111,773	$484,348
1	Rogers Sublateral	Turnout	NA	4	NA	$4,000	NA	NA	NA	NA	NA	1.5	$6,000	10%	15%	30%	$600	$900	$2,250	$9,750
1	Rogers	Turnout	NA	49	NA	$49,000	NA	NA	NA	NA	NA	1.5	$73,500	8%	12%	30%	$5,880	$8,820	$26,460	$114,660
2	Butte	Channel	5,433	NA	15.47	NA	$126,858	$507	$462,253	$74,544	$0	1.5	$996,245	12%	15%	30%	$119,549	$149,437	$379,569	$1,644,800
2	Butte	Turnout	NA	8	NA	$8,000	NA	NA	NA	NA	NA	1.5	$12,000	12%	15%	30%	$1,440	$1,800	$4,572	$19,812
2	Main Canal north of Mickelson	Channel	6,388	NA	20.62	NA	$187,990	$752	$724,531	$87,643	$0	1.5	$1,501,375	6%	12%	30%	$90,083	$180,165	$531,487	$2,303,109
2	Main Canal south of Mickelson	Channel	27,782	NA	28.50	NA	$1,003,625	$4,014	$4,354,829	$381,169	$18,521	1.5	$8,643,237	6%	12%	30%	$518,594	$1,037,188	$3,059,706	$13,258,726
2	Main	Turnout	NA	49	NA	$49,000	NA	NA	NA	NA	NA	1.5	$73,500	6%	12%	30%	$4,410	$8,820	$26,019	$112,749
2	Mickelson	Channel	1,882	NA	18.19	NA	$48,285	$193	$188,246	$25,816	$1,254	1.5	$395,691	15%	18%	30%	$59,354	$71,224	$157,881	$684,149

Project Group	Name	Feature	Length (ft)	Turnout Quantity	Channel perimeter (ft)	Turnout Cost	Geotextile Costs	Geotextile overlap costs	Shotcrete Costs	Fence Costs	Ladder Costs	Constr factor	Subtotal Cost	Engineering, CM, Survey	CMGC	Contingency	Engineering, CM, Survey	CMGC	Contingency	Total Cost
2	Mickelson	Turnout	NA	2	NA	$2,000	NA	NA	NA	NA	NA	1.5	$3,000	15%	18%	30%	$450	$540	$1,197	$5,187
																			Total Capital Cost of All Project Groups	**$30,815,554**

Steel Piping Alternative

Project Group	Name	Feature	Dia. (in)	Length (ft)	Turnout/Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	ELDER	PIPE	18	4,305	43	LF	$122	$569,693	8%	12%	30%	$45,575	$68,363	$205,089	$888,720
1	ELDER	PIPE	16	1,183	12	LF	$109	$140,243	8%	12%	30%	$11,219	$16,829	$50,488	$218,779
1	ELDER	PIPE	14	1,530	15	LF	$95	$160,290	8%	12%	30%	$12,823	$19,235	$57,704	$250,053
1	ELDER	PIPE	12	604	6	LF	$81	$54,952	8%	12%	30%	$4,396	$6,594	$19,783	$85,726
1	ELDER	PIPE	10	882	9	LF	$67	$68,088	8%	12%	30%	$5,447	$8,171	$24,512	$106,217
1	ELDER	PIPE	8	1,553	16	LF	$53	$98,480	8%	12%	30%	$7,878	$11,818	$35,453	$153,629
1	ELDER	TURNOUT	1	NA	25	EA	$8,000	$200,000	8%	12%	30%	$16,000	$24,000	$72,000	$312,000
1	RILEY	PIPE	20	2,449	24	LF	$136	$357,840	12%	15%	30%	$42,941	$53,676	$136,337	$590,794
1	RILEY	PIPE	16	1,113	11	LF	$109	$131,945	12%	15%	30%	$15,833	$19,792	$50,271	$217,841
1	RILEY	PIPE	14	2,972	30	LF	$95	$311,361	12%	15%	30%	$37,363	$46,704	$118,629	$514,057
1	RILEY	PIPE	12	738	7	LF	$81	$67,144	12%	15%	30%	$8,057	$10,072	$25,582	$110,855
1	RILEY	TURNOUT	1	NA	30	EA	$8,000	$240,000	12%	15%	30%	$28,800	$36,000	$91,440	$396,240
1	RILEY-SUB	PIPE	12	4,994	50	LF	$81	$454,358	12%	15%	30%	$54,523	$68,154	$173,111	$750,146
1	RILEY-SUB	PIPE	8	1,629	16	LF	$53	$103,300	12%	15%	30%	$12,396	$15,495	$39,357	$170,548
1	RILEY-SUB	TURNOUT	1	NA	11	EA	$8,000	$88,000	12%	15%	30%	$10,560	$13,200	$33,528	$145,288
1	ROGERS	PIPE	30	2,559	26	LF	$205	$550,279	8%	12%	30%	$44,022	$66,033	$198,100	$858,435
1	ROGERS	PIPE	24	4,728	47	LF	$164	$821,181	8%	12%	30%	$65,694	$98,542	$295,625	$1,281,043
1	ROGERS	PIPE	20	3,902	39	LF	$136	$570,147	8%	12%	30%	$45,612	$68,418	$205,253	$889,430
1	ROGERS	PIPE	18	1,340	13	LF	$122	$177,326	8%	12%	30%	$14,186	$21,279	$63,837	$276,628
1	ROGERS	PIPE	16	1,927	19	LF	$109	$228,444	8%	12%	30%	$18,275	$27,413	$82,240	$356,372

Project Group	Name	Feature	Dia. (in)	Length (ft)	Turnout/Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	ROGERS	PIPE	14	1,120	11	LF	$95	$117,337	8%	12%	30%	$9,387	$14,080	$42,241	$183,045
1	ROGERS	PIPE	12	435	4	LF	$81	$39,577	8%	12%	30%	$3,166	$4,749	$14,248	$61,740
1	ROGERS	PIPE	12	2,372	24	LF	$81	$215,807	8%	12%	30%	$17,265	$25,897	$77,690	$336,658
1	ROGERS	PIPE	10	1,509	15	LF	$67	$116,490	8%	12%	30%	$9,319	$13,979	$41,936	$181,725
1	ROGERS	TURNOUT	1	NA	49	EA	$8,000	$392,000	8%	12%	30%	$31,360	$47,040	$141,120	$611,520
1	ROGERS-SUB	PIPE	10	1,313	13	LF	$67	$101,359	10%	15%	30%	$10,136	$15,204	$38,010	$164,709
1	ROGERS-SUB	PIPE	8	922	9	LF	$53	$58,467	10%	15%	30%	$5,847	$8,770	$21,925	$95,008
1	ROGERS-SUB	TURNOUT	1	NA	4	EA	$8,000	$32,000	10%	15%	30%	$3,200	$4,800	$12,000	$52,000
2	BUTTE	PIPE	8	4,378	44	LF	$53	$277,622	12%	15%	30%	$33,315	$41,643	$105,774	$458,353
2	BUTTE	PIPE	8	1,056	11	LF	$53	$66,964	12%	15%	30%	$8,036	$10,045	$25,513	$110,558
2	BUTTE	TURNOUT	1	NA	8	EA	$8,000	$64,000	12%	15%	30%	$7,680	$9,600	$24,384	$105,664
2	MAIN	PIPE	48	2,094	21	LF	$329	$710,059	6%	12%	30%	$42,604	$85,207	$251,361	$1,089,231
2	MAIN	PIPE	42	4,560	46	LF	$288	$1,357,696	6%	12%	30%	$81,462	$162,924	$480,624	$2,082,706
2	MAIN	PIPE	36	6,709	67	LF	$246	$1,720,110	6%	12%	30%	$103,207	$206,413	$608,919	$2,638,649
2	MAIN	PIPE	34	1,933	19	LF	$233	$468,955	6%	12%	30%	$28,137	$56,275	$166,010	$719,376
2	MAIN	PIPE	32	831	8	LF	$219	$190,150	6%	12%	30%	$11,409	$22,818	$67,313	$291,690
2	MAIN	PIPE	28	3,086	31	LF	$191	$621,066	6%	12%	30%	$37,264	$74,528	$219,857	$952,715
2	MAIN	PIPE	28	1,665	17	LF	$191	$335,086	6%	12%	30%	$20,105	$40,210	$118,620	$514,021
2	MAIN	PIPE	26	2,746	27	LF	$177	$514,789	6%	12%	30%	$30,887	$61,775	$182,235	$789,686
2	MAIN	PIPE	24	2,534	25	LF	$164	$440,117	6%	12%	30%	$26,407	$52,814	$155,801	$675,139

Project Group	Name	Feature	Dia. (in)	Length (ft)	Turnout/Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
2	MAIN	PIPE	20	1,283	13	LF	$136	$187,468	6%	12%	30%	$11,248	$22,496	$66,364	$287,576
2	MAIN	PIPE	18	344	3	LF	$122	$45,522	6%	12%	30%	$2,731	$5,463	$16,115	$69,831
2	MAIN	PIPE	18	320	3	LF	$122	$42,346	6%	12%	30%	$2,541	$5,082	$14,991	$64,960
2	MAIN	PIPE	16	3,039	30	LF	$109	$360,270	6%	12%	30%	$21,616	$43,232	$127,535	$552,654
2	MAIN	PIPE	14	1,566	16	LF	$95	$164,062	6%	12%	30%	$9,844	$19,687	$58,078	$251,671
2	MAIN	PIPE	12	66	1	LF	$81	$6,005	6%	12%	30%	$360	$721	$2,126	$9,211
2	MAIN	PIPE	10	872	9	LF	$67	$67,316	6%	12%	30%	$4,039	$8,078	$23,830	$103,262
2	MAIN	PIPE	8	526	5	LF	$53	$33,355	6%	12%	30%	$2,001	$4,003	$11,808	$51,167
2	MAIN	TURNOUT	1	NA	49	EA	$8,000	$392,000	6%	12%	30%	$23,520	$47,040	$138,768	$601,328
2	MICKELSON	PIPE	10	1,877	19	LF	$67	$144,899	15%	18%	30%	$21,735	$26,082	$57,815	$250,530
2	MICKELSON	TURNOUT	1	NA	2	EA	$8,000	$16,000	15%	18%	30%	$2,400	$2,880	$6,384	$27,664
2	Pump Station	Mobilization	NA	NA	NA	NA	NA	$20,655	12%	18%	30%	$2,479	$3,718	$6,196	$33,048
2	Pump Station	Civil Works	NA	NA	NA	NA	NA	$103,275	12%	18%	30%	$12,393	$18,589	$30,982	$165,240
2	Pump Station	Pump/Motor	NA	NA	NA	NA	NA	$55,113	12%	18%	15%	$6,614	$9,920	$8,267	$79,914
2	Pump Station	Controls	NA	NA	NA	NA	NA	$36,146	12%	18%	30%	$4,338	$6,506	$10,844	$57,834
2	Pump Station	Electrical	NA	NA	NA	NA	NA	$77,456	12%	18%	30%	$9,295	$13,942	$23,237	$123,930
2	Pump Station	Building	NA	NA	NA	NA	NA	$30,982	12%	18%	30%	$3,718	$5,577	$9,295	$49,572
														Total Capital Cost of All Project Groups	**$23,466,383**

PVC Piping Alternative

Project Group	Name	Feature	Material	Dia. (in)	Length (ft)	Turnout /Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	ELDER	TURNOUT	HDPE	1	NA	25	EA	$8,000	$200,000	15%	12%	30%	$30,000	$24,000	$76,200	$330,200
1	ELDER	PIPE	PVC	8	1,553	16	LF	$6	$24,412	15%	12%	30%	$3,662	$2,929	$9,301	$40,304
1	ELDER	PIPE	PVC	12	604	6	LF	$13	$13,591	15%	12%	30%	$2,039	$1,631	$5,178	$22,439
1	ELDER	PIPE	PVC	16	1,183	12	LF	$22	$37,602	15%	12%	30%	$5,640	$4,512	$14,326	$62,081
1	ELDER	PIPE	PVC	18	4,305	43	LF	$27	$160,872	15%	12%	30%	$24,131	$19,305	$61,292	$265,600
1	ELDER	PIPE	PVC	10	882	9	LF	$9	$16,650	15%	12%	30%	$2,497	$1,998	$6,344	$27,489
1	ELDER	PIPE	PVC	14	1,530	15	LF	$17	$41,057	15%	12%	30%	$6,159	$4,927	$15,643	$67,785
1	RILEY	TURNOUT	HDPE	1	NA	30	EA	$8,000	$240,000	15%	12%	30%	$36,000	$28,800	$91,440	$396,240
1	RILEY	PIPE	PVC	12	738	7	LF	$13	$16,606	15%	12%	30%	$2,491	$1,993	$6,327	$27,417
1	RILEY	PIPE	PVC	14	2,972	30	LF	$17	$79,752	15%	12%	30%	$11,963	$9,570	$30,386	$131,671
1	RILEY	PIPE	PVC	16	1,113	11	LF	$22	$35,377	15%	12%	30%	$5,307	$4,245	$13,479	$58,408
1	RILEY	PIPE	PVC	20	2,449	24	LF	$34	$106,738	15%	12%	30%	$16,011	$12,809	$40,667	$176,224
1	RILEY-SUB	TURNOUT	HDPE	1	NA	11	EA	$8,000	$88,000	15%	12%	30%	$13,200	$10,560	$33,528	$145,288
1	RILEY-SUB	PIPE	PVC	8	1,629	16	LF	$6	$25,607	15%	12%	30%	$3,841	$3,073	$9,756	$42,277
1	RILEY-SUB	PIPE	PVC	12	4,994	50	LF	$13	$112,372	15%	12%	30%	$16,856	$13,485	$42,814	$185,526
1	ROGERS	TURNOUT	HDPE	1	NA	49	EA	$8,000	$392,000	15%	12%	30%	$58,800	$47,040	$149,352	$647,192
1	ROGERS	PIPE	PVC	10	1,509	15	LF	$9	$28,486	15%	12%	30%	$4,273	$3,418	$10,853	$47,030
1	ROGERS	PIPE	PVC	12	435	4	LF	$13	$9,788	15%	12%	30%	$1,468	$1,175	$3,729	$16,160
1	ROGERS	PIPE	PVC	12	2,372	24	LF	$13	$53,373	15%	12%	30%	$8,006	$6,405	$20,335	$88,119
1	ROGERS	PIPE	PVC	14	1,120	11	LF	$17	$30,055	15%	12%	30%	$4,508	$3,607	$11,451	$49,620

Project Group	Name	Feature	Material	Dia. (in)	Length (ft)	Turnout /Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
1	ROGERS	PIPE	PVC	16	1,927	19	LF	$22	$61,251	15%	12%	30%	$9,188	$7,350	$23,336	$101,125
1	ROGERS	PIPE	PVC	18	1,340	13	LF	$27	$50,074	15%	12%	30%	$7,511	$6,009	$19,078	$82,672
1	ROGERS	PIPE	PVC	20	3,902	39	LF	$34	$170,066	15%	12%	30%	$25,510	$20,408	$64,795	$280,778
1	ROGERS	PIPE	PVC	24	4,728	47	LF	$48	$273,809	15%	12%	30%	$41,071	$32,857	$104,321	$452,058
1	ROGERS	PIPE	PVC	30	2,559	26	LF	$74	$215,330	15%	12%	30%	$32,300	$25,840	$82,041	$355,510
1	ROGERS-SUB	TURNOUT	HDPE	1	NA	4	EA	$8,000	$32,000	15%	12%	30%	$4,800	$3,840	$12,192	$52,832
1	ROGERS-SUB	PIPE	PVC	8	922	9	LF	$6	$14,493	15%	12%	30%	$2,174	$1,739	$5,522	$23,928
1	ROGERS-SUB	PIPE	PVC	10	1,313	13	LF	$9	$24,786	15%	12%	30%	$3,718	$2,974	$9,443	$40,921
2	BUTTE	TURNOUT	HDPE	1	NA	8	EA	$8,000	$64,000	15%	12%	30%	$9,600	$7,680	$24,384	$105,664
2	BUTTE	PIPE	PVC	8	4,378	44	LF	$6	$68,819	15%	12%	30%	$10,323	$8,258	$26,220	$113,620
2	BUTTE	PIPE	PVC	8	1,056	11	LF	$6	$16,600	15%	12%	30%	$2,490	$1,992	$6,324	$27,406
2	MAIN	TURNOUT	HDPE	1	NA	49	EA	$8,000	$392,000	15%	12%	30%	$58,800	$47,040	$149,352	$647,192
2	MAIN	PIPE	PVC	8	526	5	LF	$6	$8,268	15%	12%	30%	$1,240	$992	$3,150	$13,651
2	MAIN	PIPE	PVC	10	872	9	LF	$9	$16,461	15%	12%	30%	$2,469	$1,975	$6,272	$27,177
2	MAIN	PIPE	PVC	12	66	1	LF	$13	$1,485	15%	12%	30%	$223	$178	$566	$2,452
2	MAIN	PIPE	PVC	14	1,566	16	LF	$17	$42,023	15%	12%	30%	$6,303	$5,043	$16,011	$69,380
2	MAIN	PIPE	PVC	16	3,039	30	LF	$22	$96,596	15%	12%	30%	$14,489	$11,592	$36,803	$159,480
2	MAIN	PIPE	PVC	18	344	3	LF	$27	$12,855	15%	12%	30%	$1,928	$1,543	$4,898	$21,223
2	MAIN	PIPE	PVC	18	320	3	LF	$27	$11,958	15%	12%	30%	$1,794	$1,435	$4,556	$19,743
2	MAIN	PIPE	PVC	20	1,283	13	LF	$34	$55,919	15%	12%	30%	$8,388	$6,710	$21,305	$92,322

Project Group	Name	Feature	Material	Dia. (in)	Length (ft)	Turnout /Elbow Quantity	Unit	$/Unit	Subtotal Cost	Engineering, CM, Survey (%)	CMGC (%)	Contingency (%)	Engineering, CM, Survey	CMGC	Contingency	Total Cost
2	MAIN	PIPE	PVC	24	2,534	25	LF	$48	$146,749	15%	12%	30%	$22,012	$17,610	$55,912	$242,283
2	MAIN	PIPE	PVC	26	2,746	27	LF	$56	$181,303	15%	12%	30%	$27,196	$21,756	$69,077	$299,332
2	MAIN	PIPE	PVC	28	3,086	31	LF	$65	$230,738	15%	12%	30%	$34,611	$27,689	$87,911	$380,948
2	MAIN	PIPE	PVC	28	1,665	17	LF	$65	$124,491	15%	12%	30%	$18,674	$14,939	$47,431	$205,534
2	MAIN	PIPE	PVC	32	831	8	LF	$84	$78,243	15%	12%	30%	$11,736	$9,389	$29,811	$129,180
2	MAIN	PIPE	PVC	34	1,933	19	LF	$95	$202,573	15%	12%	30%	$30,386	$24,309	$77,180	$334,447
2	MAIN	PIPE	PVC	36	6,709	67	LF	$106	$778,720	15%	12%	30%	$116,808	$93,446	$296,692	$1,285,666
2	MAIN	PIPE	PVC	42	4,560	46	LF	$144	$700,809	15%	12%	30%	$105,121	$84,097	$267,008	$1,157,036
2	MAIN	PIPE	PVC	48	2,094	21	LF	$187	$412,501	15%	12%	30%	$61,875	$49,500	$157,163	$681,040
2	MICKELSON	TURNOUT	HDPE	1	NA	2	EA	$8,000	$16,000	15%	12%	30%	$2,400	$1,920	$6,096	$26,416
2	MICKELSON	PIPE	PVC	10	1,877	19	LF	$9	$35,433	15%	12%	30%	$5,315	$4,252	$13,500	$58,499
2	Pump Station	Mobilization	NA	NA	NA	NA	NA	NA	$20,655	12%	18%	30%	$2,479	$3,718	$6,196	$33,048
2	Pump Station	Civil Works	NA	NA	NA	NA	NA	NA	$103,275	12%	18%	30%	$12,393	$18,589	$30,982	$165,240
2	Pump Station	Pump/Motor	NA	NA	NA	NA	NA	NA	$55,113	12%	18%	15%	$6,614	$9,920	$8,267	$79,914
2	Pump Station	Controls	NA	NA	NA	NA	NA	NA	$36,146	12%	18%	30%	$4,338	$6,506	$10,844	$57,834
2	Pump Station	Electrical	NA	NA	NA	NA	NA	NA	$77,456	12%	18%	30%	$9,295	$13,942	$23,237	$123,930
2	Pump Station	Building	NA	NA	NA	NA	NA	NA	$30,982	12%	18%	30%	$3,718	$5,577	$9,295	$49,572
Total Capital Cost of All Project Groups																**$10,826,123**

Groundwater Pumping Alternative

Construction Cost for 1 Patron Well				
Item	**Unit**	**Quantity**	**Unit Cost**	**Total cost**
Install Conductor Casing	ft	50	$175	$8,750
Drill Pilot Hole	ft	240	$45	$10,808
E-log	ea	1	$1,500	$1,500
Ream Pilot Hole	ft	240	$60	$14,410
Install Blank Casing	ft	182	$7	$1,228
Install Screen	ft	240	$2	$480
Install Gravel Pack	ft	240	$15	$3,603
Grout Seal	ft	240	$15	$3,603
Plumb & Alignment Test	ea	1	$1,500	$1,500
Surge/Airflit Development	ea	1	$1,500	$1,500
Pumping Development	ea	1	$1,500	$1,500
Step Test	ea	1	$1,500	$1,500
Constant Q Test	ea	1	$1,500	$1,500
Pump Cost	ea	1	$21,000	$21,000
Install Pump	ea	1	$1,500	$1,500
Electric & Wellhead Finish	ea	1	$1,500	$1,500
			Total Cost per Well	**$75,881**

Total Well Construction Cost for All Patrons			
	Project Group 1	Project Group 2	Total
Number of Patrons	119	10	129
Total Cost	**$9,029,860**	**$8,774,860**	**$17,804,720**

Ongoing Annual Groundwater Energy Costs	
	Total
Acreage Served	1,753
Patron Demand (gpm)	12,271
Number of Patrons	129
Flow Requirements (cfs)	27.4
Total acre-feet used per year	11,572
Patron Demand per patron (gpm)	95
Acre-feet used per patron per year	90
kwh per year	45,234
Cost per patron year	$2,783
Total Operating Costs	**$358,979**

D.5 Net Present Value of Alternatives

This section presents the calculations used to estimate the net present value of the Preferred Alternative and the eliminated alternatives.

Discount Rate: 2.8750 percent

Period of Analysis: 100 years

Project Groups	**Alternatives**				
	HDPE Piping	**PVC Piping**	**Steel Piping**	**Canal Lining**	**Groundwater & HDPE Piping**
Design Life (years)	100	33	50	33	50
Capital Costs					
1	$4,623,000	$4,217,000	$10,259,000	$12,787,000	$9,030,000
2	$8,845,000	$6,609,000	$13,207,000	$18,029,000	$8,775,000
Total:	**$13,468,000**	**$10,826,000**	**$23,466,000**	**$30,816,000**	**$17,805,000**
Net Present Value of Replacement Costs					
1	N/A	$2,653,000	$2,641,000	$8,455,000	$3,826,000
2	$47,000	$3,885,000	$3,349,000	$11,969,000	$332,000
Total:	**$47,000**	**$6,538,000**	**$5,990,000**	**$20,424,000**	**$4,148,000**
Annual Operation and Maintenance Costs					
1	$183,000	$183,000	$183,000	$237,000	$309,000
2	$165,000	$165,000	$165,000	$222,000	$186,000
Total:	**$348,000**	**$348,000**	**$348,000**	**$459,000**	**$495,000**
Total Percent Change in O&M:	-3%	-3%	-3%	28%	38%
Total Net Present Value of O&M Costs					

Project Groups	Alternatives				
	HDPE Piping	**PVC Piping**	**Steel Piping**	**Canal Lining**	**Groundwater & HDPE Piping**
1	$5,991,000	$5,991,000	$5,991,000	$7,759,000	$10,116,000
2	$5,402,000	$5,402,000	$5,402,000	$7,268,000	$6,089,000
Total:	**$11,393,000**	**$11,393,000**	**$11,393,000**	**$15,027,000**	**$16,205,000**
Total Net Present Value of Project					
1	$10,614,000	$12,861,000	$18,891,000	$29,001,000	$22,972,000
2	$14,294,000	$15,896,000	$21,958,000	$37,266,000	$15,186,000
Total:	**$24,908,000**	**$28,757,000**	**$40,849,000**	**$66,267,000**	**$38,158,000**

D.6 Methods Used to Determine Water Savings and Conserved Water Rates and Volumes

Farmers Conservation Alliance

November 6, 2018

Water Savings

In the summer of 2016, Black Rock Consulting and FCA coordinated with the Swalley Irrigation District (SID or the District) to perform a seepage loss study on the District's remaining open canals and laterals. The seepage loss study measured water losses in the District's Main Canal and laterals downstream from the Ponderosa Hydroelectric Power Plant (SID 2017). These laterals included the Swalley Main Canal, Deschutes Lateral, Elder Lateral, Butte Lateral, Frakes Lateral, and the Mickelson Lateral. Water losses in laterals upstream from the Ponderosa Hydroelectric Power Plant were measured in 2013 as part of a coordinated effort by staff from the District, the Deschutes River Conservancy, and Oregon Water Resources Department (SID 2017). These laterals included the Rogers Lateral, Rogers Sub-lateral, Riley Lateral, and Riley Sub-lateral.

The 2016 study used a new and calibrated Flowtracker II in accordance with the United States Geological Survey's "Discharge Measurements at Gauging Stations – Chapter 8 of Book 3, Section A, Techniques and Methods 3-A8" (USGS 2010). Oregon Registered Professional Engineers, Kevin L. Crew, P.E. and David C. Prull, P.E., managed this program. The study was performed during 2016 to inform the District's System Improvement Plan (SIP) of the seepage loss in the system. Data from this seepage loss study appears in Appendix A of the District's System Improvement Plan (SID 2017).

Discharge measurements were taken during the peak irrigation season (from May 15 through September 14) of 2016. Together, the 2016 and 2013 seepage loss studies identified 20.1 cfs of seepage and evaporation losses in the District's canals and laterals during the peak irrigation season (SID 2017; Table 1). The District assumed that piping its canals and laterals would eliminate these losses, resulting in the potential water savings of 20.1 cfs. Following the completion of the seepage loss assessment, the District piped 3,842 feet of the Rogers Lateral and 1,338 feet of the Riley Lateral. These piping projects eliminated 0.7 cfs and 0.2 cfs of losses during the peak irrigation season, respectively. The water savings associated with these two projects were removed from potential water savings associated with the proposed project presented in the Plan-EA, reducing the estimated water savings during the peak irrigation season.

Table 1. Water Losses Associated with Swalley Irrigation District's Canals and Laterals.

Canal/Lateral	Year Measured	Water Loss (cfs)	Savings from Water Conservation Projects (cfs)	Remaining Water Loss (cfs)
Rogers	2013	3.9	0.7	3.2
Rogers Sublateral	2013	0.2	0	0.2
Riley	2013	0.9	0.2	0.7
Riley Sublateral	2013	0.3	0	0.3
Elder	2016	2.6	0	2.6
Butte	2016	0.2	0	0.2
Mickelson	2016	0	0	0
Main Canal	2016	12	0	12
Total		**20.1**	**0.9**	**19.2**

Source: SID (2017)

The District's water right specifies three irrigation seasons. The District can divert 39.6 percent of its full rate in Season 1, 53.0 percent of its full rate in Season 2, and 100 percent of its full rate in Season 3 (Table 2). The 2013 and 2016 seepage loss studies identified water losses and potential water savings in the District's canal and laterals during Season 3.

Water losses in any given canal or lateral may change throughout the year depending on multiple factors, including canal or lateral discharge rates. Irrigation districts and their partners followed a simplified approach to interpolating from Season 3 water losses to Season 2 and Season 1 water losses in prior Allocation of Conserved Water projects (e.g. CW-42, CW-48, CW-59, CW-61), and this analysis adopted that approach. To calculate water losses in each season, total water losses were multiplied by the percent of the full rate allowed for diversion in that season (Table 3). To calculate volumes, seasonal loss rates were multiplied by the season duration (number of days) and then by a conversion factor (1.9835 acre-feet per cfs per day).

Table 2. Swalley Irrigation District Water Right.

Season	Dates	Allowed Rate (cfs)	Percent of Full Rate (%)
1	Apr 1 - Apr 30 & Oct 1 - Oct 30	32.60	39.6%
2	May 1 – May 14 & Sep 15 – Sep 30	43.63	53.0%
3	May 15 – Sep 14	82.33	100%

Note: Includes rates associated with Certificate 74145 following Final Order T-11111.

Table 3. Water Losses in Seasons 1, 2, and 3.

Season	Percent of Full Rate (%)	Water Loss (cfs)	Season Dates	Duration (Days)	Conversion Factor (AF/cfs/day)	Water Loss (AF/yr)
1	39.6%	7.60	Apr 1 - Apr 30 & Oct 1 - Oct 30	61	1.9835	919.92
2	53.0%	10.18	May 1 – May 14 & Sep 15 – Sep 30	30	1.9835	605.51
3	100%	19.20	May 15 – Sep 14	122	1.9835	4,646.08
					Total	**6,171.52**

Conserved Water

The HDPE Piping Alternative assumed that piping the District's canals and laterals would eliminate all of the losses identified in Table 1. As described in Section 6.10.2 of the Plan-EA, 75 percent of the water saved under this alternative would be allocated to the Deschutes River under Oregon's Allocation of Conserved Water Program. Twenty-five percent of the water saved through this alternative would remain on the District's certificate to improve water supply reliability for the associated existing irrigated lands.

The District and FCA evaluated the District's pre-project deliveries, desired deliveries, and potential post-project deliveries to assess how to distribute the water that would be saved through the proposed project between existing District and instream uses. The District identified desired delivery rates, and FCA calculated pre-project delivery rates and shortages by subtracting the estimated system losses from the District's allowed diversion rates (Table 4). This analysis used the 4,333 acres identified in SID (2017) to calculate deliveries per acre for consistency with SID (2017) and the Plan-EA. Both the total amount of water that would be saved through the proposed project and the amount of the saved water that would be allocated instream were independent of the irrigated acreage area.

Table 4. Pre-Project Delivery Rates, Desired Delivery Rates, and Pre-Project Shortages in Swalley Irrigation District.

Season	Pre-Project Certificate Rate (cfs)	Water Loss (cfs)	Pre-Project Delivery Rate (cfs)	Desired Delivery Rates (cfs)	Pre-Project Shortage (cfs)	Pre-project Delivery Rate (gpm/ac)	Desired Delivery Rate (gpm/ac)	Pre-Project Shortage (gpm/ac)
1	32.50	7.60	24.90	28.00	3.10	2.58	2.9	0.32
2	43.50	10.18	33.33	38.62	5.29	3.45	4.0	0.55
3	82.08	19.20	62.88	67.58	4.70	6.51	7.0	0.49

Source: Appendix E.6

The District and FCA distributed the water to be saved through the HDPE Alternative to the District and to instream uses in a manner that addressed the purpose and needs of the project while helping to address identified needs in the Deschutes River (Table 5, Table 6). Under the HDPE Alternative, the District would retain 25 percent of the 6,172 acre-feet/year of total estimated saved water to improve water supply reliability. The remaining 75 percent of the saved water would be allocated instream through Oregon's Allocation of Conserved Water Program (Table 6).

Table 5. Projected Post-Project Delivery Rates and Post-Project Shortages in Swalley Irrigation District Under the HDPE Alternative.

Season	Pre-Project Certificate Rate (cfs)	Water Allocated Instream (cfs)	Post-Project Allowed/ Delivery Rate (cfs)	Desired Delivery Rates (cfs)	Post-project Shortage (cfs)	Post-Project Allowed/ Delivery Rate (gpm/ac)	Desired Delivery Rate (gpm/ac)	Post-Project Shortage (gpm/ac)
1	32.50	7.60	24.90	28.00	0.30	2.58	2.9	0.03
2	43.50	10.18	33.33	38.62	1.29	3.45	4.0	0.13
3	82.08	19.20	62.88	67.58	0.70	6.51	7.0	0.07

Source: Appendix E.6

Table 6. Saved Water Allocated Instream and Remaining for the District's Use Under the HDPE Alternative.

Season	Season Dates	Total Water Saved with HDPE Piping Alternative by Season	Projected Use of Saved Water to Secure District Water Supply	Projected Use of Saved Water to Allocate Instream
1	Apr 1 - Apr 30 & Oct 1 - Oct 30	7.6 cfs 919.92 acre-feet/year	2.8 cfs 338.78 acre-feet/year	4.8 cfs 581.16 acre-feet/year
2	May 1 – May 14 & Sep 15 – Sep 30	10.2 cfs 605.51 acre-feet/year	4.0 cfs 238.02 acre-feet/year	6.2 cfs 367.50 acre-feet/year
3	May 15 – Sep 14	19.2 cfs 4646.08 acre-feet/year	4.0 cfs 967.95 acre-feet/year	15.2 cfs 3,678.15 acre-feet/year
Total volume of water saved over seasons		**6,171.52 acre-feet/ year**	**1,544.73 acre-feet/ year**	**4,626.79 acre-feet/year**

Source: Table 5-2 of the Plan-EA.

References

Swalley Irrigation District (SID). (2017). Swalley Irrigation District System Improvement Plan. Bend, Oregon: Swalley Irrigation District.

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

Appendix E

Other Supporting Information

E.1 Intensity Threshold Table

This section presents the intensity threshold table used to quantify effects to resources of concern because of the proposed action.

Table E-1. Intensity Threshold Table for the Swalley Irrigation District Irrigation Modernization Project.

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
Cultural Resources	No known, eligible resources are adversely affected or are at the lowest levels of detection or barely perceptible, and not measurable.	Affects a cultural site, structure or feature with little data potential. The historic context of the affected site(s) would be local. Not affect the contributing element of a property eligible for the National Register of Historic Places. Causes a slight change to a natural or physical ethnographic resource, if measurable and localized.	Affects a cultural site, structure or landscape with modest data potential of local, regional or state significance. Changes a contributing element but would not diminish resource integrity or jeopardize National Register eligibility. Localized and measurable change to a natural or physical ethnographic resource.	Affects a cultural site or landscape with high data potential of national context Diminishes the integrity of the resource to the extent that affects cannot be mitigated, would permanently impact the historic register eligibility of the resource, prevent a resource from meeting criteria for listing in a historic register, or reduce the ability of a cultural resource to convey its historic significance. Permanent severe change or exceptional benefit to a natural or physical ethnographic resource.
Fish and Aquatic Species	No discernable short- or long-term impacts to fish life or habitat.	Changes in watershed conditions that cause non-measurable change in existing hydrology or sediment functions. Direct or indirect habitat changes that result only in	Changes in watershed conditions that cause measurable change to hydrology or sediment functions. Direct or indirect habitat changes that cause	Changes in watershed conditions that cause high impairment to hydrology or sediment functions that affects population viability. The proposed action would likely jeopardize a species’

Resource	Intensity Threshold			
	Negligible	Minor	Moderate	Major
		non-measurable, short-term change in risk to ESA-listed and other fish species at the population or ESU scale.	measurable-, short- or long-term change in risk to ESA-listed or other fish species at the population or ESU scale.	continued existence or destroy or adversely affect a species' critical habitat.
Geology and Soils	Project activities would not disturb soils or underlying geology.	Short-term erosion during construction at project and clearing sites that would be mitigated through BMPs. Changes to primarily previously disturbed soil profiles or underlying geology.	Short-term erosion during construction at project and clearing sites that could not be mitigated. Changes to primarily undisturbed soil profiles or underlying geology.	Continued erosion during and after construction at project and clearing sites. Permanent changes to undisturbed soil profiles or underlying geology.
Land Use	Existing land uses or ownership would continue as before. A short-term change or interruption to land use or access to existing land uses.	Land use changes that are consistent with existing ownership, easements, or right-a-way.	Land use changes that are inconsistent with existing ownership, easements, or right-a-way but are compatible to adjacent.	A new unauthorized land use or access that is not compatible with adjacent land use.
Public Safety	No change in risk to human health and safety.	Any short-term risks to public health and safety could be mitigated. Eliminate a known health and safety condition in localized areas.	Any short-term risks to public health and safety could not be mitigated. Eliminate a known health and safety condition in the area affected by District operations.	Create a permanent and known health and safety condition. Eliminate a known health and safety condition on a regional level.
Recreation	No effect on the location, timing, or quality of recreation facilities and uses during and after construction.	Temporarily preclude or limit dispersed and dedicated recreational opportunities during off-peak use periods during project construction.	Temporarily preclude or limit dispersed and dedicated recreational opportunities during peak use periods during project construction.	Obstruct legally existing or planned dispersed recreational uses after project construction.

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
		Require relocation of dispersed recreational activities to an equal or better location after project construction. Expand to a limited degree existing recreational areas or opportunities.	Create or encourage new unauthorized land uses along the right-of-way for recreational purposes, such as ATV use in unauthorized areas. Create limited dispersed new recreational areas or opportunities.	Alter or eliminate dedicated recreation opportunities after project construction. Create extensive new recreational opportunities or areas.
Socioeconomics	No reduction in the yield of agricultural products or timber Non-measurable change to income and/or employment levels.	Little effect on the yield of agricultural products or timber. Temporary changes to income and/or local employment levels.	A change to the yield of agricultural products or timber at the local level Permanent changes to local employment and/or levels.	A change to the yield of agricultural products or timber at the regional or national level. Permanent changes to regional employment and/or income levels.
Vegetation	Project activities would not affect vegetation or it is limited to small areas.	Most effects would be localized and/or temporary. While individual plants could be affected, there would be no effects on a population scale. Any permanent effects would not be widespread nor affect sensitive species or populations.	A large proportion of one or more populations are affected but relatively localized and could be mitigated. Any effects to sensitive species could be mitigated	Considerable effects on plant populations over large areas. Extensive mitigation required offsetting adverse effects to sensitive species, but success not assured.
Visual Resources	Project features are visually negligible or not visible.	Landscape is a designated scenic area and project features do not attract attention to the landscape.	Landscape is a designated scenic area and some project features attract attention to the landscape.	Landscape is a designated scenic area and the majority of project features attract attention to the landscape.

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
		The majority of project features do not attract attention to the landscape. Short-term visual changes during project construction.	A majority of project features attract attention to the landscape.	Project features create a disruptive change and dominate the landscape.
Water Resources	Project activities would not disturb or alter water quantity, water quality, or groundwater quantity.	*Surface Water Quantity:* Less than 10 percent change in volume of streamflow. *Water Quality:* Short-term or non-measurable changes to water quality in waterbodies that is unlikely to result in excursions to water quality standards on the Oregon's 303(d) list. *Ground Water:* Long-term, less than 10 percent change in depth to groundwater.	*Surface Water Quantity:* Greater than 10 percent and less than 20 percent change in volume of streamflow. *Water Quality:* Permanent measurable changes to water quality in waterbodies that is unlikely to result in excursions to water quality standards on the Oregon's 303(d) list. *Ground Water:* Short-term, greater than 10 percent change in depth to groundwater.	*Surface Water Quantity:* Greater than 20 percent change in volume of streamflow. *Water Quality:* Permanent measurable changes to water quality in waterbodies that results in excursions to water quality standards on the Oregon's 303(d) list. *Ground Water:* Long-term, greater than 10 percent change in depth to groundwater.
Wetland, Flood Plains, Riparian Zones	Does not alter wetlands or change the hydraulic capacity of floodplains.	Alteration of non-jurisdictional wetland hydrology, vegetation, and/or soils changes water quality, hydrologic, and/or habitat functions. Altered hydraulic function or hydraulic capacity of floodplains to a degree that does not increase or decrease the potential for	Mitigated alteration of jurisdictional wetland hydrology, vegetation, and/or soils that changes water quality, hydrologic, and/or habitat functions.	Permanent, non-mitigated alteration of jurisdictional wetland hydrology, vegetation, and/or soils that causes changes to water quality, hydrologic, and/or habitat functions. Altered hydraulic function or changes to hydraulic capacity of floodplains to a degree that changes the

Resource	Intensity Threshold			
	Negligible	**Minor**	**Moderate**	**Major**
		flooding and damage to personal property.		potential for flooding and damage to personal property.
Wildlife	Temporary or short-term change in wildlife populations and/or habitats would not be of measurable.	Long-term changes in wildlife populations or habitats would not be measurable. Any adverse effects can be effectively mitigated.	Long-term measurable changes in local wildlife populations or habitats. Mitigated effects to sensitive species.	Long-term measurable changes to regional wildlife populations or habitats. Effects to sensitive species could not be mitigated successfully.
Wild and Scenic Rivers	No effects to the resources determining the designation of Wild and Scenic Rivers.	Any effects to resources would be compatible with the designation of the Wild and Scenic River reaches.	An effect to resources that would be incompatible with the designation but could be mitigated.	Effects to resources that would change the designation of a Wild and Scenic River reach.

Duration of Effects	
Temporary	Transitory effects which only occur over a period of days or months.
Short-term	Effects lasting 1-5 years.
Long-term	Effects lasting greater than 5 years.

E.2 Fish and Aquatic Resources Supporting Information

This appendix section presents supporting information associated with Primary Constituent Elements for bull trout critical habitat.

Table E-2. Primary Constituent Elements for Bull Trout.

Primary Constituent Element Number	Habitat Description and Characteristics
PCE 1	Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
PCE 2	Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
PCE 3	An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
PCE 4	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.
PCE 5	Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
PCE 6	In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
PCE 7	A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Primary Constituent Element Number	Habitat Description and Characteristics
PCE 8	Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
PCE 9	Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

E.3 Geology and Soils Supporting Calculations

This appendix section presents supporting calculations used to evaluate effects of the Preferred Alternative with respect to geology and soil resources.

Table E-3. Detailed Calculations to Estimate Quantity of Soil Disturbed Under the HDPE Piping Alternative.

Diameter (ft)	Sum of Length (ft)	Excavation Width (ft)	Bedding Volume (CY)	Pipe Trench Volume		Canal Volume			Total Volume Disturbed (CY) ~excluding volume of pipe~
				Pipe Trench Depth	Pipe Trench Volume (CY)	Canal Top Width (ft)	Canal Bottom Width (ft)	Canal Volume (CY)	
0.67	10,064	4	683	0.3	456	2.3	1.3	445	1,454
0.83	6,453	4	478	0.4	398	2.8	1.7	446	1,192
1.00	9,209	4	682	0.5	682	3.4	2.0	917	2,013
1.17	7,188	4	532	0.6	621	3.9	2.3	974	1,843
1.33	7,262	4	538	0.7	717	4.5	2.7	1,286	2,165
1.50	6,309	5	584	0.8	876	5.1	3.0	1,414	2,461
1.67	7,634	5	707	0.8	1,178	5.6	3.3	2,112	3,380
2.00	7,262	5	672	1.0	1,345	6.8	4.0	2,893	4,065
2.17	2,746	5	254	1.1	551	7.3	4.3	1,284	1,714
2.33	4,751	5	440	1.2	1,026	7.9	4.7	2,576	3,290
2.50	2,559	6	284	1.3	711	8.4	5.0	1,593	2,123
2.67	831	6	92	1.3	246	9.0	5.3	588	755

Diameter (ft)	Sum of Length (ft)	Excavation Width (ft)	Bedding Volume (CY)	Pipe Trench Volume		Canal Volume			Total Volume Disturbed (CY) ~excluding volume of pipe~
				Pipe Trench Depth	Pipe Trench Volume (CY)	Canal Top Width (ft)	Canal Bottom Width (ft)	Canal Volume (CY)	
2.83	1,933	6	215	1.4	609	9.6	5.7	1,545	1,917
3.00	6,709	6	745	1.5	2,236	10.1	6.0	6,013	7,238
3.50	4,560	7	591	1.8	2,069	11.8	7.0	5,563	6,598
4.00	2,094	7	271	2.0	1,086	13.5	8.0	3,336	3,719
								Total	**45,928**

Note: Pipe length and diameter information from the SID 2018 updated SIP.

E.4 Land Use Supporting Calculations

This appendix section presents supporting calculations used to evaluate effects of the Preferred Alternative with respect to land use.

Table E-4. Land Ownership in Swalley Irrigation District.

Ownership	Percentage of Area	Acres
Bend Metro Park and Recreation	2%	389
Bureau of Land Management	1%	208
Deschutes County	4%	602
Oregon Parks and Recreation	1%	229
Private	91%	14,805
State of Oregon	0%	20
U.S. Forest Service	0%	32
Total	**100%**	**16,285**

Note: Acreage data comes from the attribute table corresponding to Figure 4-6, which used GIS data from Deschutes County, BLM, USFS, and the FCA provided SID Boundary.

Table E-5. Land Zoning in Swalley Irrigation District.

Zoning	Acres	Percentage of total area
EFUAL	55	1%
EFUTRB	5,977	57%
MUA10	4,510	43%
Total	**10,543**	**100%**

Note: Acreage data comes from the GIS data from Deschutes County clipped to the FCA provided SID Boundary.

Table E-6. Land Cover in Swalley Irrigation District.

Land Cover Type	Acres	Percent of the total area
Barren Land	5	0%
Cultivated Crops	3,449	21%
Developed, High Intensity	103	1%
Developed, Low Intensity	2,555	16%
Developed, Medium Intensity	647	4%
Developed, Open Space	1,809	11%
Evergreen Forest	274	2%
Herbaceous	177	1%
Open Water	6	0%
Shrub/Scrub	6,839	42%

Land Cover Type	Acres	Percent of the total area
Woody Wetlands	422	3%
Total	**16,285**	**100%**

Note: Acreage data comes from the attribute table corresponding to Figure 4-7, which used GIS data from the 2011 National Land Cover Database clipped to the FCA provided SID Boundary.

E.5 Vegetation Supporting Calculations

This appendix section presents supporting calculations used to evaluate effects of the Preferred Alternative with respect to vegetation.

Table E-7. Calculations to Estimate New Vegetation Area Created by the Conversion of Open Canals and Laterals to a Buried System.

Pipe Diameter (ft)	Sum of Length (ft)	Canal Top Width (ft)	Total Area Converted (sq ft)
0.67	10,062	2.3	22,656
0.83	11,446	2.8	32,214
1.00	4,218	3.4	14,247
1.17	7,187	3.9	28,321
1.33	7,261	4.5	32,695
1.50	6,313	5.1	31,980
1.67	6,757	5.6	38,037
2.00	8,261	6.8	55,801
2.17	2,746	7.3	20,092
2.33	4,751	7.9	37,438
2.50	2,559	8.4	21,606
2.67	831	9.0	7,480
2.83	1,932	9.6	18,490
3.00	6,709	10.1	67,974
3.50	4,560	11.8	53,902

Pipe Diameter (ft)	Sum of Length (ft)	Canal Top Width (ft)	Total Area Converted (sq ft)
4.00	2,094	13.5	28,291
		Total	**511,223**

Note: Pipe length and diameter information from the SID 2017 SIP.

E.6 Water Resources Supporting Calculations

This appendix section presents supporting calculations used to evaluate effects of the Preferred Alternative with respect to water resources.

Table E-8. Monthly Instream Flow Requirements 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	North Canal Dam	Lake Billy Chinook	Pending	Pending	250	250	250	250	250	250	250	250	250	250	250	250

Table E-9. Deschutes River Daily Average Streamflow Below North Canal Dam Prior to 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	94	256	350	200	550
Nov	334	130	464	284	747
Dec	419	118	537	366	903
Jan	403	207	610	384	994
Feb	424	145	569	547	1,116
Mar	466	216	682	458	1,140
Apr	87	211	298	380	678
May	48	59	107	130	237

Month	Low Streamflow (cfs) - 80% Exceedance	Lower Bar	Average Streamflow (cfs) - 50% Exceedance	Upper Bar	High Streamflow (cfs) - 20% Exceedance
Jun	51	57	108	52	160
Jul	49	54	103	41	144
Aug	48	52	100	50	150
Sep	52	53	105	57	161

Note: Streamflow in the Deschutes River downstream from the City of Bend at Oregon Water Resources Department Gauge No. 14070500 are from the 1994 through 2014 water years.

Table E-10. Deschutes River Daily Average Streamflow 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	90	447	537	40	577
Nov	504	29	533	21	554
Dec	488	18	506	27	533
Jan	483	15	498	186	684
Feb	468	88	556	71	627
Mar	591	98	689	255	944
Apr	474	187	662	298	959
May	101	12	113	10	123

Month	Low Streamflow (cfs) - 80% Exceedance	Lower Bar	Average Streamflow (cfs) - 50% Exceedance	Upper Bar	High Streamflow (cfs) - 20% Exceedance
Jun	117	7	124	10	133
Jul	125	3	128	2	130
Aug	119	4	123	3	126
Sep	126	13	139	48	187

Note: Streamflow in the Deschutes River downstream from the City of Bend at Oregon Water Resources Department Gauge No. 14070500 are from the October 2016 through September 2017 water year.

Table E-11. Distribution of the Project's Total Saved Water between Instream and District Use.

Diversion Rates (cfs)					On-farm Delivery Rates (cfs)					
Season	Certificate Rate (cfs)[1]	Estimated System Losses from the 2016 Loss Assessment (cfs)[2]	Project Water Allocated Instream (cfs)[3]	Post-project Certificated Diversion Rate (cfs)[4]	Pre-project Delivery Rate (cfs)[5]	Desired Delivery Rate (cfs)[6]	Pre-project Shortage (cfs)[7]	Project Water to Shore Up District Supply (cfs)[8]	Post-project Delivery Rate (cfs)[9]	Post-project Shortage (cfs)[10]
1	32.50	7.60	4.80	27.70	24.90	28.00	-3.10	2.80	27.70	-0.30
2	43.50	10.18	6.18	37.33	33.33	38.62	-5.29	4.00	37.33	-1.29
3	82.08	19.20	15.20	66.88	62.88	67.58	-4.70	4.00	66.88	-0.70

Notes: This information is strictly for the use of providing possible outcomes of alternatives and in no way prescribes, suggests, or promises specific allocations on conserved water to instream water rights. Following the completion of each Project Group, the District may work with OWRD and its partners to measure and verify water savings pending funding availability and or any legal requirements to do so.
1. Max rate on certificate for all acres.
2. From Water Loss Assessment minus water already restored instream. Based on measured losses.
3. Estimated system losses (cfs) minus project water to shore up district supply (cfs).
4. Estimated post-project delivery rate following completion of entire project.

5. Certificate rate (cfs) minus Estimated System Losses from the 2016 Water Loss Assessment.
6. Desired per acre rate (gpm/acre) / 448.83 gpm/cfs * total acres.
7. Pre-project delivery rate (cfs) minus desired delivery rate (cfs).
8. Assumes that measured losses are correct. Represents additional water to district post-project.
9. Pre-project delivery rate (cfs) plus project water to shore up district supply (cfs).
10. Post-project delivery rate (cfs) minus desired delivery rate (cfs). Difference between desired rate and post-project rate.

Table E-12. Distribution of the Project's Total Saved Water between Instream and District Use – Continued.

On-farm Delivery Rates (gpm/acre)						
Season	Pre-project Delivery Rate (gpm/acre)[1]	Desired Delivery Rate (gpm/acre)[2]	Pre-project Shortage (gpm/acre)[3]	Project Water to Shore Up District Supply (gpm/acre)[4]	Post-project Delivery Rate (gpm/acre)[5]	Post-project Shortage (gpm/acre)[6]
1	2.58	2.90	-0.32	0.29	2.87	-0.03
2	3.45	4.00	-0.55	0.41	3.87	-0.13
3	6.51	7.00	-0.49	0.41	6.93	-0.07

Notes: This table continues from E-12. This information is strictly for the use of providing possible outcomes of alternatives and in no way prescribes, suggests, or promises specific allocations on conserved water to instream water rights. Following the completion of each Project Group, the District may work with OWRD and its partners to measure and verify water savings pending funding availability and or any legal requirements to do so.
1. Pre-project delivery rate (cfs) / acres * 448.83 gpm/cfs.
2. Identified by SID staff on 7/31/18.
3. Pre-project delivery rate (gpm/acre) minus desired delivery rate (gpm/acre).
4. Project water to shore up supply (cfs) / acres * 448.83 gpm/cfs.
5. Pre-project delivery rate (gpm/acre) plus project water to shore up district supply (gpm/acre).
6. Post-project delivery rate (gpm/acre) minus desired delivery rate (gpm/acre). Difference between desired rate and post-project rate.

Table E-13. Seasonal Allocation of Saved Water between Instream and District Use.

Season	Instream		District	
	Volume (acre-feet/year)	Proportion (%)	Volume (acre-feet/year)	Proportion (%)
1	581	63%	339	37%
2	368	61%	238	39%
3	3,678	79%	968	21%
Total	**4,627**	**75%**	**1,545**	**25%**

Table E-14. Deschutes River Post-Project Streamflow Below North Canal Dam.

Month	Pre-Project Median Daily Average Streamflow	Streamflow Restored Through Project (cfs)[1]	Post-Project Median Daily Average Streamflow instream (cfs)	ODFW Instream Water Right[2]	Restored Streamflow Percentage Increase in the upper Deschutes Basin Annual Discharge[3]
Oct	350.0	4.8	354.8	250	0.1%
Nov	463.5	0.0	463.5	250	0.0%
Dec	537.0	0.0	537.0	250	0.0%
Jan	610.0	0.0	610.0	250	0.0%
Feb	569.0	0.0	569.0	250	0.0%
Mar	682.0	0.0	682.0	250	0.0%

Month	Pre-Project Median Daily Average Streamflow	Streamflow Restored Through Project (cfs)[1]	Post-Project Median Daily Average Streamflow instream (cfs)	ODFW Instream Water Right[2]	Restored Streamflow Percentage Increase in the upper Deschutes Basin Annual Discharge[3]
Apr	298.0	4.8	302.8	250	0.1%
May[4]	107.0	6.18/15.2	113.18/122.2	250	0%/0.3%
Jun	108.0	15.2	123.2	250	0.3%
Jul	103.0	15.2	118.2	250	0.3%
Aug	99.9	15.2	115.1	250	0.3%
Sep[4]	104.5	15.2/6.18	119.7/110.7	250	0.3%/0%

Notes:
1. This information is strictly for the use of providing possible outcomes of alternatives and in no way prescribes, suggests, or promises specific allocations on conserved water to instream water rights. Following the completion of each Project Group, SID the District may work with OWRD and its partners to measure and verify water savings pending funding availability and or any legal requirements to do so.
2. Pending Instream Application # IS-70695
3. According to "Groundwater Hydrology of the Upper Deschutes Basin and its Influence on Streamflow" by Marshall Gannett, Michael Manga, and Kenneth Lite, Jr., the upper Deschutes Basin has a mean annual discharge of 6003.5 cfs.
4. These months are split between two irrigation seasons: Season 2 (May 1 - May 14 and September 15 – September 30) and Season 3 (May 15 – September 14).

E.7 Allocation of Conserved Water Program

This appendix section presents information on the State of Oregon's Allocation of Conserved Water Program.

The Oregon Water Resources Department manages the Allocation of Conserved Water Program. The Allocation of Conserved Water Program allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. Use of this program is voluntary and provides benefits to both water right holders and instream values.

The statutes authorizing the program were originally passed by the Legislative Assembly in 1987. The primary intent of the law is to promote the efficient use of water to satisfy current and future needs--both out-of-stream and instream. The statute defines conservation as "the reduction of the amount of water diverted to satisfy an existing beneficial use achieved either by improving the technology or method for diverting, transporting, applying or recovering the water or by implementing other approved conservation measures."

In the absence of Department approval of an allocation of conserved water, water users who make the necessary investments to improve their water use efficiency are not allowed to use the conserved water to meet new needs; instead, any unused water remains in the stream where it is available for the next appropriator. In exchange for granting the user the right to "spread" a portion of the conserved water to new uses, the law requires allocation of a portion to the state for instream use.

After mitigating the effects on any other water rights, the Water Resources Commission allocates 25 percent of the conserved water to the state (for an instream water right) and 75 percent to the applicant, unless more than 25 percent of the project costs come from federal or state non-reimbursable sources or the applicant proposes a higher allocation to the state. A new water right certificate is issued with the original priority date reflecting the reduced quantity of water being used with the improved technology. A certificate is issued for the state's instream water right, and, if requested, a certificate is issued for the applicant´s portion of the conserved water. The priority dates for the state's instream certificate and the applicant's portion of conserved water must be the same date and will be either the same date as the original water right or one-minute junior to the original right.

Reference

Oregon Water Resources Department (OWRD). (2017). Allocation of Conserved Water. Retrieved from: http://www.oregon.gov/owrd/pages/mgmt_conserved_water.aspx. Accessed November 10, 2017.

E.8 Consultation Letters

USDA

United States Department of Agriculture

Natural Resources Conservation Service

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

September 26, 2018

Mr. Gregg Garnett, Field Office Manager
U.S. Bureau of Reclamation
Bend Field Office
1375 SE Wilson Ave, Suite 100
Bend, OR 97702-1435

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Mr. Garnett,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

- Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

ECC: Elizabeth Heether, USBR
Tom Makowski, NRCS, Portland, Oregon

USDA

United States Department of Agriculture

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

September 26, 2018

Ms. Anita Andazola
US Army Corps of Engineers Portland District Regulatory Branch
211 East Seventh Avenue, Ste. 105
Eugene, OR 97401-2722

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Ms. Andazola,

A copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR has been uploaded to your FTP site (AMRDEC) located at https://safe.amrdec.army.mil/safe/ for review. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

; Acting STC

RONALD ALVARADO
State Conservationist

Enclosures:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

ECC: Tom Makowski, NRCS

FW: AMRDEC Safe Access File Exchange Pick Up

2 messages

Diridoni, Gary - NRCS, Portland, OR <Gary.Diridoni@or.usda.gov> Mon, Oct 1, 2018 at 7:58 AM
To: Alexis Vaivoda <alexis.vaivoda@fcasolutions.org>, "Makowski, Tom - NRCS, Portland, OR" <tom.makowski@or.usda.gov>

For your files. USACE downloaded the materials.

Gary Diridoni
Resource Conservationist (State Environmental Compliance Liaison)
Oregon Technical & Planning Team
USDA - Natural Resources Conservation Service
1201 NE Lloyd Blvd; Suite 900
Portland, Oregon 97232
gary.diridoni@or.usda.gov
Phone: (503) 414-3092

-----Original Message-----
From: no-reply@amrdec.army.mil <no-reply@amrdec.army.mil>
Sent: Friday, September 28, 2018 3:22 PM
To: Diridoni, Gary - NRCS, Portland, OR <Gary.Diridoni@or.usda.gov>
Subject: AMRDEC Safe Access File Exchange Pick Up

AMRDEC Safe Access File Exchange Pick-Up Notice

The file(s) you sent through SAFE (Package ID 15373783) were downloaded at 9/28/2018 5:21:53 PM
by: andrea.r.wagner@usace.army.mil

File description: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment files zipped for review and comment

Alexis Vaivoda <alexis.vaivoda@fcasolutions.org> Mon, Oct 1, 2018 at 8:32 AM
To: "Diridoni, Gary - NRCS, Portland, OR" <Gary.Diridoni@or.usda.gov>
Cc: "Makowski, Tom - NRCS, Portland, OR" <tom.makowski@or.usda.gov>

Thanks Gary.
[Quoted text hidden]
--
ALEXIS VAIVODA
c 503.881.8203 | o 541.716.6085
fcasolutions.org | instagram | facebook | twitter | linkedin

USDA

United States Department of Agriculture

Natural Resources Conservation Service

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

September 26, 2018

Ms. Teal Purrington, Planning and Environmental Coordinator
Bureau of Land Management
Prineville District Office
3050 NE 3rd Street
Prineville, OR 97754

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Ms. Purrington,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

, Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

ECC: Tom Makowski, NRCS

USDA

United States Department of Agriculture

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Service

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

September 26, 2018

Mr. Paul Henson, PhD
State Supervisor, Oregon Fish and Wildlife Office
U.S. Fish and Wildlife Service
2600 SE 98th Avenue
Portland, OR 97266

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Mr. Henson,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

Additionally, please submit any reports with recommendations on the conservation and development of fish and wildlife as identified in the Watershed Protection and Flood Prevention Act of 1954, Section 12, Consultation Request letter dated July 20, 2017 if any surveys or investigations have been conducted.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, 503-414-3202 or tom.makowski@or.usda.gov.

2

An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

Watershed Protection and Flood Prevention Act of 1954, Section 12, Consultation Request for the Irrigation Infrastructure Improvement projects in the Swalley, Swalley, and Central Oregon Irrigation Districts

cc: Tom Makowski, NRCS

ecc: Bridget Moran, USFWS

USDA
United States Department of Agriculture

Natural
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Conservation
Service

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

September 26, 2018

The Honorable Katherine Brown, Governor
State of Oregon
Office of the Governor
900 Court Street NE, Suite 254
Salem, OR 97301-4047

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Governor Brown,

In accordance with section 2 of Executive Order 10913, and our responsibility as assigned by the Secretary of Agriculture, we are transmitting for your review and comment the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance (FCA) for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). The application for assistance in the preparation of the Draft Plan-EA was approved by NRCS on July 6, 2017.

We are requesting that you review this Draft Plan-EA in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov.

2

An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

Jay Gibbs, Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

cc: Ms. Lauri Aunan, Water Policy Advisor to Governor Katherine Brown
Mr. Jason Miner, Natural Resources Policy Director to Governor Katherine Brown
Mr. Richard Whitman, Director, Oregon Department of Environmental Quality
Mr. Tom Byler, Director Oregon Water Resources Department
Ms. Meta Loftsgaarden, Director, Oregon Watershed Enhancement Board
Ms. Vicki Walker Director, Oregon Department of State Lands
Mr. Curt Melcher, Director, Oregon Department of Fish and Wildlife
Mr. Tom Makowski, NRCS, Portland, Oregon

ecc: Mr. Jason Miner, Natural Resources Policy Director to Governor Katherine Brown
Ms. Lauri Aunan, Water Policy Advisor to Governor Katherine Brown
Ms. Meta Loftsgaarden, Director, Oregon Watershed Enhancement Board
Mr. Richard Whitman, Director, Oregon Department of Environmental Quality
Ms. Vicki Walker Director, Oregon Department of State Lands
Mr. Curt Melcher, Director, Oregon Department of Fish and Wildlife
Mr. Tom Byler, Director Oregon Water Resources Department

USDA

United States Department of Agriculture

Natural Resources Conservation Service

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

September 26, 2018

Mr. Robert Brunoe
General Manager, Branch of Natural Resources
The Confederated Tribes of the Warm Springs Reservation
P.O. Box C
Warm Springs, OR 97761

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Mr. Brunoe,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

Jay Gilles, - Acting STC

RONALD ALVARADO
State Conservationist

Enclosures:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

ECC: Tom Makowski, NRCS

USDA

United States Department of Agriculture

Natural
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Conservation
Service

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

September 26, 2018

Ms. Christine Curran, Deputy State Historic Preservation Officer
Parks and Recreation Department
State Historic Preservation Office
725 Summer Street, NE, Suite C
Salem, Oregon 97301-1226

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Ms. Curran,

A copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR has been provided for your review utilizing the Go Digital submittal process. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

The draft watershed plan does not address the Agency's responsibilities for Section 106 of the National Historic Preservation Act (NHPA). While a Memorandum of Agreement between SID and Oregon State Historic Preservation Office (SHPO) has been developed, incorporated into the Plan-EA, and initial consultation between NRCS and SHPO has occurred (SHPO Case No. 17-1165), further consultation will occur in fulfilment of Section 106 of the NHPA, as funding for project implementation is allocated.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource

Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

Jas Gibbs, Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

ECC: Dr. Dennis Griffin, Oregon SHPO
Ian Johnson, Oregon SHPO
Jessica Gabriel, Oregon SHPO
Tom Makowski, NRCS, Portland, Oregon

USDA

United States Department of Agriculture

Natural Resources Conservation Service

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

September 26, 2018

Mr. Anthony DeBone, County Commissioner Chair
Board of County Commissioners
1300 NW Wall, Suite 200
Bend, OR 97703

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Mr. DeBone,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received by this office on or before October 24, 2018. If your comments are not received by the due date, we will assume you do not wish to comment.

The Draft Plan-EA is available for public review and comment. Copies may be obtained by contacting Tom Makowski, Assistant State Conservationist (Watershed Resource Planning), USDA, NRCS, 1201 NE Lloyd Blvd, Portland, Oregon, 97232, phone 503-414-3202 or tom.makowski@or.usda.gov. An electronic version has been made available for viewing and downloading at Oregon Watershed Plans web page, found at https://oregonwatershedplans.org. NRCS will consider all comments received and will respond to those received by October 24, 2018. Comments received will be made available for public inspection.

Sincerely,

, Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

ECC: Tom Makowski, NRCS
Nick Lelack, Community Development Director

USDA
United States Department of Agriculture

Natural Resources Conservation Service

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

September 26, 2018

Mr. Eric King, City Manager
City of Bend
710 NW Wall St.
Bend, OR 97703

Subject: Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment

Dear Mr. King,

Embedded in this letter is a website link to the copy of the draft watershed plan–environmental assessment (Draft Plan-EA) for the Swalley Irrigation District Irrigation Modernization Project, located in Deschutes County, OR. This Draft Plan-EA was prepared by Farmers Conservation Alliance for the United States Department of Agriculture, Natural Resources Conservation Service in cooperation with the Deschutes Basin Board of Control and Swalley Irrigation District (SID) under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566) and in accordance with section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190).

The purpose of this project is to improve water conservation, water delivery reliability, and public safety on SID-owned canals and laterals. The preferred alternative would include converting up to 16.6 miles of open canal, lateral, and aging pipe to buried pipe.

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Sincerely,

Acting STC

RONALD ALVARADO
State Conservationist

Enclosure:
Swalley Irrigation District Irrigation Modernization Project Draft Watershed Plan–Environmental Assessment Outreach Flyer

ECC: Tom Makowski, NRCS, Portland, Oregon
Susy Munson, City of Bend

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bend Field Office
63095 Deschutes Market Road
Bend, Oregon 97701
Phone: (541) 383-7146 FAX: (541) 383-7638

July 24, 2017

Memorandum

To: Assistant State Conservationist, NCRS – Watershed Resources and Planning, Portland, Oregon

From: Field Supervisor, Bend Field Office, Bend, Oregon

Subject: Deschutes Basin Board of Control and Natural Resource Conservation Service, Scoping Comments

Thank you for the opportunity to provide recommendations and input during your National Environmental Policy Act (NEPA) scoping process for the Irrigation Modernization Project. The U.S. Fish and Wildlife Service (Service) supports this proposal and is eager to see the resulting conserved water returned to the Deschutes River.

The Service has been leading a large scale, conservation planning effort for water management that will benefit threatened and endangered species in the Deschutes River Basin in Central Oregon. This effort has spanned many years and has involved eight Central Oregon irrigation districts (constituting the Deschutes Basin Board of Control), the City of Prineville (collectively the Applicants), as well as other stakeholders and interested parties. The goal of this planning effort is to develop an Endangered Species Act (ESA) habitat conservation plan (HCP) under section 10(a)(1)(B) of the ESA that provides non-Federal parties the opportunity to conserve the ecosystems upon which listed species depend, ultimately contributing to their recovery.

The Deschutes Basin HCP has been in development for a number of years. The Applicant's goal is to complete the planning process in 2019. The goal of the Deschutes Basin HCP is to manage water in the Deschutes Basin in a manner that addresses the long-term certainty for water users but provides necessary water for species covered by the plan (Oregon spotted frog (*Rana pretiosa*), bull trout (*Salvelinus confluentus*), and steelhead (*Oncorhynchus mykiss*), sockeye salmon (*Oncorhynchus nerka*) and spring Chinook salmon (*Oncorhynchus tshawytscha*)). The Applicant's conservation approach is to modernize their existing irrigation infrastructure, and return the conserved water back in-stream to support the conservation of the covered species.

Currently, low flows in the Deschutes River Basin result in a myriad of impacts to fish and wildlife resources. Water management that alters water levels has reduced habitat suitability for the Oregon spotted frog, and increased flows are necessary to meet the life history demands of this species. Further, low flows impact water quality in the Deschutes River by exacerbating temperature and dissolved oxygen problems. Water quality often dictates the spread and extent of invasive aquatic species (plants and wildlife), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River

Current proposed piping projects within Central Oregon Irrigation District (COID), Swalley Irrigation District (SID), and Tumalo Irrigation District (TID) could potentially conserve approximately 72,284 acre feet of water (Newton and Perle 2006). This would amount to approximately 195 cubic feet per second (cfs) in the river per irrigation season (180 days). These conservation opportunities are the very approach that the Habitat Conservation Plan envisions to restore the necessary flows in the Deschutes River.

We look forward to coordinating with you throughout the scoping process and during the development of the EA. We will provide input as needed during the formulation of your draft document. If you have any questions or if we can be of any assistance, please contact Emily Weidner or myself at 541-383-7146.

Literature Cited

Newton, D., and M. Perle. 2006. Irrigation district water efficiency cost analysis and prioritization. DWS Final Report, Newton Consultants, Redmond, Oregon.

USDA United States Department of Agriculture | Forest Service | Deschutes National Forest | 63095 Deschutes Market Road
Bend, OR 97701
541-383-5300

File Code: 2500
Date: August 15, 2017

Margi Hoffmann
Community Relations Director
11 Third Street, Suite 101
Hood River, Oregon 97031

Dear Ms. Hoffmann:

The Deschutes National Forest (DNF) attended the public open house presentation by Central Oregon Irrigation District on July 10, 2017, and has reviewed the conservation measures proposed for funding by Tumalo and Swalley Irrigation districts available at www.oregonwatershedplans.org. The DNF would like to submit this letter in support of the proposed watershed plans and conservation measures put forth by all three Irrigation Districts. The improved irrigation infrastructure that would come through these proposed projects to conserve water, reduce energy consumption, increase irrigation delivery efficiency, improve public safety, and benefit instream habitat for aquatic species (both ESA listed and non-listed species) represents a concerted effort on the part of the Irrigation Districts to advance water conservation efforts throughout the Deschutes River Basin that aims to provide a more equitable distribution of water to rivers, farms and municipalities, as well as to install the infrastructure needed to respond to future water conservation/distribution pressures that may arise with a growing central Oregon population and climate change.

Much of the Deschutes River above Bend, Tumalo Creek, and Crescent Creek flows through National Forest System lands. As the steward of these lands, the DNF has long been involved in a collaborative effort to address issues with the functioning condition of physical and ecological processes in these rivers and streams as it relates to regulated flow for irrigation. These proposed conservation measures will help to trend instream flow regimes toward a condition that will help to facilitate the passive and active restoration of these processes, and the functioning condition of an important part of the central Oregon landscape that is managed for public benefit.

The DNF understands that the proposed conservation measures are another step toward improving upon the conservation of water resources in central Oregon, and looks forward to continuing to work in partnership with the Irrigation Districts to further this cause into the future.

Sincerely,

JOHN ALLEN
Forest Supervisor

Caring for the Land and Serving People

Printed on Recycled Paper

Oregon
Kate Brown, Governor

Department of Environmental Quality
Eastern Region Bend Office
475 NE Bellevue Drive, Suite 110
Bend, OR 97701
(541) 388-6146
FAX (541) 388-8283
TTY 711

Date: July 21, 2017

To: Margi Hoffman, Community Relations Director, Farmers Conservation Alliance

From: Eric Nigg, Water Quality Manager

Subject: Preliminary Investigative Report for the Swalley Irrigation District (SID) Irrigation Modernization Project (June 29, 2017)

The Oregon Department of Environmental Quality was asked to review the above referenced report and provide comments on our anticipated regulatory authority over the project through our rules or through implementation of the Federal Clean Water Act (CWA). In addition, we are providing comments on water quality topics discussed in the report in hopes that this information can be used to inform the Watershed Plan that will be drafted as part of the NEPA process.

At this point in time, we believe that DEQ might have regulatory authority over the proposed project in the areas listed below. The degree of our involvement in the first two areas will be determined by the type of permit (if any) required by the U.S. Army Corp of Engineers and the amount of ground disturbing activities, which will likely be determined on a case-by-case basis.

Section 401 Removal and Fill Certification. Section 401 of the CWA gives states and tribes the authority to issue state water quality certifications for projects that require a federal license or permit that may result in a discharge to waters of the US. The certification may condition a permit to ensure the discharge will comply with applicable provisions of the CWA, including state water quality standards. Oregon's water quality standards specify the designated use of a waterbody (e.g., for water supply or recreation), pollutant limits necessary to protect the designated use (in the form of numeric or narrative criteria), and policies to ensure that existing water uses will not be degraded by pollutant discharges. The federal permit or license cannot be issued until a 401 Water Quality Certificate is received.

DEQ works closely with the U.S. Army Corps of Engineers (USACE). The USACE determines whether a project will be reviewed under an Individual or Nationwide Permit. ***Individual Permits*** are for projects that have more than minimal impacts and have both general and project-specific conditions to ensure that the project can meet State water quality standards. ***Nationwide Permits*** are for projects that are expected to have minimal impacts. More information can be found on DEQ's website: http://www.oregon.gov/deq/wq/wqpermits/Pages/Section-401.aspx.

Construction Stormwater Permits. Construction Stormwater Permits. National Pollutant Discharge Elimination System (NPDES) general permits are required for construction activities including clearing, grading, excavation, materials or equipment staging and stockpiling that will disturb one or more acres of land and that may result in a discharge to waters of the state. They also apply to construction activities that will disturb less than one acre that are part of a common plan of development or sale, if the larger common plan of development or sale will ultimately disturb one acre or more. More information can be found on DEQ's website: http://www.oregon.gov/deq/wq/wqpermits/Pages/Stormwater-Construction.aspx

Total Maximum Daily Loads. As identified in the SID Report, there are 303(d) listed water bodies in the project area. Once a water body has been identified as water quality limited, the CWA requires the establishment of a pollutant total maximum daily load (TMDL) for that water body. TMDLs are assessments that determine the maximum amount of pollutant that can be present in a water body while meeting water quality standards. The loading capacity is allocated to point, nonpoint, and future sources of pollution.

TMDLs are implemented via water quality management plans, which include the designation of local management agencies (DMAs) who have legal authority over a sector or source of contributing pollutants. DMAs are required to develop TMDL Implementation Plans which describes the management activities they will implement to meet their responsibilities under the TMDL. DEQ has named irrigation districts as DMAs in basins where we have determined that the laterals, canals and/or dams operated by the district contribute to the delivery of nonpoint sources of pollution, such as bacteria, heat or nutrients, to 303(d) listed water bodies. DEQ has not named irrigation districts as DMAs due to the water quality impacts associated with reduced flows below diversions, although restoration of flows is encouraged in the TMDL analysis. More information on TMDLs can be found on DEQ's website:
http://www.oregon.gov/deq/wq/tmdls/Pages/default.aspx

TMDLs have not yet been completed anywhere in the Deschutes Basin. At this point, we are in the process of developing TMDLs in the project area to address the 303(d) listings for dissolved oxygen, pH and chlorophyll-*a*. We expect to begin a stakeholder involvement process for this effort sometime in 2018 and SID will be invited to participate. At this point we do not know whether or not SID will be named as a DMA and what TMDL implementation responsibilities they might have.

Comments on Specific Sections of the Preliminary Report

1. **Section 1**. The third paragraph mentions that some segments have already been piped. How many miles have already been piped and what proportion of the district?
2. **Section 3**. The paragraph below Table 3-1 indicates that SID provides water to patrons through one primary diversion and 15 single farm diversions on the Deschutes River. From Figure 3.0.1 in the Appendix, it appears that all of the proposed piping will be associated with the one primary diversion, and not with any of the single farm diversions. Is that correct? It would also be helpful to understand the relative magnitude of the diversions from the single farm diversions as compared with the primary diversion at North Canal dam.
3. **Section 3.1.1**. (a) The first sentence states that the Deschutes River in the project area does not meet water temperature standards for *salmon and trout*. While it is true that salmon and trout are two of the beneficial uses protected by the state standards, there are other beneficial uses protected by these standards as well. A list of all of the beneficial uses in the Deschutes Basin can be found at the following location on DEQ's website:
   http://www.deq.state.or.us/wq/rules/div041/dbutables/table130a.pdf. (b) As is pointed out in Section 5.6.3, there are other water quality impairments (pH and dissolved oxygen) in the project area in addition to temperature impairments. (c) The second paragraph states that the project could return *up to* (emphasis added) 16 cfs of water to the Deschutes River. It would be helpful to know how much water will be restored through this project, how that amount will be determined, and the timing of the restored water.
4. **Section 3.1.3**. The second paragraph begins by referencing the District's previous aggressive conservation efforts. It would be helpful to have a description in this document about what these previous efforts have been. Have they resulted in any conserved water protected in-stream?

Page **2** of **3**

5. **Section 3.2.** This section states that stream flow benefits would be realized by allocating saved water instream and creating instream water rights through the Conserved Water Program. How much water is SID agreeing to protect and during what times of year?
6. **Section 5.2.** Are there any discharges to natural water bodies as part of the SID system? This would be helpful to know in terms of evaluating potential water quality impacts of proposed activities.
7. **Section 5.6.1.** (a) In the last sentence on page 15, low stream flows of 13 cfs are referenced. Are these summer stream flows? (b) Similarly, in the second sentence of the next paragraph, flows as high as 160 cfs are referenced. Are these also summer flows? (c) It should be noted that, although the instream water right of 250 cfs may be a target for meeting fish needs, this target may not meet water quality needs.
8. **Section 5.6.3.** (a) The second sentence lists dissolved oxygen and temperature as parameters that can be exacerbated by low flows. pH levels can also be exacerbated by low flows. (b) The last sentence of this paragraph is incorrect. The Deschutes River is included on the 303(d) list for flow modification and habitat modification. These are Category 4C listings, which indicates that the impairment is not caused by a pollutant therefore a TMDL is not needed. The other impairments described in this paragraph are Category 5 listings, which indicates that a TMDL is required to address the listing. Given that flow and habitat modifications are 303(d) listings, and both are parameters that could be affected by water management, would it be helpful to add sub-sections for these parameters to Section 5.6.3? (c) For each of the water quality parameters listed in this section, it would be helpful to have a description of how this parameter would be affected by changes in stream flow. This information could be used to support the claims of improved water quality that would be realized through implementation of the project.
9. **Section 5.6.3.1.** (a) In addition to affecting fish, elevated stream temperatures can also affect other aquatic life. (b) The temperature criterion that applies throughout the project area is 18.0 degrees Celsius (64.4 degrees Fahrenheit).
10. **Section 5.6.3.2.** The dissolved oxygen spawning season for the Deschutes River through the project area is January 1 to May 15. The 303(d) impairment listings are based on the criterion of 11.0 mg/L or 95 percent saturation. The last sentence in this section also references a season of October 1 to June 30 and we do not know where those dates came from.
11. **Section 5.6.3.3.** (a) The description of factors affecting pH is not accurate. We would suggest a further review of reference material on this topic. One possible source would be DEQ's issue paper on the topic, available at the following location on DEQ's website: http://www.deq.state.or.us/wq/standards/docs/19921994wqStandardsReview.pdf. (b) The pH listings for the Deschutes River in the project area occur year-round (both the summer and fall/winter/spring seasons).
12. **Section 5.7.** The first paragraph in this section discusses the fish screen on SID's primary diversion. Do the other 15 single farm diversions have screens as well?
13. **Section 7.3.1.** Under #1 on the list of the identified purpose and need on page 28, it could be noted that other water quality parameters, such as pH and dissolved oxygen, could also be improved in addition to temperature.

We thank you for the opportunity to review the preliminary document and to provide comments. We also look forward to assisting with funding of the project through our Clean Water State Revolving Loan Fund program. Please feel free to contact me or Bonnie Lamb if you have any questions. I can be reached at (541) 633-2035 or nigg.eric@deq.state.or.us and Bonnie can be reached at (541) 633-2027 or lamb.bonnie@deq.state.or.us.

ec: Kelly Hill, DEQ Regional Solutions Liaison
Bonnie Lamb, DEQ Basin Coordinator

Page **3** of **3**

E.9 Cultural Resources Memorandum of Agreement

This appendix section provides the SID Resolution and Amendment to Memorandum of Agreement between SID and the Oregon State Historic Preservation Office.

SWALLEY IRRIGATION DISTRICT
RESOLUTION 18-01

RESOLUTION ACCEPTING AMENDMENT TO MEMORANDUM OF AGREEMENT BETWEEN THE SWALLEY IRRIGATION DISTRICT & THE STATE HISTORIC PRESERVATION OFFICE

BE IT RESOLVED that the Board of Directors of Swalley Irrigation District accepts and approves the attached Amendment to Memorandum of Agreement (MOA Amendment) between the District and the State Historic Preservation Office, and

FURTHER RESOLVED that President McCarrel is hereby approved to execute the attached MOA Amendment in full and attached hereto.

BE IT SO RESOLVED this 21st day of March, 2018, by unanimous vote of the board of directors.

President McCarrel

ATTEST:

Secretary Camarata

AMENDMENT TO

MEMORANDUM OF AGREEMENT

BETWEEN THE SWALLEY IRRIGATION DISTRICT & THE STATE HISTORIC PRESERVATION OFFICE

**FOR THE PIPING OF
THE SWALLEY IRRIGATION DISTRICT MAIN CANAL PIPING PROJECT,
SWALLEY IRRIGATION DISTRICT,
BEND VICINITY, DESCHUTES COUNTY, OREGON**

WHEREAS, the Agreement was executed on January 10, 2007; and

WHEREAS, the Agreement was further interpreted in a letter from SHPO to Swalley (SID) on May 2, 2017; and

WHEREAS, Swalley Irrigation District now intends to convert the last 4.5 miles of open canal to a fully closed pressurized piped system; and

WHEREAS, a typographical error was made on the 2007 MOA in reference to a "1903" map, which should read "1908"; and

NOW, THEREFORE, in accordance with Stipulation 2 of the Agreement, the Swalley Irrigation District, and the State Historic Preservation Office agree to amend the Agreement as follows:

1. Amend Stipulation 2 so it reads as follows:

   a. Within one (1) year of piping the last 4.5 miles of the Main Canal and all other canal segments, SID will erect no less than five (5) interpretive signs along the original Main Canal footprint. The signs will be no smaller than 2 ft. x 3 ft. in size and must be weatherproof or built to withstand outdoor installation. The interpretive signs will describe the history of the canal and its role in the development of Deschutes County using no less than 300 words and will include the original 1908 map, representative modern and historical photos of the ditch including any segments or features of particular interest or significance, that convey the Swalley Canal story. The interpretive signs are intended to be permanent fixtures along the original Main Canal footprint and will be located in areas easily accessible to the public.
   b. In addition, SID will create a "Historical Records" section on its website to house original maps, photos, written history, century-old ledger books, and other primary documents that demonstrate the history of SID; this website will be available to the public for a minimum of five (5) years.
   c. Lastly, SID will display a section of historic wood stave pipe in front of their office for a minimum of five (5) years with an interpretive sign measuring no less than 2 ft. by 3ft. explaining its cultural significance with a narrative of no less than 300 words regarding water management and development in The West.
   d. The interpretive signs will be prepared by persons that possess the skills of either a Secretary of the Interior's Standards qualified Historian, Architectural Historian, Cultural Resource Specialist, Exhibit Specialist/Graphic Artist, or by an organization that has the ability to create and design professional quality interpretive panels.
   e. SID will provide the SHPO at least one (1) opportunity lasting a minimum of thirty (30) calendar days to comment and suggest applicable revisions to the interpretive signs and narratives as specified above before the signs are finalized and installed. Comments provided by the

signatories and consulting parties shall be taken into consideration within the limits of the project as described in the Stipulations.

f. Stipulation 2 will not be considered fulfilled until items 2.a through 2.d have been completed.

2. Amend the MOA to include the following administrative clauses:

a. DISPUTE RESOLUTION

Signatories to this MOA may object at any time to any actions proposed or the manner in which the terms of this MOA are implemented by submitting the concern in writing to the other signatory. Upon receipt, the receiving party shall consult with the other party for sixty (60) calendar days, or another time period agreed to by all signatories, to resolve the objection. If SID determines that such objection cannot be resolved, SID will:

i. Forward all documentation relevant to the dispute, including the other signatory's proposed resolution, to the Advisory Council on Historic Preservation (ACHP). The ACHP shall provide SID with its advice on the resolution of the objection within sixty calendar (60) days, or another time period agreed to by all signatories, of receiving adequate documentation. Prior to reaching a final decision on the dispute, SID shall prepare a written final decision that takes into account any timely advice or comments regarding the dispute from the ACHP, signatories and Concurring Party as set forth in the original MOA, and provide the signatories and Concurring Party with a copy of this written response within thirty (30) calendar days of receiving a response from the ACHP. SID will then proceed according to its final decision.

ii. If the ACHP does not provide its advice regarding the dispute within the thirty (30) calendar day time period, SID shall provide the signatories and Concurring Party a final written decision within thirty additional (30) calendar days that takes into account any timely comments regarding the dispute from the signatories and Concurring Party to the MOA, and provide them and the ACHP with a copy of such written response.

iii. SID's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

b. AMENDMENTS

Any signatory may request that this MOA be amended by submitting such a request to the other signatory in writing. SID shall consult with the signatory for up to sixty (60) calendar days, or another time period agreed to by all signatories, concerning the necessity and appropriateness of the proposed amendment. Any signatory may request the involvement of the ACHP during the amendment process. At the end of the consultation period SID shall provide an amended MOA for signature by the signatories or a written statement describing why SID choose not to pursue an amendment to this MOA. Amendments shall be effective on the date a copy of the MOA signed by all of the signatories is filed with the ACHP.

c. TERMINATION

If any signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation b, above. If within sixty (60) days, or another time period agreed to by all signatories, an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatory.

Once the MOA is terminated, and prior to work continuing on the undertaking, SID must either (a) execute an MOA pursuant to 36 CFR § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. SID shall notify the signatories as to the course of action it will pursue.

d. DURATION

This MOA will expire if its terms are not carried out within ten (10) years from the date of its execution. At the close of ten years, signatories may review the existing MOA and choose to extend the duration another ten years without mandatory changes or renegotiation of the document if acceptable to all signatories. Prior to such time, SID may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with Stipulation b above should such action be necessary.

e. EXECUTION

Execution of this MOA by the SID and SHPO and implementation of its terms evidence that SID took into account the effects of the undertaking on historic properties and afforded the ACHP an opportunity to comment.

Signatories

Swalley Irrigation District

By: [signature] 3/21/18
Board of Directors Chairman, Swalley Irrigation District — Date

Oregon State Historic Preservation Office

By: [signature: Christine Curran] 3.21.18
Deputy Oregon State Historic Preservation Officer — Date

E.10 Historical Background

This appendix section provides information on the federal Carey Desert Lands Act of 1894 and irrigation development in Central Oregon.

At the turn of the twentieth century, Central Oregon, known then as the Deschutes country, was one of the most remote regions in the nation. Settlers were enticed with opportunities to capitalize on the Deschutes River, promising lands for agriculture, and immense pine forests. Two major factors contributed to the settlement and agricultural development of Central Oregon: the arrival in 1900 of the Columbia Southern railroad, and the State of Oregon's acceptance in 1901 of the 1894 federal Carey Act, which encouraged states to pursue development of arid lands (NPS 2015). In exchange for up to 1 million acres of federal land, states made up to 160 acres available to settlers who agreed to improve and cultivate the land. The Carey Act enabled states to issue irrigation contracts to private developers who were expected to design and build irrigation projects, as well as recruit settlers to farm the new areas. The State would issue a water right to the private developer for a particular project, but the State would not be responsible for financing or construction. If an irrigation project failed, the State reassigned the contract to another development company. While limited irrigation in Central Oregon had begun before these changes, the Carey Act helped spur the creation of more irrigation companies and investment in large-scale irrigation projects (NPS 2017).

References

U.S. Department of the Interior, National Park Service (NPS). (2015). National Register of Historic Places Registration Form, Pilot Butte Canal Historic District (Cooley Road-Yeoman Road Segment). Retrieved from: https://www.nps.gov/nr/feature/places/pdfs/15001052.pdf. Accessed September 7, 2017.

U.S. Department of the Interior, National Park Service (NPS). (2017). National Register of Historic Places Registration Form, Pilot Butte Canal: Downtown Redmond Segment Historic District. Retrieved from: http://www.oregon.gov/oprd/HCD/NATREG/docs/national_register_recent/OR_DeschutesCo_PilotButteDowntownRedmondSegment.pdf. Accessed September 7, 2017.

E.11 Wild and Scenic Outstandingly Remarkable Values

This appendix section presents supporting information associated with Outstandingly Remarkable Values identified for the middle Deschutes River.

Table 5-15 Outstandingly Remarkable Values for Middle Deschutes River[15]

Outstandingly Remarkable Value (ORV)	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 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 1900's.
Geologic	Fifty million years of geologic history are dramatically displayed on the canyon walls of the middle Deschutes River and lower Crooked Rivers. Volcanic eruptions which occurred over thousands of years created a large basin dramatized by colorful layers of basalt, ash and sedimentary formations. The most significant contributor to the outstandingly remarkable geologic resources are the unique intra-canyon basalt formations created by recurring volcanic and hydrologic activities.
Hydrology	Water from springs and stability of flows through the steep basalt canyons has created a stream habitat and riparian zone that is extremely stable and diverse, 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 kayaking and rafting, picnicking,

[15] ORV descriptions gathered from www.rivers.gov/rivers/deschutes.php accessed September 10, 2018.

Outstandingly Remarkable Value (ORV)	Outstandingly Remarkable Value Description
	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 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.