2024 GRANT SOLICITATION

IRRIGATION MODERNIZATION FUNDING

GRANT APPLICATION

APPLICATION DEADLINE: 5:00 PM ON JANUARY 17, 2024

Application must be received by this date and time

Send application electronically to: OWRD.Grants@water.oregon.gov

Mail application to: **OREGON WATER RESOURCES DEPARTMENT**
Attention: Grant Coordinator
725 Summer Street NE, Suite A
Salem, OR 97301

Application Assistance – Instructions, Scoring Criteria and Pre-Application Conferences

We encourage all applicants to review the *Irrigation Modernization Funding Application Instructions* and *Scoring Criteria* while drafting their application and to request a *Pre-Application Conference* before applying. OWRD will review your draft application and provide feedback. You must submit your draft application two weeks before the pre-application conference. Pre-application conferences will not be scheduled the week of the application due date. To learn more, check out the Pre-application Conference document under Irrigation Modernization Funding on the Water Project Grants and Loans, Applications, Forms and Guidance webpage.

APPLICATION SUBMISSION INSTRUCTIONS

1. Complete Sections I through VIII in the spaces provided. **Use the Irrigation Modernization Funding Grant Application Instructions and Scoring Criteria documents when completing your application.** All resources are available at the Water Project Grants and Loans webpage.
2. Complete the application checklist.
3. Submit the application on the form provided by OWRD. Do not alter the application for the purpose of formatting or changing the document structure.
4. Please ensure that the Certification portion of Section II is signed with a live signature by the Applicant and, if applicable, the Co-Applicant.
5. Submit the completed application and all attachments via email or in hard copy. Electronic application submission is the preferred method. You may scan a copy of the signed signature page and submit it with your application as long as both documents are included in the same email.
6. If the application is submitted in hard copy, use 8 ½" x 11" single sided, unstapled pages. Provide any attachments to the application on 8 ½" x 11" single-sided, unstapled pages.
7. Applicants are discouraged from submitting information considered proprietary unless it is deemed essential for proper evaluation of the application. Please note that eligible and complete applications will be posted on OWRD's Funding Cycle History webpage.
8. Contact OWRD at 971-301-0718 or OWRD.Grants@water.oregon.gov if you have any questions.

IRRIGATION MODERNIZATION FUNDING

2024 GRANT APPLICATION

I. Project Information

Project Name: Arnold Irrigation District Deschutes Basin Flow Restoration Project – Phases 3-4

Grant Funding Request: $ 2,860,000

Match Funding: $ 8,624,000

Total Cost of Project (Grant Funding Request + Match Funding): $ 11,551,000

II. Applicant Information

Applicant Name: Arnold Irrigation District		Co-Applicant Name:
Address:	19604 Buck Canyon Road	Address:
	Bend, OR 97702	
Phone:	541-382-7664	Phone:
Email:	stevejohnson@arnoldirrigationdistrict.com	Email:

Principal Contact: Steve Johnson		Fiscal Officer: Same as principal
Address:	19604 Buck Canyon Road	Address:
	Bend, OR 97702	
Phone:	541-382-7664	Phone:
Email:	stevejohnson@arnoldirrigationdistrict.com	Email:

Certification: I certify that this application is a true and accurate representation of the proposed work and that I am authorized to sign as the Applicant or Co-Applicant. By the following signature, the Applicant and Co-Applicant (if applicable) certify that they are aware of the requirements of an Oregon Water Resources Department funding award, have read and are aware of conditions within the example grant agreement on the OWRD's website and are prepared to implement the project, if awarded.

Signature of Applicant/Authorized Person: ____________ Date: 1/17/2024

Print Name: STEVE JOHNSON Title: DISTRICT MANAGER

Signature of Co-Applicant/Authorized Person: ____________ Date: ________

Print Name: __________ Title: ____________

III. Eligibility

1. Is your project an irrigation modernization project? ☒ Yes ☐ No

   An irrigation modernization project is a project that improves water use efficiency of irrigation systems on currently irrigated agricultural lands.

   Attention - If the answer is "No" to this question, your project is not eligible for this funding.

November 2023 1

I. Project Information

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Address:	19604 Buck Canyon Road	Address:
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Phone:	541-382-7664	Phone:
Email:	stevejohnson@arnoldirrigationdistrict.com	Email:

Principal Contact: Steve Johnson		**Fiscal Officer: Same as principal**
Address:	19604 Buck Canyon Road	Address:
	Bend, OR 97702	
Phone:	541-382-7664	Phone:
Email:	stevejohnson@arnoldirrigationdistrict.com	Email:

Certification: I certify that this application is a true and accurate representation of the proposed work and that I am authorized to sign as the Applicant or Co-Applicant. By the following signature, the Applicant and Co-Applicant (if applicable) certify that they are aware of the requirements of an Oregon Water Resources Department funding award, have read and are aware of conditions within the example grant agreement on the OWRD's website and are prepared to implement the project, if awarded.

Signature of Applicant/Authorized Person: ______________________________ Date: ________

Print Name: _____________Title: _____________________________________

Signature of Co-Applicant/Authorized Person: ______________________________ Date: ________

Print Name: ___________ Title: ____

III. Eligibility

1. Is your project an irrigation modernization project? ☒ Yes ☐ No

   An irrigation modernization project is a project that improves water use efficiency of irrigation systems on currently irrigated agricultural lands.

   Attention - If the answer is "No" to this question, your project is not eligible for this funding.

2. Does your project leverage federal funding? ☒ Yes ☐ No

Attention - If the answer is "No" to this question, your project is not eligible for this funding.

If yes, please identify which qualifying federal match you have:

☒ Natural Resources Conservation Service funds associated with an authorized watershed plan

☐ U.S. Bureau of Reclamation WaterSMART grant

☐ U.S. Environmental Protection Agency grant *and* your entity is eligible to be on the Department of Environmental Quality's Intended Use Plan

Note: The federal funding source must also be listed in question 24 with match documentation.

3. Select applicant entity type for both applicant and co-applicant (if applicable).

☐	City	☐	Non-Profit Organization
☐	Cooperative	☐	Partnership
☐	Corporation	☐	Port
☐	Oregon County	☐	Soil and Water Conservation District
☐	Drainage District	☐	Sole Proprietorship
☐	Indian Tribe	☐	Water Control District
☐	Individual	☐	Water Improvement District
☒	Irrigation District	☐	Other:

4. Provide a brief, one to two paragraph description of the water supply need that the project intends to address. Please reference (and attach) supporting data or reports that document the need.

Arnold Irrigation District (Arnold or the District) operates over 39 miles of canals and laterals in the Deschutes Basin. The original system was built over a century ago by early settlers using methods and materials available to them at that time: open canals lined with porous volcanic rock. The open canals cause a tremendous amount of seepage, resulting in loss of nearly 50 percent of the water withdrawn. Thus, with the current system, Arnold must withdraw double the amount of water delivered to patrons.

Phases Three and Four of the Arnold Irrigation District Flow Deschutes Basin Restoration Project (herein referred to as 'this phase[1]' and/or 'project') will enclose 22,751 length-feet (LF) of open canal into leak-free piping to eliminate the seepage loss and restore 8.7 cubic-feet-per-second (CFS) of flow to the Deschutes Basin during the spring and winter. The water conserved will be protected instream for the benefit of water quantity, water quality, and habitat for native and listed species in the Deschutes Basin.

5. Is either the Applicant or Co-Applicant required to have a Water Management and Conservation Plan (WMCP)? ☒ Yes ☐ No

[1] This project is phase three and four of four of the Arnold System Improvement Plan (SIP) as described in Attachment 6. All details and project benefits listed in this application are for this specific phase, Phase Three and Four. Any benefits that will be realized at the completion of all four phases of the SIP will be specifically noted.

If yes, has the plan been submitted to the Water Resources Department and received approval?

☒ Yes ☐ No

Pursuant to ORS 541.659, if an applicant is required to have a water management and conservation plan, the plan ***must be submitted*** *to OWRD* ***and receive approval*** *prior to department acceptance of an application for a grant from the account. The application will be ineligible if a required plan has not been submitted and approved prior to the application deadline. Please contact wrd_dl_wmcp@water.oregon.gov with any questions about WMCPs.*

IV. Project Summary and Location

6. Provide a brief, 4-5 sentence summary of the proposed project. Please include the goal and scope of the project and summarize project implementation. Refer to the *Irrigation Modernization Funding Application Instructions* for additional information on what to include.

The Arnold Irrigation District Deschutes Basin Flow Restoration Project – Phases Three and Four enclose over four miles (22,751 LF) of open canal into leak free HDPE piping to restore 8.7 cfs with the goal of restoring streamflow to the Deschutes Basin that will be protected instream[2] for the Deschutes Basin immediately after the construction concludes. This is the final part of a four-phase system improvement plan that will eventually restore and protect 32.5 cfs to the basin through enclosing the Arnold Main Canal into piping. Phase One at 17,022 LF and conserving 11.2 CFS began construction in September 2023 with completion on schedule in April 2024. Phase Two at 23,175 LF is scheduled to begin construction in October 2024 and will be completed in April 2025 conserving 12.6 cfs. This phase will improve conditions for native and ESA-listed species, improve public safety, and provide a resilient solution for water supply reliability in the Deschutes Basin.

Instructions: Please answer the following questions about the location of the proposed project.

7. Please provide the following information about the project location.
   a. Latitude, Longitude (in decimal degrees): 43.993 / -121.326
   b. County: Deschutes
   c. Watershed/Basin: Deschutes

8. Please attach and label, Attachment #1, a site plan map(s) showing all the following items:

[2] The conserved water will be legally protected instream from the Arnold diversion flowing to North Unit Irrigation District (NUID.) Following the completion of each phase, NUID would legally protect the water released from Wickiup Reservoir through an instream lease under Oregon water law (ORS 537.348 [2] and OAR 690-077). The water leased instream would retain the same priority date as NUID's originating water right (Certificate 51229). The instream lease would protect water in the Deschutes River downstream from Wickiup Reservoir during the non-irrigation season (i.e., in the late fall, winter, and early spring). Once an instream lease was approved by Oregon Water Resources Department (OWRD), the leased portion of NUID's water right would be unavailable for use by NUID or its patrons.

a. ☐ Project area boundaries

b. ☐ True north arrow

c. ☐ Map title and legend

d. ☐ Latitude and longitude of project location

e. ☐ Property boundaries

f. ☐ Surface water bodies

g. ☐ Location of involved structures (existing or proposed)

h. ☐ Tax Map and Lot numbers of each property in project area boundary. Use the same Tax Lot No. on the map as is used in Question 9 below. ***Note: Each property where project work is planned must be identifiable on the map or your application will be deemed incomplete.***

i. ☐ Point(s) of Diversion and Place(s) of Use associated with the project (if applicable)

j. ☐ Proposed measurement location(s) (if applicable)

9. Complete the table below to identify any properties that will be impacted by project implementation. Indicate the types of activities that would occur on each impacted property. ***Note: Each property identified below must be shown on the attached site map or your application may be deemed incomplete***. *Add rows as needed.*

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type (✓ One)**	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation? (✓ all that apply)**	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S12E00000	4422	☐Public ☒Private	Thumb Inc.	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E30 NENE	4404	☐Public ☒Private	JL Ward Co	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E30 NWNE	4404	☐Public ☒Private	JL Ward Co	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E30 SWSE	4404	☐Public ☒Private	JL Ward Co	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S12E19 SWSE		☒Public ☐Private	Highway 97, ODOT, State of Oregon	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW		☒Public ☐Private	Highway 97, ODOT, State of Oregon	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW	100	☐Public ☒Private	Morning Star Christian School	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW	200	☐Public ☒Private	Oregon Department of Transportation	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW	300	☐Public ☒Private	Morning Star Christian School	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW		☐Public ☒Private	BNSF Railroad	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 SESW	500	☐Public ☒Private	Carter Ryan Haun & Sarah Wavers	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S12E19 SESW	600	☐Public ☒Private	Richard & Brandee Kaloke	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 SESW	700	☐Public ☒Private	Kristin Wolter	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 SESW	800	☐Public ☒Private	Bryan Christopher & Cady Zivney	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 SESW	900	☐Public ☒Private	William Joseph & Jessica Cheri Steed	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 NESW	14200	☐Public ☒Private	Paul J & Cindy B Shonka	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 SESW	1000	☐Public ☒Private	Christine A Lucero & John Hill	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒
18S12E19 SESW	1100	☐Public ☒Private	Cathleen Rose	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact:	Excavation & restoration	☒

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18S12E19 SESW	14502	☐Public ☒Private	Roger A Kadel Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NESW	14501	☐Public ☒Private	Morgan William Smith Family Revocable Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	1500	☐Public ☒Private	Denbrook Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	1400	☐Public ☒Private	Daryl C Cronen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	1300	☐Public ☒Private	Rya Hickey & Brooke Riemer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	1200	☐Public ☒Private	Isaac Paul Martin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	1100	☐Public ☒Private	BSTS Investments LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S12E19 NWSW	1000	☐Public ☒Private	Priscilla Vazquez & Victor Gamino	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	14500	☐Public ☒Private	Terry L & Candice E Anderson Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	14800	☐Public ☒Private	Carol Bosque & Robin Cordano	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	900	☐Public ☒Private	Justin T Duke	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	800	☐Public ☒Private	Carrie Blake	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	700	☐Public ☒Private	Jeffrey Lynn & Audrey Annette Nash	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	100	☐Public ☒Private	Virgil R & Marian E McElmurry	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S12E19 NWSW	600	☐Public ☒Private	Lonnie G. & Annette K. White	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	500	☐Public ☒Private	Brenda J & Daniel F Owen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	400	☐Public ☒Private	Mary B Robinson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	300	☐Public ☒Private	Shannon W Osborne, Jr	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S12E19 NWSW	200	☐Public ☒Private	Jeffrey J & Lyn H Stormont	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 NESE	1200	☐Public ☒Private	Matthew Hammer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 NESE	1100	☐Public ☒Private	Paul Caldwell Bacon, II & Beth Anne Lyons	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E24 NESE	1000	☐Public ☒Private	Matthew S Reed	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	900	☐Public ☒Private	Sarah Mackin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	4100	☐Public ☒Private	Brookswood Living LLC TJ & Charissa Toney	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	800	☐Public ☒Private	Roger M Campbell	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	700	☐Public ☒Private	Kevin R Stanton	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	600	☐Public ☒Private	Kimberly M Irving	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E24 NESE	500	☐Public ☒Private	Amasa J Atkinson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒

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18S11E24 NESE	400	☐Public ☒Private	Diania L Gogenola	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SESE	900	☐Public ☒Private	Carl Lee & Dorothy Ann Duke	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NESE	300	☐Public ☒Private	Jeremy Bigalke & Soraya Setareh	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NESE	200	☐Public ☒Private	Lenka Svoboda & Michael E Moor	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NESE	100	☐Public ☒Private	Patricia D Leeper, Pamela Lynn Ruehmann, & Michael Allen Leeper	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NESE		☒Public ☐Private	Brookswood Blvd, Deschutes County	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E24 NWSE	100	☐Public ☒Private	Groza Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NWSE	200	☐Public ☒Private	Amy L Pfeiffer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NWSE	800	☐Public ☒Private	Paulette Lynn Byers	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NWSE	900	☐Public ☒Private	Brian F Lamb & Monica Vines The Vines-Lamb Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NWSE	1000	☐Public ☒Private	Roy K Daniels & Christine D Daniels Roy D Daniels Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 NWSE	1100	☐Public ☒Private	Douglas E Miller	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E24 NWSE	1200	☐Public ☒Private	Roselynn Itti & Tyler J Westlund	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 NWSE	600	☐Public ☒Private	Breeana Kay Thompson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 NWSE	700	☐Public ☒Private	Robert Coffelt	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 SWSE	3800	☐Public ☒Private	Mike Brogan	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 SWSE	3700	☐Public ☒Private	Shelly L Rainey-Ricci & Judy Novella-Farrow	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 SWSE	3600	☐Public ☒Private	Douglas J & Gail E Eldred	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒
18S11E24 SWSE	3500	☐Public ☒Private	Jeremy M & Melissa L Kane	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E24 SWSE	3400	☐Public ☒Private	Gerald D Baez	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	3900	☐Public ☒Private	Richard T & Deanna R Brinkman & Matthew J Huserik	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	3300	☐Public ☒Private	Bradley F & Heidi A Reid Reid Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	3200	☐Public ☒Private	Marcel Russenberger	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	3100	☐Public ☒Private	Marcel Russenberger	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	3000	☐Public ☒Private	Marcel Russenberger	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E24 SWSE	4000	☐Public ☒Private	Jeremy M & Brittany J Avery	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

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18S11E24 SWSE	2900	☐Public ☒Private	Marcel Russenburger	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	4100	☐Public ☒Private	Philip Alan & Heather Ann Phifer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	4200	☐Public ☒Private	Alexandra Nickoli	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	2800	☐Public ☒Private	Thomas J Bennett	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	4300	☐Public ☒Private	Marc A Scott Marc Allan Scott Revocable Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	4400	☐Public ☒Private	Brandon J & Cynthia Wightman	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E24 SWSE	2700	☐Public ☒Private	Fred C Holmes & Judith L Peters Fred C Holmes & Judith L Peters Revocable Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SESW	1900	☐Public ☒Private	Sandy Rager	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SESW	1800	☐Public ☒Private	Adale Simoneaux & Ryan Martin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SESW	1700	☐Public ☒Private	James A Gwin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	2600	☐Public ☒Private	Kelsie M Johnson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E24 SWSE	2500	☐Public ☒Private	Cliff & Chrity Wheeler	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E24 SESW	1600	☐Public ☒Private	Jonathan W & Anne K Birky	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	1500	☐Public ☒Private	Richard & Vera Gilbert	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	1400	☐Public ☒Private	Jennifer Voigt & Geri T Garami	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	2400	☐Public ☒Private	Ruby A Swanson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	1300	☐Public ☒Private	Thomas E & Karrie D Newman	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	1200	☐Public ☒Private	Raquel Deras Diaz & Gerardo Bacho Merino	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E24 SESW	1100	☐Public ☒Private	Clayton Markson & Candice Erin Smith	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E24 SWSE	2300	☐Public ☐Private	Robert Leo Birchem	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E24 SESW	Baker Rd	☒Public ☐Private	Deschutes County	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E24 SWSE	2200	☐Public ☒Private	Duane E & Kimberly Kaye Holesapple	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNE	3200	☐Public ☒Private	Joshua David	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E24 SESW	1000	☐Public ☒Private	Robert E Blue	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NENW	2000	☐Public ☒Private	Donald E & Virginia L Miller	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NENW	1900	☐Public ☒Private	Doug & Amy Raley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E25 NWNE	3100	☐Public ☒Private	Cliff W & Christy E Wheeler Wheeler Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1800	☐Public ☒Private	Gerald R Propst & Nicelle K West	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1700	☐Public ☒Private	Scott Cereghino & Christine Meyers	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1600	☐Public ☒Private	Virginia L Roberts	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1500	☐Public ☒Private	Christopher Michael & Natalie Jane Yoakum	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	2100	☐Public ☒Private	Kevin M & Donna J Brady	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1400	☐Public ☒Private	Tristan P & Debra A Decarne	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E25 NENW	2200	☐Public ☒Private	Nicholas Addy	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1300	☐Public ☒Private	Justin Van Patten & Laurel Lee Noordam	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	2300	☐Public ☒Private	Emily Colleen Dougan	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	2400	☐Public ☒Private	John Stephen Ward & Teresa L Harshman-Ward	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	2500	☐Public ☒Private	Kristy Martin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	2600	☐Public ☒Private	Scott Alan & Chelsie Nicole Smith	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	1200	☐Public ☒Private	Bruce R & Alicia M Esche	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E25 NENW	2700	☐Public ☒Private	Shannon O'Neill	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NENW	2800	☐Public ☒Private	Jason Biggerstaff & Emily Wells	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NENW	01100	☐Public ☒Private	Rachel & Nicholas Dantona	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NENW	2900	☐Public ☒Private	Robert K Braymen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NENW	1000	☐Public ☒Private	Thomas M Tucker	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NENW	3000	☐Public ☒Private	Larry Jr & Mary Ann Keown Keown Revocable Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E25 NENW	900	☐Public ☒Private	Randy D Ellingson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NENW	800	☐Public ☒Private	Lawrence E Johnson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NWNW	2900	☐Public ☒Private	Michael & Karen Stanton	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NWNW	2800	☐Public ☒Private	Robert James Lee	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NWNW	2700	☐Public ☒Private	Paul K & Jeannine Hamley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NWNW	2600	☐Public ☒Private	Katie Keck	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 NWNW	2500	☐Public ☒Private	Kathryn M Luce & Mina L Jenner	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E25 NWNW	2400	☐Public ☒Private	Ryan Foster	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	3000	☐Public ☒Private	Glen W & Kellie S King	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	2300	☐Public ☒Private	Canyon River Ventures LP	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	3100	☐Public ☒Private	Zachary W & Shailah King	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	3200	☐Public ☒Private	Matthew A & Heidi J Odman	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	3300	☐Public ☒Private	Janine E Moore	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E25 NWNW	3400	☐Public ☒Private	Occupant	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒

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18S11E25 NWNW	3500	☐Public ☒Private	Alexander Michael & Barbara Lyn Males	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	2200	☐Public ☒Private	William E Windsor	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	3600	☐Public ☒Private	Cory Waters	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	2100	☐Public ☒Private	Gregory A & Rebekka M Nores	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	3700	☐Public ☒Private	Tania Maia Miller & Matthew Wayne Brick	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	2000	☐Public ☒Private	Kathy & Gary Gasper	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	3800	☐Public ☒Private	Bradley T & Monique R Wilson Wilson Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

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18S11E25 NWNW	1900	☐Public ☒Private	Adrian T Galler & Teresa Q Waggoner	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	3900	☐Public ☒Private	Sung Y Lee & Jennifer Mittler-Lee	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	1800	☐Public ☒Private	Amy A Ohran	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	4000	☐Public ☒Private	Thomas D & Tamara D Lence	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	1700	☐Public ☒Private	Kimberly A & Samuel Gammond	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	4100	☐Public ☒Private	Nicholas Garrett & Amy Joellyn Dragt	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E25 NWNW	1500	☐Public ☒Private	Sine Brothers LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

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18S11E25 SWNW	600	☐Public ☒Private	Robert D & Valerie Rekward	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 SWNW	700	☐Public ☒Private	David N & Joy E Richard	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 NWNW	1600	☐Public ☒Private	Casey M Feist	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 SWNW	800	☐Public ☒Private	Jacqlyn R Evans William R Evans Descendant's Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 SWNW	900	☐Public ☒Private	Corine June Fraser Fraser Family Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E25 SWNW	1000	☐Public ☒Private	Kenneth D & Patricia A Ridenour	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E25 SWNW	1100	☐Public ☒Private	Jason Adam Kurant	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 SWNW	1300	☐Public ☒Private	Gary & Stephanie R Philbrick Gary Philbrick Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 SWNW	1200	☐Public ☒Private	Yzaguirre, NIC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 SENE	300	☐Public ☒Private	Michael James & Lisa Linda Lahey	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 SENE	200	☐Public ☒Private	Jesse & Angela Christensen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E25 SWNW	1400	☐Public ☒Private	Keoni Byron	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 SENE	100	☐Public ☒Private	Gary Len Gesler	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 SENE	1600	☐Public ☒Private	Willard H & Linda Kerneen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1500	☐Public ☒Private	Teodoro Medina & Maria Magdalena Mendoza	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1700	☐Public ☒Private	Cynthia E Perrine	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1400	☐Public ☒Private	Cathryn R Witty	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1300	☐Public ☒Private	Mark & Denise Teel	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1800	☐Public ☒Private	Karrie R Kraft & Hannah C Bolger	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	1200	☐Public ☒Private	Bradford A Ritter & Amy C Brannan	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E26 NENE	1100	☐Public ☒Private	Anne Burkley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	1900	☐Public ☒Private	Andrea L & Dennis S Miller	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	2000	☐Public ☒Private	David A Johnson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	1000	☐Public ☒Private	Bradley M & Tricia Lee Manalatos	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	900	☐Public ☒Private	Vince W Tilden & Polly A Huhnen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	2100	☐Public ☒Private	Edwin B & Sylvia M Barrett	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒
18S11E26 NENE	2200	☐Public ☒Private	K James & Robin S McQuiston Choctaw Rental LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 NENE	800	☐Public ☒Private	John J Casagranda	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	2300	☐Public ☒Private	Caitlyn Anne Drost	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	2400	☐Public ☒Private	Anthony R & Nancy J Goode	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	4400	☐Public ☒Private	Clark R Crawley & Judith A Bembry	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	4300	☐Public ☒Private	Randy Fair & Olivia Stevenson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	2500	☐Public ☒Private	Kenneth A & Kaitlin R Beemer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENE	4200	☐Public ☒Private	Roddy M Bramhall	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 NENE	4100	☐Public ☒Private	John R Schellenber & Candice M Keiper	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	4000	☐Public ☒Private	Lois Reed	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	2600	☐Public ☒Private	Marlena Celeste Hanne & Ingrid Eva Bamberg	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	3900	☐Public ☒Private	Garry Wayne Dodds & Emily Elizabeth Pappo	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	2700	☐Public ☒Private	Thad M & Kelly L Brown	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	2800	☐Public ☒Private	Julie Grover	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	3800	☐Public ☒Private	Kenneth Dale & Michelle Henry	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 NENE	2900	☐Public ☒Private	Jeffrey L Fatland	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3000	☐Public ☒Private	David & Danielle Kelley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3700	☐Public ☒Private	Trevor J & Evelyn D McDonald	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3100	☐Public ☒Private	Paul Norman Wine	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3200	☐Public ☒Private	Kimberly A Focht-Fothergill Gregory M Fothergill	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3600	☐Public ☒Private	Kevin O & Linda J Potter	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENE	3300	☐Public ☒Private	Glenn M & Diana M Reed	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E26 NENE	3400	☐Public ☒Private	Christopher S Taylor	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENE	3500	☐Public ☒Private	Cynthia A Whittington	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NWNE	1800	☐Public ☒Private	Anthony C Grimes & Holly Potter	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NWNE	1700	☐Public ☒Private	David C & Jane E Bredendick Bredendick Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NWNE	1900	☐Public ☒Private	Richard L Stephens & Tina M Couinard	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NWNE	1600	☐Public ☒Private	Lance L Davis	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NWNE	1601	☐Public ☒Private	Two Kilts Holdings LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

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18S11E26 NWNE	2000	☐Public ☒Private	Geoff Scott & Norma Jean Reynolds	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1500	☐Public ☒Private	Dennis Clayton & Kathy Ellen Gobble Dennis & Kathy Gobble Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	2100	☐Public ☒Private	Nora Williams	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	2200	☐Public ☒Private	Todd Stephen Cook	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1400	☐Public ☒Private	James Bernard Voelzoe & Andrea Joan Callen Voelzow Callen Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1300	☐Public ☒Private	Russel Taylor & Zsuzsanna Snyder	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E26 NWNE	2300	☐Public ☒Private	Timothy P & Darla J Linn	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1200	☐Public ☒Private	Jeffrey R & Jennifer M Cornett	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	2400	☐Public ☒Private	Timothy P & Darla J Linn	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1100	☐Public ☒Private	Ann K Wheelock & David L Lund	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	2500	☐Public ☒Private	Johnnie L & Pamila Gogenola	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	1000	☐Public ☒Private	Robert & Deborah Van Nest Andrew Van Nest & Brandi Baughman	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E26 NWNE	2600	☐Public ☒Private	Richard G & Susan M Klampe	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NWNE	900	☐Public ☒Private	Rosalina Wong & Russell Morley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NWNE	2700	☐Public ☒Private	Denise Y Yager & Gerhard Matheis Denise S. Yager Trust Gerhard Matheis & Denise S Yager Gerhard Matheis Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NWNE	800	☐Public ☒Private	Robert & Jenny Jacox	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NWNE	2800	☐Public ☒Private	Denise S. Yager & Gerhard Matheis Denise S Yager Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

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18S11E26 NWNE	700	☐Public ☒Private	Breanna & Chance Mesquit Kevin M & xxxxxxx A Strech	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	2900	☐Public ☒Private	Christopher Morgan Schaening Harold C Schaening Leah Schaening Harold & Leah Schaening Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	600	☐Public ☒Private	John Paul Calkins & Christy Weickum	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	3000	☐Public ☒Private	Chance M & Alesha Easley	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	500	☐Public ☒Private	Jennifer Ann Mawn	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E26 NWNE	400	☐Public ☒Private	Lova J Rhodes	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3300	☐Public ☒Private	Ronald L & Judy L Beran	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3100	☐Public ☒Private	Laura J Fine Laura J Fine Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3400	☐Public ☒Private	Emily E Pile	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3500	☐Public ☒Private	Chasen T Schultz	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3200	☐Public ☒Private	Kerry Jon Schoning	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NWNE	3600	☐Public ☒Private	Rebekkah V Amezcua & Yoni J Serano	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒

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18S11E26 NWNE	3700	☐Public ☒Private	Gerald B & Joyce A Golden Golden Family Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NWNE	3800	☐Public ☒Private	David & Brenda Johnson Choctaw Canal House LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 SWNE	1100	☐Public ☒Private	Janet M Russell Janet M Russell Revocable Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	600	☐Public ☒Private	Richard Scott Naylor	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 SENW	100	☐Public ☒Private	Janet M Russell Janet M Russell Revocable Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 SENW	200	☐Public ☒Private	Janet M Russell Janet M Russell Revocable Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

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18S11E26 NENW	4200	☐Public ☒Private	Kirk A Vaughn	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	700	☐Public ☒Private	Shawn & Molly Kurz	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	4100	☐Public ☒Private	Hannah Gonzales	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	800	☐Public ☒Private	Michael C Sigler	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	4000	☐Public ☒Private	Nathan L & Jill D Walker	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	3900	☐Public ☒Private	Michelle A & Brian N Wright	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	900	☐Public ☒Private	Jeremy T Austin & Callie G Magdziuk	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒

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18S11E26 NENW	3800	☐Public ☒Private	Gabriel J Dimmick	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	1000	☐Public ☒Private	Tara & Keoni Feurtado	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3700	☐Public ☒Private	Darin L Hussey	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3600	☐Public ☒Private	Alan Schuman	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3500	☐Public ☒Private	Robert Rahner & Sue Rogers	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3400	☐Public ☒Private	Nancy Libadisos Nancy Libadisos Revocable Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 NENW	1100	☐Public ☒Private	Cynthia C Ong Cynthia Choy Ong Living Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3300	☐Public ☒Private	Shane A Jones & Jeannette K Prince	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3200	☐Public ☒Private	Ronald E & Jackie S Johnson	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3100	☐Public ☒Private	Lysa D Miller	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	1200	☐Public ☒Private	Donald G & Bonnie L Swearingen	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	3000	☐Public ☒Private	Irving Living Center LLC	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒
18S11E26 NENW	1300	☐Public ☒Private	Ashley Marie & Ronald Scott Williams	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	Tax Lot No. (e.g. 100)	Ownership Type (✓ One)	Property Owner of Record	What type of activity occurs on this site as part of project implementation? (✓ all that apply)	If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).	Property identified & labelled on the map (✓ when complete)
18S11E26 NENW	1400	☐Public ☒Private	Rene & Jeannie L Soliz Rene Soliz & Jeannie L Soliz Joint Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	2900	☐Public ☒Private	James B & Diane M Seguin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	1600	☐Public ☒Private	Dylan Hood Paris	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	1700	☐Public ☒Private	Brian L Roberts	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	2800	☐Public ☒Private	Shaylyn Rae Potter & Helen Billie Patton	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒
18S11E26 NENW	2700	☐Public ☒Private	Casey Ree Bergum	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	Tax Lot No. (e.g. 100)	Ownership Type (✓ One)	Property Owner of Record	What type of activity occurs on this site as part of project implementation? (✓ all that apply)	If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).	Property identified & labelled on the map (✓ when complete)
18S11E26 NENW	1800	☐Public ☒Private	Brian M Tranter	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENW	1900	☐Public ☒Private	Lisa Marie Bushong	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENW	2600	☐Public ☒Private	Amanda F Detweiler	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E26 NENW	2000	☐Public ☒Private	Jennifer & Christopher Tidwell	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E23 SESW	4000	☐Public ☒Private	James T Mills & Catherine L Dolan	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E23 SESW	3900	☐Public ☒Private	Montessah Frost & Bryan Sokol	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒
18S11E23 SESW	3800	☐Public ☒Private	Jennifer L Packard	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ______	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E26 NENW	2500	☐Public ☒Private	Debra Reynolds	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E23 SESW	3700	☐Public ☒Private	Ralph & Amy J Price	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E23 SESW	3600	☐Public ☒Private	Kent T Knipmeyer	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 ENW	2400	☐Public ☒Private	Samantha & Jamie Voyles	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E23 SESW	3500	☐Public ☒Private	Amelia E Smith & Lucas R Bates	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E26 NENW	2300	☐Public ☒Private	Lee Wesley Davis	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒
18S11E23 SESW	3400	☐Public ☒Private	Patricia Belle Haaby Patricia Haaby Trust	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ___	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	Tax Lot No. (e.g. 100)	Ownership Type (✓ One)	Property Owner of Record	What type of activity occurs on this site as part of project implementation? (✓ all that apply)	If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).	Property identified & labelled on the map (✓ when complete)
18S11E26 NENW	2200	☐Public ☒Private	Jennifer D & Edward Piercy III	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E26 NENW	2100	☐Public ☒Private	Ian Larkin	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E23 SESW	3200	☐Public ☒Private	Joel W & Deborah A Brick	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E23 SESW	3300	☐Public ☒Private	Ami Simpson & Cody Fuller	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E23 SWSW	3300	☐Public ☒Private	Talitha Stewart	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E23 SESW	3100	☐Public ☒Private	Jason & Michelle Colquhoun	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒
18S11E23 SWSW	3200	☐Public ☒Private	Andrew S & Leah J Knopp	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ____________	Excavation & restoration	☒

Tax Map No. (e.g. 12S06W-12714)	**Tax Lot No.** (e.g. 100)	**Ownership Type** (✓ One)	**Property Owner of Record**	**What type of activity occurs on this site as part of project implementation?** (✓ all that apply)	**If applicable, identify the type and extent of ground disturbing activity (e.g. test pits, borings, new road construction, excavation, etc.).**	**Property identified & labelled on the map (✓ when complete)**
18S11E23 SWSW	3000	☐Public ☒Private	Heidi Degraaf	☐ Access site ☒ Project work ☒Ground disturbing activity ☐Other impact: ________________	Excavation & restoration	☒

10. For each property listed in Question 9, evidence will be required documenting legal easement on or ownership of all lands where the work will be carried out. Evidence includes but is not limited to: (i) documentation of easement, (ii) easement holder's agreement to allow Grantee to carry out the work, or a portion of the work on the servient estate, or (iii) deed or other documentation of land ownership. *Submission of this information will be a condition of the grant agreement; you can provide it now or after the grant agreement is signed.*

V. Project Details and Description

Instructions: Please answer the following questions.

11. Provide additional information (building on the project summary) to further describe the proposed project and how the project will achieve its goals.

This Project encloses over four miles (22,751 LF) of open canal into leak free piping to restore 8.7 cubic-feet-per-second (CFS) that will be protected instream for the Deschutes Basin. Piping the canals have two immediate outcomes (1) substantial reduction in amount of water diverted to serve Arnold's patrons; and (2) substantial increase in water remaining instream for the benefit of listed and native species. All benefits of the project will be realized immediately after construction of this phase.

The conserved water will be legally protected instream from the Arnold diversion flowing to North Unit Irrigation District (NUID.) Following the completion of each phase, NUID would legally protect the water released from Wickiup Reservoir through an instream lease under Oregon water law (ORS 537.348 [2] and OAR 690-077). The water leased instream would retain the same priority date as NUID's originating water right (Certificate 51229). The instream lease would protect water in the Deschutes River downstream from Wickiup Reservoir during the non-irrigation season (i.e., in the late fall, winter, and early spring). Once an instream lease was approved by Oregon Water Resources Department (OWRD), the leased portion of NUID's water right would be unavailable for use by NUID or its patrons. Arnold signed its first agreement with NUID for Phase 1 and will execute the instream releases with the completion of construction in Spring 2024. That agreement is included as Attachment 8.

Purpose and Need

Compared to the natural hydrologic regime, the Deschutes River and its tributaries experience extreme streamflow variability seasonally due to the storage and diversion of water for agricultural use. Resource agencies have identified streamflow as a primary concern in the Deschutes River (UDWC 2014). Reservoir operations lead to low winter streamflow and high summer streamflow in the Deschutes River upstream from Arnold's diversion. The combined diversions of the seven major irrigation districts and the cities that divert water in or near Bend lead to low spring, summer, and fall streamflow in the Deschutes River, downstream of Arnold's diversion.

The Deschutes River and its tributaries support a variety of sensitive species, of which three are currently listed as threatened under the Endangered Species Act (ESA) and include the Oregon spotted frog, Mid-Columbia Steelhead, and Bull Trout. Major efforts have been made to support these species and their habitats; however, lawful irrigation-related activities continue to limit streamflow, negatively affecting fish and aquatic habitat. Current irrigation activities have the potential to result in incidental "take" 7 of ESA-listed species in the Deschutes River and its tributaries. The eight irrigation districts of the Deschutes Basin and the City of Prineville (the applicants) have together developed and submitted the Deschutes Basin Habitat Conservation Plan (HCP; AID et al. 2020) to the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), which includes irrigation activity conservation measures. The conservation measures include streamflow targets in the Deschutes River and its tributaries that the applicants must meet to benefit the ESA-listed species. USFWS and NMFS provided a final permit decision on December 31, 2020, which adopts the HCP and enables the applicants to avoid the unauthorized take of ESA-listed species by issuing incidental take permits. To meet the requirements set forth in the HCP, the applicants must identify mechanisms that would enable them to keep water instream; mechanisms like this project. Additionally, the Deschutes River is listed as an impaired waterway under Section 303(d) of the Clean Water Act (CWA) because it does not meet one or more of the State of Oregon's water quality standards for salmon and trout, as well as other beneficial uses throughout the year.

The open canals are a risk to public safety. In addition to multiple instances of injury in AID, at least 10 deaths have occurred in other irrigation district canals near AID ("19-year old Redmond woman died" 2014; KTVZ 2014; Chu 2004; Cliff 2008; Flowers 2004; Golden 2007; Minoura 2007). The District's location in a partly urbanized area heightens the potential for an accident, as the Main Canal passes through urban areas, rural residences, private lands, and irrigated fields. During the summer, water depths in the Main Canal range between 2 to 6 feet, with velocities up to 5 cfs. These conditions make it difficult for a healthy, strong adult to stand in or climb out of the canal without assistance. A child or non/weak-swimmer would have an even higher risk of drowning in a canal with these attributes. If a person or animal falls into a canal, they could have serious difficulty gaining hold on the banks to climb out due to the volume and speed of the moving water. Currently, barriers or fences are not present at the top bank of the canal. The failure of the earthen canal and risk of localized flooding is also a concern for the District. The District experiences sinkholes on a regular basis including a most recent one in May 2021. In 2015, Deschutes County was the fastest growing county in Oregon, based on the Oregon Population Report (PSU 2015). Public safety risks associated with the open canal will continue to grow as the county's population grows.

The water released in the spring will also have a large impact on North Unit Irrigation District's ability to provide water to their patrons. With the completion of all four phases of piping the Arnold Canal, the conserved water will contribute 11,083 Acre-feet of water annually to NUID's irrigation supply. This represents approximately 6-8.5 percent of NUID's average irrigation water supply from the Deschutes River and Wickiup Reservoir. Phase 2 of this project will contribute 4,286 acre-feet (38% of the total four-phase project total.) In a district that saw nearly 70 percent of its fields fallow over the last season, this will be an important asset to NUID's ability to provide water and continue agricultural production in the district.

Watershed and Resource Opportunities Realized through the Project

Enclosing the open canals into leak-free piping will result in the following benefits to the region:

- Improved streamflow, water quality, habitat, and habitat availability in the Deschutes River downstream from Wickiup Reservoir by protecting 100 percent of the water saved instream during the non-irrigation season (refer to Section 18 of this application for detail);
- Support and maintain existing agriculture through enhanced water supply reliability and improved water management (refer to Section 17 of this application for detail);
- Minimize the potential for flooding, injury, and loss of life associated with the open canals (refer to Section 19 of this application for detail); and
- Reduce the District's O&M involved in delivering irrigation water to its patrons (refer to Section 18 of this application for detail).

Construction Methods and Details

This project will pipe over four miles of open canal. The pipes are 48 inches in diameter. This phase construction will start in the fall of 2025 and will be complete before the start of the irrigation season in April 2026. Construction includes mobilization and staging of construction equipment, delivery of pipe to construction areas, excavation of trenches, fusing of pipelines, placement of pipe, compaction of backfill, and restoration and reseeding of the disturbed areas. Pipe installation would require storage areas for pipe, construction equipment, and other materials. Areas that have been previously disturbed and are accessible through existing access routes would be used when possible.

The project area would be accessed from AID's existing maintenance roads as well as public roads. Existing maintenance roads may require some improvements for use during construction. Vegetation clearing before construction, vegetation and weed management during construction, and reseeding after construction of Arnold's Right-of-Way and easements would be completed according to Arnold's current vegetation management practices and NRCS's Oregon and Washington Guide for Conservation Seedings and Plantings (NRCS 2000). During construction, vegetation clearing would be minimized to the extent practicable. Trees would only be removed if there were no other alternative to access the construction site or they posed a safety threat to construction crews.

12. Describe partnerships and collaborative efforts associated with the planning or implementation of this project. Include a description of how parties of diverse interests worked, or will work, together to achieve a common goal.

This project is part of a regional effort by irrigation districts to pipe open canals into leak-free piping. Arnold is a member of the Deschutes Basin Board of Control (DBBC), a consortium of irrigation districts. Through regional collaboration efforts, the DBBC and their members have been systematically piping irrigation canals for the past decade. Additionally, to date, Arnold has piped approximately 22% of its own system. Thus, Arnold can pull from both its own and its partners' experience in piping the system.

Piping the main canal in four phases was studied extensively and the following documentation demonstrates planning, environmental assessments, and other details:

- Attachment 4: Watershed Plan - Environmental Assessment for the Arnold Irrigation District Irrigation Modernization Project, Final 2022
- Attachment 6: System Improvement Plan, 2017
- Attachment 7: Finding of No Significant Impact, 2022

This project is part of a regional effort to prioritize conservation and instream flow restoration through enclosing open irrigation canals into leak-free piping. As such, there have been several plans and assessments that have studied the benefits and impacts of these efforts spanning several decades. The following documents recommend the piping of irrigation canals or conservation efforts to restore instream flow in the Deschutes Basin. Copies of these reports are available upon request:

- Deschutes Basin Habitat Conservation Plan, DBBC, 2020
- Upper Deschutes Subbasin Assessment, Upper Deschutes Watershed Council, 2003
- Upper Deschutes Subbasin Fish Management Plan, Oregon Department of Fish and Wildlife, 1996

13. List letters of support for this project (name and/or affiliation of sender is sufficient). Attach copies of the letters to your application.

This project has received widespread support from several collaborators and supporters. In Attachment 5 you will find letters from:

- Deschutes Basin Board of Control
- Deschutes River Conservancy
- U.S. Fish and Wildlife Service

Project Tasks

14. Identify tasks necessary for the proposed project using the following format. Include as many tasks as necessary to implement the project. If your proposed project receives grant funding, the tasks identified will be incorporated into your grant agreement as the "Project Description."

Note: Project management and administration are common functions within specified tasks and not a separate task. All cost match and grant budget funds must apply to the tasks identified below. See the Budget Procedures and Allowable Costs document on the [Applications, Forms and Guidance webpage] for more information.

For each task address the following:

Task number. Task Title

- Task schedule: State the approximate dates during which the task will be completed.
- Description of task activities: Include specific details of the task such as purpose, planned approach, and proposed methods.

Task 1. Engineering Design to Bid Solicitation

- Task schedule: Q3 2024 – Q3 2025
- Description of key task activities:
  - Engineering design to final plans
  - develop solicitation document for construction contractor, including pipe and ancillary materials procurement
  - publicly advertise and receive bids for contractor and materials procurement
  - select and award to contractor following Oregon Statutes for Public Procurements
- Permits/Regulatory Approvals Required: None

Task 2. Contracting

- Task schedule: Q2 - Q3 2025
- Description of key task activities:
  - Execute Contract with selected contractor
  - Contract compliance
  - Ensure Contractor submits required regulatory notices
  - Contract termination
- Permits/Regulatory Approvals Required: None

Task 3. Construction (includes Materials Procurement)

- Task schedule: Q3 2025 – Q2 2026
- Description of key task activities:
  - Contractor mobilization to project site
  - Contractor implement facilities and controls
  - Supplier to manufacture and ship materials to project site
  - Contractor clear, grub
  - Contractor installs pipe, materials and appurtenances in accordance with the professional design drawings and specifications
  - Contractor substantially complete the work
  - Contractor final complete the work in accordance with the plans and specifications
  - Project progress reporting
  - Post Construction rehabilitation and as-builts
  - SCADA network implementation and synch w existing

Permits/Regulatory Approvals Required: FONSI, received August 2022. At this time, Arnold isn't aware of any additional construction or road crossing permits required to complete construction. However, we are coordinating with Deschutes County on any compliance requirements for construction.

Task 4. Project Management, Project Inspections, Post Project Implementation Review (including instream water right protection)

- Task schedule: Q3 2025 – Q4 2026
- Description of key task activities:
    - Overall QAP
    - Attend initial and ongoing project meetings with selected contractor
    - Review and approve submittals
    - Review and coordinate requests for information, potential change orders, change orders and other contract related documents
    - Perform part-time field observation services
    - Attend weekly meetings with the contractor and owner
    - Prepare daily monitoring reports
    - Participate in Substantial and Final Completion observations of the work to ensure compliance with the contract documents
    - Arnold to perform initial and course of establishment seeding and maintenance
    - Contractor and Arnold to perform Warranty walk after project Substantial Completion
    - Arnold to operate and maintain system elements
- Permits/Regulatory Approvals Required: None

Copy and paste additional tasks as needed.

15. Project Task Scheduling – Estimated total project duration: 40 months

    Place an "X" in the appropriate column to indicate when each task would occur. Note that successful applicants will not receive their grant agreement until Q3 of 2024. OWRD cannot reimburse for costs incurred prior to the effective date of the grant agreement. Project tasks listed must match the tasks identified in Question 14.

Tasks	**Calendar year** 2024				**Calendar year**2025				**Calendar year**2026			
(Add more rows as needed)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1. Engineering Design to Bid Solicitation	☐	☐	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐
Task 2. Contracting	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☐
Task 3. Construction	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☐	☐
Task 4. Project Inspection, Post Project Implementation Review and Project Maintenance (including instream water right protection)	☐	☐	☐	☐	☐	☐	☒	☒	☒	☒	☒	☒

16. Describe how you propose to measure and report the water diverted and used from the proposed project. Include a proposed method, timing, frequency, and location of measurement in your proposal. Consider that many forms of measurement will incur additional costs.

Note: Funded projects with any diversion of water are required by statute to "regularly measure and report the water diverted and used from the project" [ORS 541.692(3)]. OWRD makes the final determination on the method, timing, frequency, and location of measurement. Grant funds can be used to pay for measurement and reporting expenses during the life of the grant.

Water diversion and quantification of savings (cfs) will be done on a daily basis during irrigation season utilizing OWRD and USBR stream and diversion gauges for the AID Diversion, NUID Diversion and Deschutes River gauges BENO, WICO and DEBO. These readings will be compared to historical diversion quantities and the identified amount of conserved water will be provided by AID to NUID for confirmation. The accumulative Acre Feet (AF) conserved will be tallied for the full irrigation season and scheduled by NUID for release out of WICO. This will be overseen and agreed by all DBBC member Districts.

During irrigation season, daily readings will be taken remotely through installed water measurement telemetry SCADA and manually by canal staff gauges to confirm amount of conserved water. These readings will then be compared to the diversion totals.

Arnold Irrigation District and North Unit Irrigation District are entering into a legal agreement for the conserved water. The methodology for determining the tracking and release of conserved water will be developed by Arnold, and agreed to by NUID and OWRD. The methodology will ensure the proper water is passed to NUID in the spring and stored in Wikiup Reservoir in the winter.

The methodology to manage and report the amount of conserved water from the Arnold ID Main Canal piping project as it progresses through all three phases. This methodology is important for NUID, DBBC, OWRD and project partners to thoroughly understand as we move forward this upcoming 2024 irrigation season and subsequent years.

This Model will serve as the operating construct for determining the base diversions and then reconciling to actual daily diversions to determine the amount conserved and to be passed downstream to NUID. This approach utilizes 2019 as the baseline year of 100% natural flow availability.

This methodology is intended to model Oregon's Conserved Water Statutes, but these statutes do not allow instream water protection in a different season from the original right. it should be considered a hybrid process. This methodology should be considered a hybrid process. As a hybrid, it does address the vagaries of natural flow availability and provide a realistic mechanism to calculate and document the amounts of conserved water through each phase.

METHODOLOGY

Baseline [reference Attachment 10]

2019 is considered the most current approximation of operating available natural flows for Arnold ID (Arnold) and will function as a surrogate for the water right certificate to deduct conserved water totals and arrive at diversion maximums.

On each day of irrigation season, the cubic feet per second (cfs) amount of available live flow supply to Arnold is estimated with the DRiFT model and then compared to the 2019 levels. If natural flow availability meets or exceeds 2019 then availability is considered at 100%. If natural flow availability is at 100% then the maximum calculated conserved water for that day of the irrigation season would apply. Arnold's diversion would not to exceed availability and the full amount of conserved water would be computed.

- For example, June 25, 2019, Arnold diverted 98 cfs. Since this day is in Season 3 of the irrigation season the entire 11.2 cfs is conserved and Arnold would only divert a maximum amount of 86.8 cfs [98–11.2 =86.8]

This amount of conserved water will be communicated daily to NUID and to the other Deschutes irrigation districts through a daily morning text group and is monitored by the OWRD watermaster. Arnold will also keep a live google shared sheet with NUID, DBBC and OWRD recording each daily diversion tracked using the USBR Hydromet data. The identified amount of Arnold conserved water will be posted and will not be diverted by another downstream district except NUID.

The daily quantities will be reconciled with the OWRD WaterMaster monthly, or bi-weekly storage reports to insure full accountability and accuracy. If natural flow availability is found to be greater or less than the data utilized in the daily worksheet then the amount of conserved water will be correspondingly corrected.

Availability Adjustment Factor

If the natural flow availability to Arnold falls below the 2019 flow then an adjustment to the expected amount of conserved water would decrease an equivalent percentage.*

- For example, the 2019 diversion on June 25th was 98.0 cfs. If natural flow availability on June 25, 2024 is only 91.0 cfs then there is a 7% (7/98=.07) reduction in the expected conserved water which would be 10.4 cfs. Arnold would only divert 80.6 cfs [91-10.4=80.6] of natural flow .

**Storage is separated from natural flow at the Arnold ID diversion and is not included in the conserved water total delivered to NUID*

Conserved water amounts by season and by project phase along with the 2019 baseline flows are provided in Attachment 10. Hypothetical calculation examples are for in May 31 and June 5.

DRiFT 2.0

The DRiFT tool was constructed to enhance water planning for the Deschutes River irrigation districts by determining both daily and monthly natural flow calculations. These calculations had been conducted by the OWRD's Regional Office but only monthly, and sometimes bi-weekly. The onset of severe and continued drought conditions required more frequent estimates of natural flow and storage used between the OWRD monthly reports.

It is anticipated that the DRiFT tool will facilitate the documentation and calculation of conserved water generated by Arnold and delivered to NUID. This feature has been requested by the DBBC and DRC to the programmers of DRiFT to be available at the beginning of the 2024 irrigation season.

Water Rights, Permits, and Regulatory Approvals

Attention – All current, pending, or planned water rights necessary to implement the proposed project must be listed below for the application to be accepted as complete.

17. Identify any <u>currently held</u> water rights needed to <u>implement the proposed project</u> below. Check all of the following that apply and provide the information requested in the table below:
    a. ☒ The applicant holds the water right(s) required for the project. If checked, list all water rights required for the project in the table below, adding rows as needed. See the Application Instructions for further instruction, including how to find water right information.
    b. ☐ The applicant has legal access to a water right that will be required for the project and has been given permission to use the water right(s). If checked, list all water rights required for the project in the table below, adding rows as needed. See the Application Instructions for further guidance, including how to find water right information.

Water Right Number (Include prefixes, if applicable, e.g., G 00010)	Is this an application, permit, certificate, limited license, special or final order, transfer, decree, lease, or claim?	Water Right Amount			Tax Map/Lot IDs within the Place of Use where water will be used to implement the proposed project
		Max Volume (ac-ft)	Max Rate (cfs)	Duty (ac-ft/ac)	
74197	Certificate		150	15.42	Irrigation Season: Deschutes River through NUID; Storage Season: released out of Wickiup Reservoir

18. Identify any <u>new</u> water rights needed for the proposed project. Complete the table adding any essential information describing needed water rights or status.

Type of Water Right Surface water, Groundwater, Limited License, Conserved water certificate, Storage, Secondary Use permit, Transfer, Instream Lease, etc.	**Status** Application not yet submitted, Application submitted and in progress (if submitted include application number)	Anticipated Water Right Amount			Tax Map/Lot IDs within the anticipated Place of Use where water will be used to implement the proposed project
		Max Volume (ac-ft)	Max Rate (cfs)	Duty (ac-ft/ac)	
Instream Right	Not submitted	*4286*			Irrigation Season: Deschutes River through NUID; Storage Season: released out of Wickiup Reservoir

19. In the table below, provide a list of any permits and regulatory approvals needed to implement the project. Indicate the status and efforts to-date of each. Please attach copies of any secured permits/approvals. *Add rows as needed for additional permits.*

Project Activity Requiring Permit/Regulatory Approval	Permit/ Regulatory Approval Name and Entity Issuing	Status and Efforts to Date
Construction and Installation	FONSI – USDA	Received 8/8/2022

Construction and Installation	NRCS Chief authorization	Received 12/6/2022

If no permits or regulatory approvals are required, please provide an explanation below.

VI. Public Benefits

Instructions: Describe how the project would provide public benefits in each of the three public benefit categories (economic, environmental, social/cultural). In your responses, describe current conditions and anticipated project outcomes and benefits. Provide evidence to support your claims. Descriptions should be quantitative when possible.

Applications are scored and ranked based on the descriptions of the economic, environmental, and social/cultural public benefits and the likelihood of the project achieving the claimed benefits. More specifically, the evaluation is based on the change in conditions expected to result from the project as demonstrated in the application.

Application Tip: Please read the **Scoring Criteria** document on the Applications, Forms and Guidance webpage as you complete this section. The Scoring Criteria document will be used for both Irrigation Modernization Funding applications and Water Project Grants and Loans (WPGL) applications. Irrigation Modernization projects will be evaluated in the same manner as WPGL projects with one exception. For projects involving surface water rights where the project conserves water, priority shall be given to projects that legally protect a portion of the conserved water instream commensurate with the amount required under the approach described in ORS 537.470.

The Scoring Criteria document includes definitions of each public benefit and a description of how the public benefits are evaluated and scored. Applications that do not demonstrate public benefit in each of the three categories (economic, environmental, social/cultural) will be deemed incomplete. Applications **must** achieve a minimum score of seven in each of the three public benefit categories during the evaluation process to be eligible for funding.

Leave blank any public benefits that are not applicable to the proposed project.

20. Economic Benefits – ORS 541.673(2)
    a. Does the project create or retain jobs? If so, explain.

This project will create living wage jobs in design and construction during the construction of the project, and also secure agriculture jobs in the region indefinitely.

The 2020 Census confirmed that Deschutes County is the fastest growing county over the past decade in Oregon. The region has seen a 25.7 percent increase in population from 2010. Construction remains one of the highest non-farm source of employment in Central Oregon. As a public works project, Arnold uses the prevailing wage rates for all construction activities. Laborers on this project earn from $36 - $90 per hour plus fringe benefits.

As a part of the Plan Environmental Assessment for this Project, a regional economic impact assessment was done to look at the annual jobs created over a 107-year period. With successive phases of this project, Arnold expects to directly create over 80[3] jobs per year for the next seven years and $3.6 million in average annual income over the 7-year construction period. In other words, Phase 3-4 is responsible for creating 80 jobs for one year; and the Arnold Canal four phase project will retain these same jobs for seven years.

During construction of Phases 3-4, additional jobs will be created beyond the job site. This project requires gravel, steel, concrete, equipment, fencing, and other materials. This creates jobs indirectly. This project is expected to create 30 indirect jobs with $1.1 million in annual income.

This project will also secure and create agriculture jobs. Based on the regional economic assessment, this project will create 50 additional jobs over the analysis period. Agriculture in Deschutes County accounts for approximately 50,000 jobs with over half of the jobs directly related to crop production. This project will not only result in a stable, resilient and reliable water delivery infrastructure, but also encourages on-farm improvements.

Together, the estimated annualized job benefit to the region is $1.6 million in average annual income over the 107-year period of analysis of the project.

Aside from the regional economic analysis, there are other indirect jobs related to the conservation of water and improvement of instream flow. In a 2011 Report by Trout Unlimited through the University of Michigan School of Natural Resources and Environment, researchers concluded that "The Deschutes River provides annual market value of $134.7 million as revenue to six focal industries: agriculture, tourism, recreation, hotels, real estate, and commercial salmon. Agriculture in Central Oregon irrigated by the Deschutes River generates $40.2 million in annual revenues… Many jobs in agriculture, hotels, tourism and recreation would not be available without the river and these four industries provide an estimated 3,433 jobs with total wages of $73.0 million to Central Oregon for residents of the region each year" (Hartmann, Kasameyer, Springer 2011 – Report available upon request.) Every effort to conserve water for restoration of in-stream flows in the Deschutes Basin grows and retains jobs by protecting the most valuable resource to the region.

b. Does the project increase economic activity? If so, explain.

This project increases economic activity in the region and nationally. In the Plan-EA, Arnold

[3] The System Improvement Plan for Arnold, while categorized I four phases, is being constructed in three winters for three similar lengths (~20,000 LF each). Quantitative benefits analyzed in the Environmental Assessment were calculated for the entire project. Thus, benefits for each of the three construction periods divided the total project in thirds. Benefits described in the public benefit section may be similar to previous applications due to the benefits being spread over three nearly equal spans.

looked into socioeconomic resources using the 2017 IMPLAN economic impact model for Oregon's Deschutes, Jefferson, and Crook Counties and found that piping the open canals would have a beneficial effect on employment and income from construction activities and agricultural production and related farm household income in the county.

The Regional Economic Development (RED) from the project would create construction jobs. Refer to question A for details on the job growth and income.

Additionally, water conserved through the piping would be passed on to North Unit Irrigation District (NUID) where it would decrease agricultural damages associated with irrigation water shortages beginning in 2028. Water conservation for the project is expected to enhance agricultural productivity in NUID. NUID will benefit the irrigation year following completion of construction for this phase. This phase will contribute 4,286 acre-feet of water to NUID's patrons each year indefinitely. This amounts to an approximate 3 percent increase of NUID's delivery annually. NUID saw about 70 percent of its fields fallow over the past several years due to persistent drought – this increase will be noticeable and help to provide a stable supply to NUID through conserved water.

When annualized over the 107-year period on analysis of the project, the regional economic effects in Jefferson County and neighboring Crook and Deschutes counties are estimated at approximately 50 jobs and $1 million in income annually. In all, the economic analysis found that the project would result in $1,600,000[4] beneficial effects annualized over the 107 year analysis period.

c. Does the project result in increases in efficiency or innovation? If so, explain.

The primary purpose of the project is water conservation and efficiency. This project encloses nearly 4 miles of open porous canal into leak free piping that will immediately conserve 8.7 cfs, or nearly 50% of the water that was previously lost due to seepage. The conserved water will remain instream during the irrigation season and winter months.

d. Does the project result in enhancement of infrastructure, farmland, public resource lands, industrial lands, commercial lands or lands having other key uses? If so, explain.

This project has three major enhancements of infrastructure and farmlands: (1) creates a climate resilient and modern infrastructure for Arnold and its patrons; (2) increases usable land by burying the pipeline and thus regaining usable land; and (3) eliminates instances of water theft or extraneous diversions.

This project modernizes and enhances the current water conveyance infrastructure with a piped system that not only results in efficiency, improved water management but also

[4] 2020 dollars, annually, over 107 year analysis period

provides resilience for climate change and sustainability of the use of the land for farming. The efficiencies and elimination of seepage loss will provide a stable water supply for agriculture where current conditions as well as climate models are showing more instances of drought (IPCC 2022). By only withdrawing the amount of water needed for delivery to patrons, and leaving 8.7 cfs in stream that was previously lost through the lining of the canals, Arnold is able to secure more water instream to support important functions of the Deschutes Basin.

The buried pipeline increases usable land for over 4 miles, allowing for planting and restoration on private land. Arnold believes that this will increase property values for the area affected as well as improve safety.

Currently, with the open canals, water theft is possible. With a simple shovel and pump, extraneous diversions can be made from the open canals. Arnold employs ditch riders to monitor and eliminate this; however, it is possible. With the enhancement of the piped system, this brand of water theft will become impossible and Arnold can ensure all the water withdrawn is delivered for its primary use.

e. Does the project enhance economic value associated with tourism or recreational or commercial fishing, with fisheries involving native fish of cultural significance to Indian tribes, or with other economic values resulting from restoring or protecting water instream? If so, explain.

According to Travel Oregon, tourism generated nearly $1.28 billion in Central Oregon in 2018 and has steadily increased 6-8% per year over the past decade. While wildfires and COVID-19 have hampered tourism in the region in the past several summers, visitors still flock to the Deschutes Basin for its recreational opportunities and scenic beauty. This project will increase flows to the Deschutes River during the important summer months through a key recreation corridor between the Arnold and NUID diversion – enhancing in-water recreation from rafting, floating, fishing, and swimming.

Additionally, the increased flows will improve recreational fishing for redband trout and brown trout in the Deschutes River. This is especially important and helpful during low flow months in the summer that have created temperature issues inhabitable for native fish.

f. Does the project result in increases in irrigated land for agriculture? (which may include increasing irrigated acres, agricultural economic value, or productivity of irrigated land) If so, explain.

This project will secure agricultural economic value and productivity through partial pressurization of the water delivery resulting in pumping power savings (refer to Attachment 6, page 22 for details.) This phase of the project will reduce pumping cost by 12% resulting in an estimated pumping savings of 52,886 kilowatt hours per year. The delivery of pressurized water coupled with the savings of pumping cost incentivizes investment of farm

improvements that enhance the agricultural economic value and productivity of the land. Depending on the efficiency method, yields can increase 10 – 30% on the same land. Thus, this project could yield to more effective and efficient irrigated lands that could result in higher crop yields, more efficient irrigation practices, and overall improvements to agriculture for the region.

21. Environmental Benefits – ORS 541.673(3)
    a. Does the project result in measurable improvement in protected streamflows? If so, complete the subquestions below and explain.
        i. Complete the table below:
            - List the existing water right information of the source water right to be moved, protected, or transferred instream, and
            - Name the legal means proposed to permanently dedicate and protect water instream by the Oregon Water Resources Department.

        IMPORTANT Note: You MUST include the legal protection of water instream to receive a score for this public benefit. Projects which permanently dedicate water instream will extra points. ***If awarded funding, the legal protection of water instream will be a condition of funding. Contact the Grant Coordinator for any questions about these grant conditions.***

Legal Protection of Water Instream *(add rows to table as needed)*

Water right permit or certificate number to be used in transaction for instream protection (e.g., irrigation, reservoir, or AR/ASR; S-####)	Rate(s) (cfs)/duty (ac-ft/ac) or volume (ac-ft) of the contributing water right	Estimated rate (cfs)/duty (ac-ft/ac) or volume (ac-ft) of water to be legally protected instream	Percent (%) of right to be legally protected instream	Transaction for Legal Means of Instream Protection (chose one)
74197	4286	4286	100	☐ Instream transfer ☒ Allocation of Conserved Water ☐ Above-ground storage release ☐ Below-ground storage release
				☐ Instream transfer ☐ Allocation of Conserved Water ☐ Above-ground storage release ☐ Below-ground storage release

ii. **If using the Allocation of Conserved Water Program**: Identify the percent of the conserved water that will be permanently dedicated instream and protected by the Oregon Water Resources Department: ______%

iii. Describe how the protected streamflows accomplish one or more of the following:

(A) Supports the natural hydrograph;

(B) Improves floodplain function;

(C) Supports state- or federally-listed sensitive, threatened or endangered fish species;

(D) Supports native fish species of cultural importance to Indian tribes; or

(E) Supports riparian habitat important for wildlife:

All (100 percent) conserved water resulting from this Project will be returned instream and protected through a legal agreement with NUID. Thus, this project will directly impact and improve the natural hydrograph; support state and federally listed sensitive, threatened, and endangered fish species; support native fish species of cultural importance to Indian tribes; and support riparian habitat important for wildlife. The benefits listed in this section will be realized immediately after construction of this phase.

i. Supports the natural hydrograph:

Compared to the natural hydrologic regime, the Deschutes River and its tributaries currently experience extreme streamflow variability seasonally due to the storage and diversion of water for agricultural use. Resource agencies have identified streamflow as a primary concern in the Deschutes River (UDWC 2014). Reservoir operations lead to low winter streamflow and high summer streamflow in the Deschutes River upstream from Arnold's diversion. The combined diversions of the seven major irrigation districts and the cities that divert water in or near Bend lead to low spring, summer, and fall streamflow in the Deschutes River, downstream of Arnold's diversion.

This project will conserve and protect 8.7 cfs of water in both the irrigation season and during the winter. During the irrigation season, this conserved water would stay instream in the Deschutes River through to NUID's diversion, restoring more natural flows during the critical late summer months. In the winter, the water would be released from Wickiup Reservoir. This stable increased flow will interrupt the current freeze/thaw cycle caused by low flows, and limit harmful erosion caused by fluctuation of flows providing an improved riparian buffer and keeping vegetation submerged. Both factors are critical to Oregon spotted frog overwintering as well as breeding in the early spring.

Altered flow regimes can contribute to dissociation between life history strategies and environmental conditions, leading to reduced persistence reported for many wildlife populations inhabiting regulated rivers. The Oregon spotted frog (Rana pretiosa) is a threatened species occurring in floodplains, ponds, and wetlands in the Pacific Northwest with a core range in Oregon, USA. All life stages of R. pretiosa are reliant on aquatic habitats, and inundation patterns across the phenological timeline can have implications for population success. Monthly survival was strongly associated with the extent and variability of inundated habitat, suggesting some within-season fluctuations at higher water levels could be beneficial. Seasonal survival was lowest in the winter for all three sites, owing to limited water availability and the greater number of months within this season relative to other seasons.

Reestablishing a more natural hydrologic regime in these reaches could allow the river channel to supply water to wetlands and riparian areas via infiltration through channel banks, thus enhancing wetland and riparian function by facilitating processes such as surface and groundwater exchange as well as physical and chemical transformations and supporting riparian plant communities.

C. Supports state- or federally-listed sensitive, threatened or endangered fish species:

This project will result in improved habitat conditions for native and ESA-listed species including the Oregon Spotted Frog. Just twenty years ago, flows out of Wickiup Reservoir could reach below 50 cfs during the winter. These low flows caused a damaging and erosive thaw/freeze cycle near the reservoir that denigrated habitat for wildlife and significantly modified the natural river channel and characteristics. Low streamflow in the fall, winter, and early spring associated with upstream reservoir storage limit riparian vegetation in the Deschutes River. Low streamflow along these reaches can expose the channel bed and riverbanks facilitating erosion and fine sediment and nutrient delivery. Because streamflow is strongly correlated with critical physical and biological characteristics of the river, it influences the functions of associated riparian areas (National Research Council 2002). This could result in loss of ecological functions. Through efforts by DBBC members to enclose open canals, modification of reservoir operations, and other measures, this past winter the flows reached 105 cfs out of Wickiup reservoir - doubling the past low flows. Recent conserved water projects completed by DBBC member districts have brought the instream effective total to 135 cfs. The completion of Arnold Phase 1 in 2024 with 11.2 cfs will bring that total to 146.2 cfs. This project completion, Arnold Phase 2 - 4, in 2025 will result in an additional 21.5 cfs and bring the effective flow to 171.1 cfs representing an overall increase of 20.2%. HCP conservation objectives has a target of 300 cfs by 2028, so Arnold's projects brings the resulting flows to 57% of goal. DBBC conservation and modernization projects in the region have the long-term goal of increasing flows to 600 cfs. The targets under the HCP are conditions of an Endangered Species Act incidental take permit; this permit covers the water management activities in the basin. If targets are not met, then operations to all applicants are threatened.

This project will support two important life stages of the frog – overwintering (winter) and breeding (spring). The conserved water will be held in Wickiup Reservoir for release over the winter. Under existing channel and wetland conditions, the WUA generally increases with increasing water depth. In the winter, this project will allow for increased flows that will result in more high-quality overwintering habitat that is created upon the margins of the river and in adjacent wetlands (River Design Group 2017). Breeding habitat in the spring is also driven by water depth, water velocity, substrate composition, and proximity to vegetation. Breeding habitat also generally increases with increasing flows. Moreover, restoring this flow instream will provide better tools to provide more suitable conditions for the Oregon spotted frog.

This project will provide substantial instream benefit improving stream flow, water quality and habitat conditions for recently reintroduced steelhead as the area and depth of the wetted channel increase. In February 2010, Mid-Columbia steelhead were not identified by the USFWS as occurring in Deschutes County, but the steelhead were recently reintroduced into a tributary of the middle Deschutes River (Whychus Creek), approximately 35 miles downstream of the project area. Big Falls, a natural barrier to steelhead, is about 25 miles downstream of the project area and will likely prevent steelhead from accessing all but a portion (15 miles) of the stream reach improved by the project.

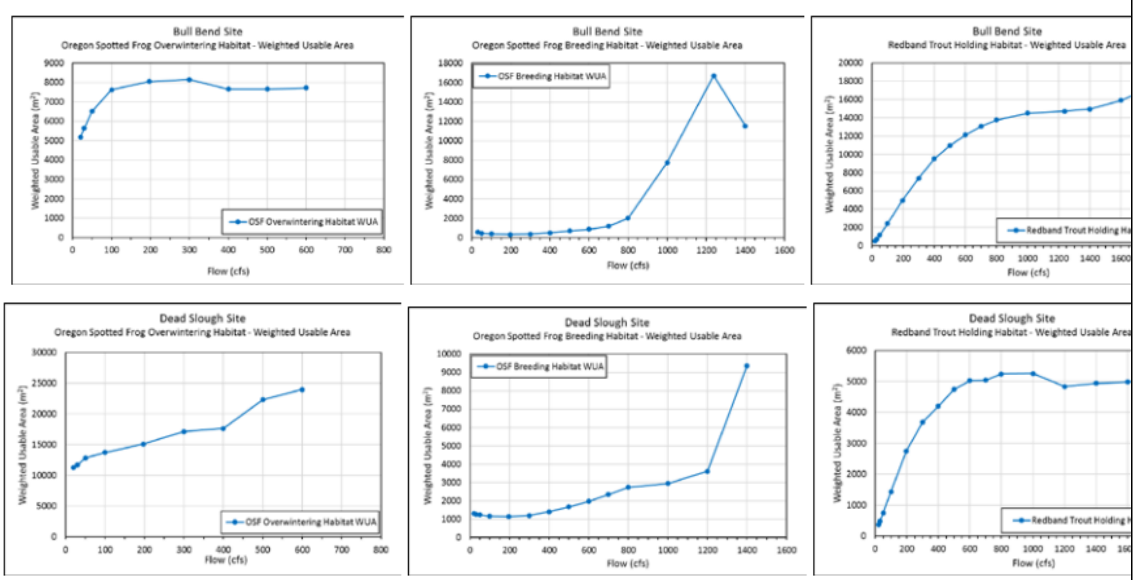
D. Supports native fish species of cultural importance to Indian tribes:

The protected instream flow in the winter will provide a benefit for the Deschutes River basin from the Upper Deschutes below Wickiup Reservoir all the way down to Lake Billy Chinook; including enhanced flow for endangered Bull Trout and Steelhead, as well as popular recreational fish species like rainbow trout, brown trout, kokanee, and smallmouth bass. Lake Billy Chinook is a popular recreational fishing lake, and an important cultural landmark to the Confederated Tribes of the Warm Springs. Adding instream flow to the system will enhance the tribe's efforts for recovery of culturally important species, such as kokanee and steelhead, in the lake.

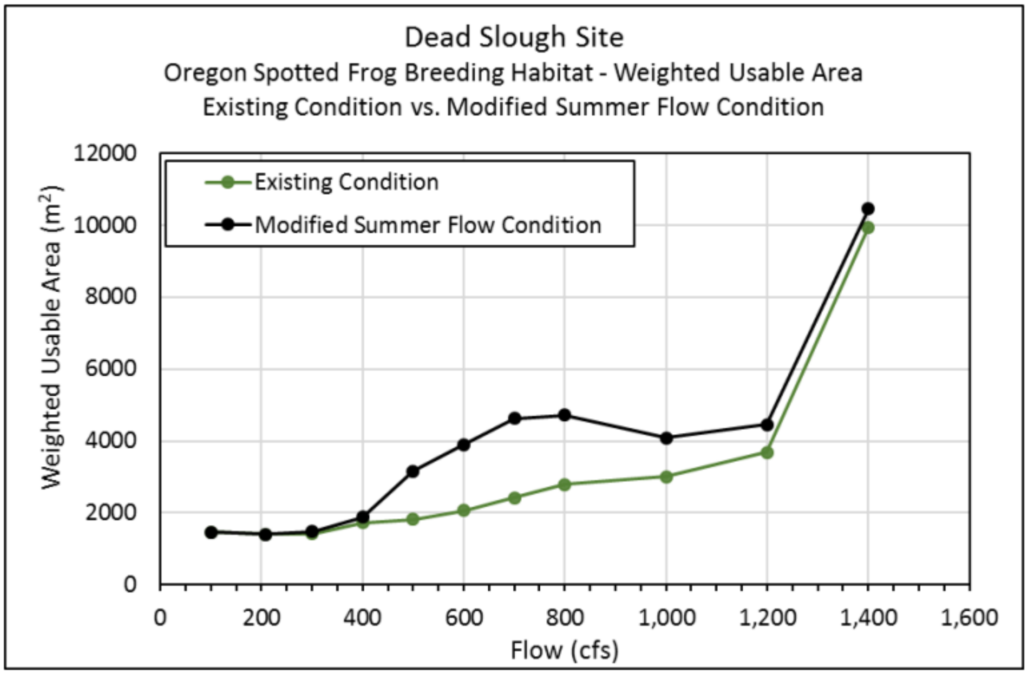
E. Supports riparian habitat important for wildlife:

In a 2017 study commissioned by the Deschutes Basin Board of Control, the habitat area downstream of Wickiup Dam was studied. The two areas are named Bull Bend and Dead Slough. Wetted usable area (WUA) was calculated for the Oregon spotted frog and Redband trout (not ESA listed) using hydraulic model outputs and species-life stage habitat preference information. The results suggest that “Oregon spotted frog overwintering habitat suitability at both sites increases with flow as off-channel habitats are inundated by low velocity inflows. Overwintering habitat suitability at Bull Bend increases rapidly from 20 cfs to 200 cfs, and then remains relatively consistent until 1,000 cfs. Next year, through Arnold and their partners efforts, the flows will increase another 24% to 135 cfs due to operational changes. Through Arnold’s completed Project alone will increase flows another 25%, an 837.5% increase over recently recorded winter flows. Along with other partners in the basin, flows will reach 300 cfs in seven years, and to 600 cfs in twenty years. Peak habitat suitability is associated with shallow water depths, low velocities, and inundated emergent vegetation. Similarly, Redband trout similarly increases with increasing flow as the river interacts with mid-channel and channel margin woody debris (Brandt, Caldwell, 2017.)

The following plots show the improvement of WUA in the habitat below Wickiup Dam due to increased flow:



This Project is an important tool to reach the near-term goal of reaching 300 cfs instream flow below Wickiup Dam to improve habitat for the Oregon spotted frog. The following plot displays the existing condition and the modified flow regime. The plot shows that the increase of flows coupled due to additional water left instream with the additional weighted usable area results in improved Oregon spotted frog breeding habitat. Without this project, additional flows will not be available to provide this modified flow condition that benefits the Oregon spotted frog breeding habitat.



b. Does the project result in water conservation? If so, explain.

The primary purpose of this project is water conservation and protection of instream flow in the Deschutes Basin. In the open porous canals, 45 percent of the water withdrawn is lost to seepage. This project will result in 8.7 cfs (2,978 acre-feet) of water being conserved immediately upon completion. Thus, 45% of the water is conserved. This water would have previously been withdrawn and lost through the porous canals. Piping the project reduces the amount of water Arnold needs to withdraw to deliver to patrons due to the previous seepage loss.

c. Does the project result in measurable improvement in groundwater levels that enhances environmental conditions in groundwater restricted areas or other areas? If so, explain.

Returning conserved water to protected instream use will allow for a more natural hydrograph in the Basin. This may provide more normal conditions for fill and refill of groundwater sources, thus improving groundwater levels.

d. Does the project result in a measurable improvement in the quality of surface water or groundwater? If so, explain.

The surface water in the Deschutes Basin is constrained by a history of over-appropriation. Water management in the Deschutes Basin has altered seasonal streamflow patterns, increasing streamflow above historical levels in some reaches, and decreasing streamflow below historical levels in others. Low streamflow during the irrigation season impacts water quality in the Deschutes River by exacerbating temperature and dissolved oxygen problems. Additionally, water quality conditions in the river often dictates the spread and extent of invasive aquatic species (McCormick et all. 2009), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River. The water quality impairments in the basin do not meet water quality standards under the Clean Water Act Section 303(d.) The following table lists the impaired waterbodies in the Deschutes Basin associated with Arnold's operations:

Name	**Listed Reach**	**Parameters included in Oregon's 303(d) List**
Crane Prairie Reservoir	N/A	Aquatic Weeds or Algae
Deschutes River	Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 226.8)	Temperature
Wickiup Reservoir	N/A	Aquatic Weeds or Algae
Deschutes River	Wickiup Reservoir Dam (RM 226.8) to North Canal Dam (RM 164.8)[1]	Temperature Dissolved oxygen pH Sedimentation Turbidity Chlorophyll a
Deschutes River	North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0)	Temperature Dissolved Oxygen

[1]The Arnold Canal Diversion is located at River Mile (RM) 174.5 in the Deschutes River

Low streamflow impacts water quality in the Deschutes River by exacerbating temperature and dissolved oxygen problems. In addition, water quality often dictates the spread and extent of invasive aquatic species (McCormick et al. 2009), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River. Low streamflow and water quality impairments are recognized as key limiting factors for fish populations in the basin (NMFS 2009). Low streamflow and elevated water temperatures in the middle Deschutes River during the irrigation season negatively affect salmonid growth and survival (Recsetar et al. 2012). Availability of cold-water refugia for temperature-sensitive fish species is of key importance when river temperatures rise above acceptable standards. Water temperatures that are out of the normal range for a given fish species can increase physiologic stress; increase susceptibility to predators; and influence growth rates, feeding, metabolism, and development.

The Project would increase late fall, winter, and early spring streamflow in the Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5). Water quality in the Deschutes River downstream of Wickiup Reservoir is greatly influenced by water quality in Wickiup Reservoir itself, and higher winter flows are typically associated with improved water quality. During the irrigation season, water previously diverted for consumptive use would remain instream longer in the Deschutes River, increasing flows by 8.7 cfs until RM 164.8 at NUID's diversion at North Canal Dam.

In cold, winter months, however, the banks of waterbodies with low streamflow are susceptible to freeze-thaw cycles that can increase bank erosion and increase sediment in the water. Given the pollutant input, less water also leads to higher concentration of pollutants than more water quality. Therefore, greater streamflow also helps to dilute pollutants.

Additionally, although Arnold does not allow its canal and lateral system to be used for stormwater management in an effort to avoid the risk of contaminating irrigation water with potential stormwater pollutants; piping the canals eliminates the opportunity to be indirectly used for stormwater conveyance or disposal. Enclosing the system would return the landscape along the canal to its original grade and to the natural surface runoff patterns that existed prior to the presence of the open canals.

e. Does the project increase ecosystem resiliency to climate change impacts? If so, explain.

In recent years, water temperature has been exasperated by multiple consecutive years of drought. Again in 2023 the DBBC has asked for a drought declaration to commissioners representing Jefferson, Crook, and Deschutes Counties as well as Governor Tina Kotek. Historic cycles in Central Oregon show a drought cycle occurring about every ten years. However, over the past thirty years alone there have been ten drought declarations in Deschutes County with another expected for this year. We believe we are already seeing the impacts of climate change in our basin.

The most recent Inter-governmental Panel on Climate Change (IPCC) report, they found that escalating climate change impacts causing hotter droughts and progressive loss of seasonal water storage in snow and ice will tend to reduce summer season flows in much of western North America. Completing this project as soon as possible will result in keeping 8.7 cfs in stream in those critical drought summer months and provide a resiliency measure against climate change.

A recent vulnerability assessment of southern and central Oregon shows the effects of climate change on hydrology will be highly significant with decreased snowpack and earlier snowmelt shifting the timing and magnitude of streamflow, with significantly lower summer flows (Halofsky, Peterson, Ho, 2019.) Additionally, climate models show a change in fall and winter inflows to the reservoirs. Ultimately, this could result in higher flows in the fall and winter in addition to lower flows in the late summer. The conservation of water from this Project will allow for a more resilient future for the watershed by allowing for more water to remain instream or in storage to provide adequate flow and habitat for ESA and native species throughout the critical seasons.

f. Does the project result in improvements that address one or more limiting ecological factors in the project watershed? If so, explain.

ow streamflow and water quality impairments are recognized as key limiting factors for fish populations in the basin (NMFS 2009). Low streamflow and elevated water temperatures in the middle Deschutes River during the irrigation season negatively affect salmonid growth and survival (Recsetar et al. 2012). Availability of cold-water refugia for temperature-sensitive fish species is of key importance when river temperatures rise above acceptable standards. Water temperatures that are out of the normal range for a given fish species can increase physiologic stress; increase susceptibility to predators; and influence growth rates, feeding, metabolism, and development.

The Project would increase late fall, winter, and early spring streamflow in the Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5). Water quality in the Deschutes River downstream of Wickiup Reservoir is greatly influenced by water quality in Wickiup Reservoir itself, and higher winter flows are typically associated with improved water quality. During the irrigation season, water previously diverted for consumptive use would remain instream longer in the Deschutes River, increasing flows by 8.7 cfs until RM 164.8 at NUID’s diversion at North Canal Dam.

22. Social/Cultural Benefits – ORS 541.673(4)
   a. Does the project promote public health and safety and of local food systems? If so, explain.

The current open main canal poses a risk to public safety as a drowning and flooding hazard. In addition to multiple instances of injury in Arnold's current system, at least ten deaths have occurred in the region in the open irrigation canals. Arnold's system is near a partly urbanized area that heightens the potential for accident. During the summer, water depths in the Main Canal range between 2 and 6 feet with velocities up to 5 cfs. These conditions make it difficult for a healthy, strong adult to stand in or climb out of the canal without assistance. A child or weak swimmer would have an even higher risk of injury or death with these conditions. If a person or animal falls into a canal, they could have serious difficulty gaining hold to the banks due to the volume and speed of the moving water. Currently, barriers and fences are not present at the top bank of the canal. Additionally, the failure of the earthen canal and risk of localized flooding is a major concern. Arnold has experienced sinkholes on a regular basis including a most recent case in May 2021 that required the shutdown of the canal and repairs in a residentially developed area of the district. The sinkhole was approximately 25 feet deep and 40 feet wide and required the area to be blocked off from any public access due to the risk of the sinkhole potentially opening further and risking injuries.

The Project improves Arnold’s water delivery infrastructure, further securing its ability to deliver water to its patrons that contribute to the local food systems. Most of the water use is agricultural for food and livestock products. Approximately 36% of the land served by Arnold is planted in alfalfa, 36% in hay/pasture, 28% in lawn/garden and miscellaneous.

Piping of these laterals also prevents contaminants, such as herbicides and pesticides, from entering the water supply for Arnold's patrons. This is extremely important to the safety of the local food system; especially for a patron dairy producer and several farms that sell food products to the local farmers markets.

b. Does the project result in measurable improvements in conditions for members of minority or low-income communities, economically distressed rural communities, tribal communities or other communities traditionally underrepresented in public processes? If so, explain.

Arnold recognizes the importance of supporting members of minority or low-income communities, economically distressed rural communities, tribal communities, or other communities traditionally underrepresented in public processes.

The Deschutes Basin is part of 10 million acres of lands ceded to the United States by the CTWS. Under rights reserved by federal treaty, tribal members harvest salmon and steelhead from the rivers of the Deschutes Basin. Tribal fishing opportunity has become severely restricted because of fish passage barriers, low fish abundance, and the need to protect weak or threatened stocks (CTWS 2020). Arnold and NRCS conducted tribal consultation with the Tribal Historic Preservation Office (THPO) in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order (EO) 13175, Consultation and Coordination with Indian Tribal Governments, to maintain NRCS's government-to government relationship between Native villages and tribes. NRCS sent a letter to the Confederated Tribes of Warm Springs (CTWS) requesting input and notifying them of the scoping process. CTWS is currently being consulted during the planning phase of the project.

Improving conditions of fish through instream flow restoration was found to help improved threatened fish and aquatic species habitat and populations. Improving these populations would benefit cultural values to the CTWS including enhanced fishing, community, health, cultural identity, subsistence, and religious tribal values.

Arnold also maintains and values a special government-to-government relationship with the CTWS with direct communication and coordination on basin activities. District leadership ensures CTWS is aware, included, and consulted on district activities as well as inclusion on basin initiatives.

Through the Plan-EA process, it was determined that the piping project is not located near any racial, socioeconomic, or environmental justice groups and complies with Executive Order 12898.

c. Does the project promote recreation and scenic values? If so, explain.

This project promotes recreation and scenic values through restoration of instream water as well as restoration of natural land areas following construction of the buried water pipeline.

Two sections of the Deschutes River that are part of the federal Wild and Scenic Rivers system (PL 90-542; 16 U.S.C. 1271 et seq.) have the potential to be affected by the proposed project:

- The Deschutes River from Wickiup Reservoir (RM 226.8) to the Bend UGB at the southwest corner of Section 13, T18S, R11E (approximately RM 172.0) is classified as “Scenic” and “Recreational” with Outstandingly Remarkable Values (ORVs) including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, and Vegetation. This section of the Deschutes River has no sections classified as Wild (USDA 1996).
- The Deschutes River from Odin Falls (RM 139.9) to the upper end of Lake Billy Chinook (RM 120.0) is classified as “Scenic” with its ORVs including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, Hydrology, Botanical/Ecological, and Wilderness (BLM 1992).

The overall goals of the Wild and Scenic River Management Plans (USDA 1996 and U.S Department of Interior 1992) are to maintain the current character of the river area and provide long-term protection and enhancement of its ORVs. Additional goals include protecting and enhancing instream and land-based biological, cultural, and physical resources and providing for appropriate recreational use and public access while maintaining the wild and scenic nature of the river (USDA 1996 and U.S. Department of Interior 1992).

Increased streamflow would be consistent with Wild and Scenic River management goals (U.S. Department of Interior 1992). The project would have beneficial effects on some of the qualities that support these designations. Specifically, any effect of increased streamflow would be an enhancement to fish, recreation, scenery, wildlife, hydrological, and botanical/ecological values.

After construction, areas adjacent to the canal would be restored to near prior contours. The area over the pipe would be graded to blend with the side of the canal. Disturbed areas, including the newly buried pipes, would be planted with a seed mix of native grasses and forbs in consultation with NRCS. Recreationists would have views of a vegetated corridor rather than either open water or an empty canal, depending on the season. Disturbance to existing mature trees during construction would be minimized to the extent possible, and these trees would also be part of the vegetated corridor. Additionally, these activities consistent with the ORVs of Wild and Scenic Rivers and State Scenic Waterways.

d. Does this project contribute to the body of scientific data publicly available in this state? If so, explain.

> Oregon Water Resources Department and other state and federal agencies maintain stream gages along the Deschutes River and Wickiup Reservoir. The conservation effects of the piping will be able to be tracked and measured through the stream gages, further improving the ability to track usage and manage the Deschutes Basin for multiple purposes.
>
> Several other irrigation districts and regional partners are also engaged in piping conservation projects in Central Oregon. In the near future, the Deschutes Basin will have more water protected instream than in the past 100 years. Effects to the ecosystem function of the protected instream water will be observed and quantified for the next several decades. Arnold looks forward to continuing to participate in conservation and habitat improvement efforts with its regional partners that contribute to the body of knowledge of both water management and ecosystem function in the region.

e. Does this project promote state or local priorities, including but not limited to the restoration and protection of native fish species of cultural significance to Indian tribes? If so, explain.

> The Deschutes Basin is part of 10 million acres of lands ceded to the United States by the CTWS. Under rights reserved by federal treaty, tribal members harvest salmon and steelhead from the rivers of the Deschutes Basin. Tribal fishing opportunity has become severely restricted because of fish passage barriers, low fish abundance, and the need to protect weak or threatened stocks (CTWS 2020). Improving conditions of fish through instream flow restoration was found to help improved threatened fish and aquatic species habitat and populations. Improving these populations would benefit cultural values to the CTWS including enhanced fishing, community, health, cultural identity, subsistence, and religious tribal values.
>
> Additionally, this project is part of state-wide and basin priorities and plans including:
>
> - Deschutes River Basin Habitat Conservation Plan, 2020
> - The Deschutes Subbasin Plan, Northwest Power and Conservation Council, 2005
> - Upper Deschutes River Fish Management Plan, Oregon Department of Fish and Wildlife, 1996
> - Upper Deschutes Agricultural Water Quality Management Area Plan, Oregon Department of Agriculture, 3rd rev. 2013
> - Integrated Water Quality Report, Oregon Department of Environmental Quality, 2004/2006
> - Deschutes Basin Restoration Priorities, Oregon Watershed Enhancement Board, 2006
> - Middle Deschutes Monitoring Project, Oregon Department of Fish and Wildlife, 2012

f. Does this project promote collaborative basin planning efforts, including but not limited to efforts under Oregon's Integrated Water Resources Strategy? If so, explain.

Arnold is a member of the DBBC an unprecedented collaboration between eight irrigation districts (Arnold, Central Oregon, Lone Pine, North Unit, Ochoco, Swalley, Three Sisters and Tumalo). Arnold also participates in the Deschutes Basin Study Work Group (BSWG) through an agreement with Bureau of Reclamation and the Deschutes Basin Board of Control to complete the Deschutes River Basin Study. The BSWG is an incredibly diverse group with members from the eight irrigations in addition to Avion Water Company, Bend Paddle Trail Alliance, Central Oregon Flyfishers, Cities of Bend, Madras, Prineville, and Redmond, Crooked River Watershed Council, Deschutes County, Deschutes River Conservancy, Native Reintroduction Network, Natural Resources Conservation Service, Oregon DEQ, OWRD, Portland General Electric, Trout Unlimited, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Forest Service, Upper Deschutes River Coalition, Upper Deschutes Watershed Council, Water for Life, and Water Watch. Both of these diverse collaborative groups produce studies contributing to the body of knowledge of the basin, develop habitat conservation plans, identify immediate and long-term needs of the basin's water resource management, and provide a venue to communicate and coordinate all basin efforts. These efforts are an excellent example of collaborative place-based planning for the Deschutes Basin. Additionally, Phase 1 of this project was funded through a series of restoration and irrigation modernization grants through Oregon Watershed Enhancement Board that solidified the importance of this project for the state's water restoration objectives.

This Project also directly correlates to the efforts suggested through the Integrated Water Resources Strategy. The following Recommended Actions in the IWRS directly relate to this project:

- Recommended Action 3.a: Regional efforts identified the needs for instream; thus, encouraging conservation projects such as piping projects.
- Recommended Action 4.c: Piping the canal contributes to energy savings through the elimination of pumps in addition to the significant water savings by eliminating 50 percent seepage through the canals.
- Recommended Action 7.a: This project is a significant investment in sustainable infrastructure that will be minimal maintenance and serve the district for decades.
- Recommended Actions 9.a - 9.c: Irrigation districts in the Deschutes Basin coordinate and collaborate in several venues that contribute to collaborative place-based planning efforts including the Deschutes Basin Board of Control, the Deschutes Basin Study Work Group, The Deschutes Basin Water Collaborative, Deschutes River Conservancy, and other efforts. Canal piping is a direct result from this successful place-based planning effort.
- Recommended Action 10.a: Completion of this project will eliminate a 50 percent seepage loss in the irrigation canals, a substantial benefit to water use efficiency and water conservation.
- Recommended Action 10.D: Arnold Irrigation District is committed to transferring the water right for all conserved water over to the State of Oregon for protection instream. This is a large environmental benefit that occurred without regulatory intervention

- Recommended Actions 11.A, 11.B, 11.D: Returning water instream improves watershed health, resiliency, and capacity, provides instream flow protections, as well as protecting and restoring instream habitat for fish and wildlife.

Arnold and its partners in the DBBC, NRCS and Farmers Conservation Alliance (FCA) have held numerous public meetings and outreach throughout their history to both inform and include the public on its activities. In addition, all BSWG and DBWC meeting notes are publicly available on the Bureau of Reclamation's website.

Arnold's board meetings are also open to the public with sufficient time for public comments and communication with the public. All meeting agendas and minutes are available at Arnold's website.

VII. Project Budget

Instructions: Please answer the following questions about the proposed project budget using the table provided. All Grant and Match Funds must be allowable costs as described in the OWRD's Grant Budget Procedures and Allowable Costs document.

23. Please provide an estimated line-item budget for the proposed project. Please note that indirect costs **are not** an allowable grant expense. See the Budget Procedures and Allowable Costs on the OWRD Applications, Forms, and Guidance webpage for further guidance.

OVERALL PROJECT BUDGET Line Items	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
Staff Salary/Benefits	67,000			67,000
Contractual/Consulting		8,624,000	2,860,000	11484000
Supplies				
Materials				
Travel				
Equipment (must be approved)				
Other:				
Totals	**67,000**	**8,624,000**	**2,860,000**	**11,551,000**

VIII. Match Funding

24. **Instructions:** Fill out the table below and attach the appropriate documentation for both secured and pending match (add rows as needed). Label the documentation as Attachment #3.

    Applicants must have one of the following sources of federal match:

    - Natural Resources Conservation Service funds associated with an authorized watershed plan
    - U.S. Bureau of Reclamation WaterSMART grant

- U.S. Environmental Protection Agency's grants that are eligible to be on the Department of Environmental Quality's Intended Use Plan

For secured funding, you must *attach a letter of support* or other documentation from the match funding source (including match from your own organization) that:

- Specifies the dollar amount identified for this project,
- Equals the dollar amount shown in the "Amount/Dollar Value" column in the table below,
- Describes the work to be accomplished through the match.

For pending resources, you must attach *other written documentation showing a request* for match funding. Documentation must:

- Include the amount of match funding requested or anticipated,
- Include the project name,
- Note the date on which a future funding application will be submitted,
- Identify the funding program from which funds are pending, and
- Provide evidence that the project is eligible for the funding program identified.

The total match funds listed below must match the amounts in Section I and Question 23.

Match Funding Source (if in-kind, briefly describe the nature of the contribution)	**Type (✓ only one)**	**Status (✓ only one)**	**Amount/ Dollar Value**	**Date Match Funds Available** *(Month/Year)*
NRCS PL 566	☒cash ☐in-kind	☒secured ☐pending	8,624,000	12/2023
In-Kind, Staff salary/benefits	☐cash ☒in-kind	☒secured ☐pending	67,000	12/2023
	☐cash ☐in-kind	☐secured ☐pending		
Total of Match Funds			= $8,691,000	

IRRIGATION MODERNIZATION FUNDING
APPLICATION CHECKLIST

Please use this checklist to ensure that your application is complete, and you have included required attachments with your application. We will not accept an application deemed ineligible or incomplete in any section.

Application:

☐ Section II is signed by Applicant/Authorized Person and Co-Applicant/Authorized Person (if applicable).

☐ All questions have been addressed.

Required Attachments:

☒ Attachment 1 – Site map (Question 8)

☒ Attachment 2 – Documentation of match funding (Question 24) includes the following:

a) Match documentation for **all** match funding sources listed in the match fund table.

b) Match funding documentation that clearly identifies the dollar amount and describes the work to be accomplished with the match.

Optional Attachments:

☒ Property access authorization (Question 10): Attachment # 3

☒ Letters of support (Question 13): Attachment # 5

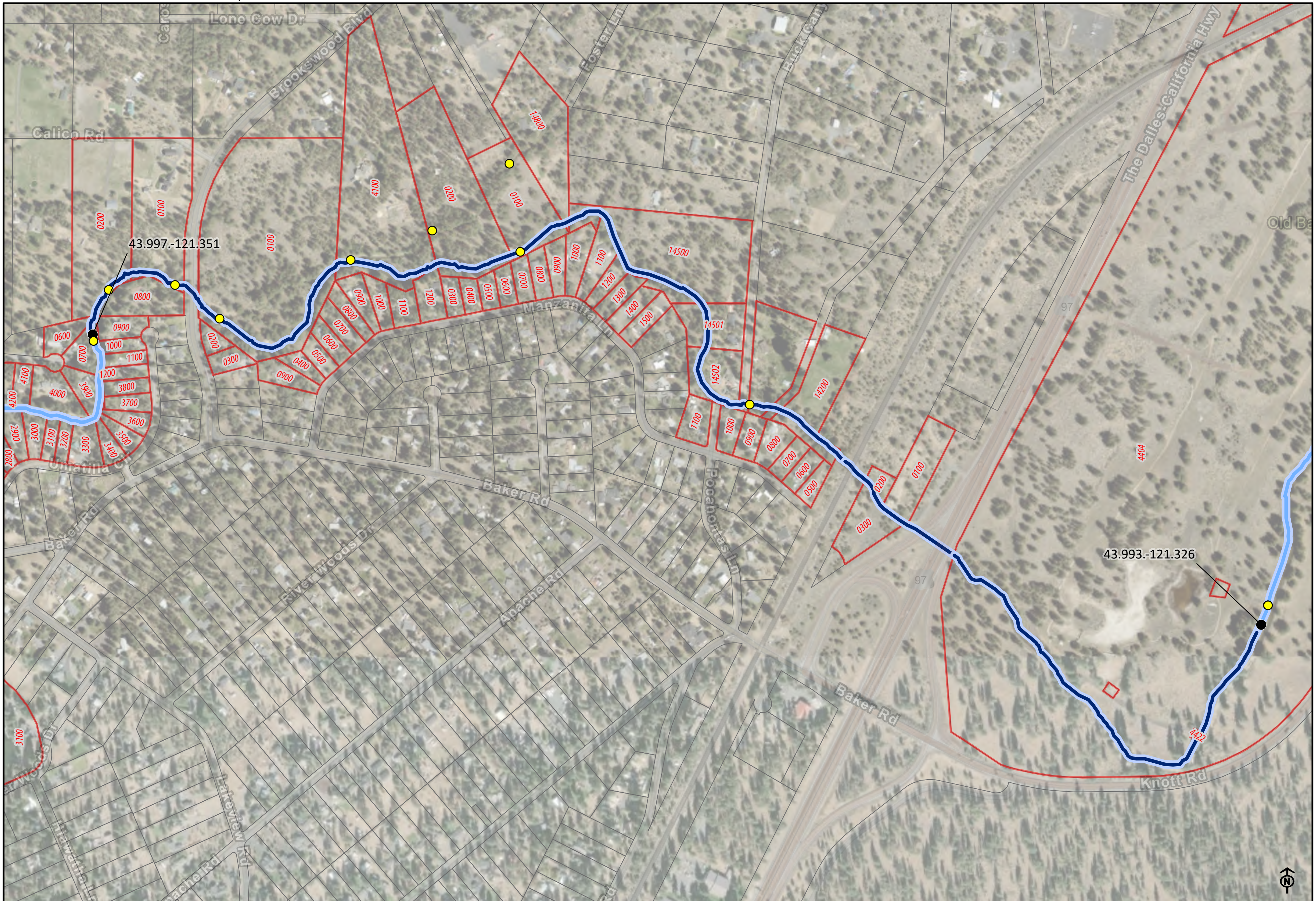
☒ Plans, designs, and/or engineering specifications: Attachment # 6

☒ Secured permits and regulatory approvals needed to implement the project (Question 19): Attachment # 7

☒ Other: Project Feasibility and Planning Information Attachment # 4
Attachment #8 Sample MOU with North Unit Irrigation District

Attachment #9 Active and Anticipated Conservation and Restoration Projects

Attachment 1 - Site Map



Main Canal Piping
Phase 3

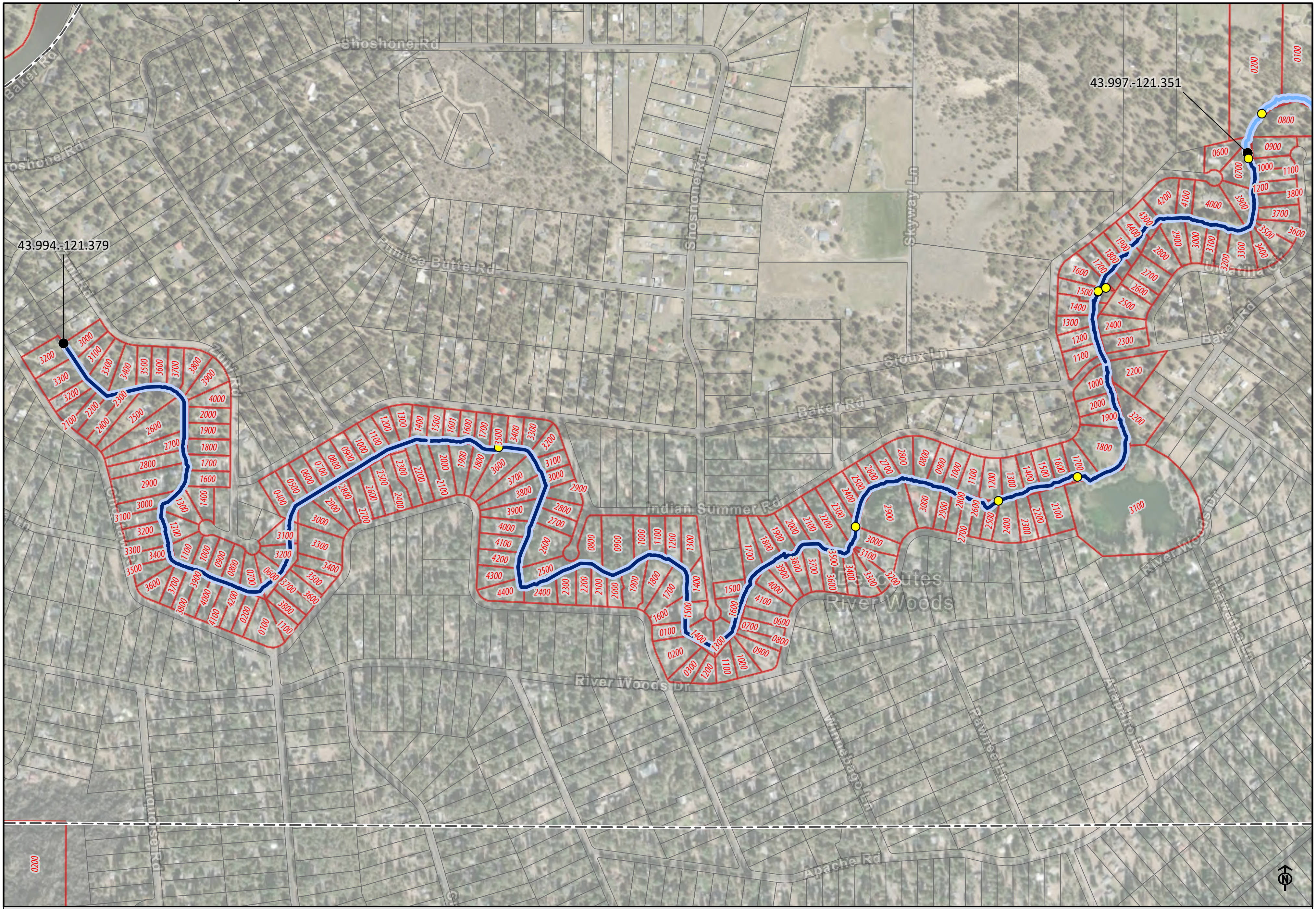
Phase 3 Piping Segement
Other Phases
Phase 3 Project Limits
Head Gate
Phase 3 Canal Taxlots
Taxlots

ARNOLD IRRIGATION DISTRICT

Source: County of Crook, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri Community Maps Contributors, Oregon State Parks, State of

0 500 1,000 2,000 Feet

Attachment 1 - Site Map



Main Canal Piping Phase 4

Phase 4 Piping Segement

Other Phases

Phase 4 Project Limits

Head Gate

Phase 4 Canal Taxlots

Taxlots

ARNOLD IRRIGATION DISTRICT

Source: County of Crook, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri Community Maps Contributors, Oregon State Parks, State of

0 500 1,000 2,000 Feet

USDA

United States Department of Agriculture

December 6, 2022

SUBJECT: PDM – Public Law 83-566, the Watershed Protection and Flood Prevention Act of 1954, as amended— Watershed & Flood Prevention Operations Program (WFPO), Authorization of Final Watershed Plan – Environmental Assessment (Plan-EA) for the Arnold Irrigation District Infrastructure Modernization Project in Deschutes County, Oregon

TO: Ron Alvarado
State Conservationist
Portland, OR

File Code: 390-1

This memorandum authorizes Federal assistance for the installation of works of improvement, under the Authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law P.L. 83-566) for the Arnold Irrigation District Infrastructure Modernization Project in Deschutes County, Oregon. Assistance should be in accordance with the terms, conditions, and stipulations included in the Final Watershed Plan - Environmental Assessment (Plan-EA) for the Arnold Irrigation District Infrastructure Modernization Project, as funds appropriated for this purpose are made available.

Copies of letters to your congressional delegation informing them of this authorization are enclosed. Please contact each member of your congressional delegation within 30 days with details on this project and the funding status of the works of improvement. We also suggest that you provide the local sponsors with the appropriate information regarding project status and projected annual funding needs.

Sincerely,

Terry J. Cosby
Chief

Enclosures
cc: (w/o enclosures)
Astor Boozer, Regional Conservationist, West, USDA-NRCS, Washington, D.C.
Louis Aspey, Associate Chief, USDA-NRCS, Washington, D.C.
Karen Woodrich, Acting Deputy Chief for Programs, USDA-NRCS, Washington, D.C .

Natural Resources Conservation Service
P.O. Box 2890
Washington, D.C. 20013

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

Astrid Martinez, Director, Conservation Planning & Technical Assistance Division, NRCS, Washington, D.C.
Steven Reinsch, Acting Director, Conservation Engineering Division, USDA-NRCS, Washington, D.C.
Tim Wilson, Acting Director, National Water Management Center, CPTAD, USDA-NRCS, Little Rock, Arkansas
Kevin Farmer, Branch Chief Watershed Programs, CPTAD, USDA-NRCS, Washington, D.C.
Ralph Smith, Watershed Operations Program Manager, CPTAD, USDA-NRCS, Washington, D.C.

Office of Management and Budget Fact Sheet

Summary Watershed Plan-Environmental Assessment Document For Arnold Irrigation District Infrastructure Modernization Project Upper Deschutes Basin Subwatersheds: Lava Island Falls-Deschutes River, Overturf Butte-Deschutes River, Deschutes Junction, and Odin Falls-Deschutes River Deschutes County, Oregon Oregon 2nd Congressional District	
Authorization	PL 83-566 Stat. 666 as amended (16 U.S.C. Section 1001 et. Seq.) 1954
Lead Sponsor	Deschutes Basin Board of Control and Arnold Irrigation District (co-sponsor)
Proposed Action	The Arnold Irrigation District (AID or the District) Infrastructure Modernization Project is an agricultural water conveyance efficiency project. The proposed action would pipe 13.2 miles of Arnold Irrigation District's Main Canal owned and operated by the District. Implementation of the proposed action would meet PL 83-566 Authorized Project Purpose (v), Agricultural Water Management, through irrigation water conservation and more reliable agricultural water supply. Federal assistance through PL 83-566 would support the District in addressing the following watershed problems and resource concerns: water loss in District infrastructure; water delivery and operations inefficiencies; instream flow for fish and aquatic species; and risks to public safety from open irrigation canals. Implementation of the proposed action would address the sponsor's objectives and goals to reduce seepage loss and provide better-managed water diversions for farm use; support agricultural land use; improve streamflow for fish, aquatic, and riparian habitat; and increase public safety.
Purpose and Need	The purpose of this project is to improve water conservation in District-owned infrastructure, improve water supply management and delivery reliability to District patrons, and improve public safety on up to 13.2 miles of the District-owned Main Canal. Federal assistance is needed to support the District in addressing water loss in District infrastructure, District water delivery and operation inefficiencies, diminished instream flows that limit fish and aquatic habitat, and public safety risk caused by open canals.
Description of the Preferred Alternative	Under the Preferred Alternative, AID would pipe 13.2 miles of the Main Canal.
Project Measures	Under the Preferred Alternative, project sponsors would install 13.2 miles of pipe ranging in size from 48 to 63 inches in diameter. Additionally, 88 turnouts would be upgraded to pressurized delivery systems. Below the District's diversion, an elevated pipe would replace the first 450 feet of the existing, elevated flume. The pipe would be buried along the rest of the flume and Main Canal. Construction of the Preferred Alternative would occur over 7 years.

<table>
<tr><th colspan="4">Resource Information</th></tr>
<tr><th>Subwatersheds</th><th>12-digit Hydrologic Unit Code</th><th>Latitude and Longitude</th><th>Subwatershed Size</th></tr>
<tr><td>Lava Island Falls-Deschutes River</td><td>170703010405</td><td>43.99453392, -121.4567205</td><td>12,518 acres</td></tr>
<tr><td>Overturf Butte – Deschutes River</td><td>170703010406</td><td>43.98818452, -121.359427</td><td>31,374 acres</td></tr>
<tr><td>Deschutes Junction</td><td>170703010801</td><td>44.07052471, -121.268003</td><td>47,339 acres</td></tr>
<tr><td>Odin Fall - Deschutes</td><td>170703010805</td><td>44.1377907, -121.2207872</td><td>66,358 acres</td></tr>
<tr><td>Subwatershed Total Size</td><td colspan="3">157,582 acres</td></tr>
<tr><td>Arnold Irrigation District Size</td><td colspan="3">20,799 acres</td></tr>
<tr><td>Climate and Topography</td><td colspan="3">The project is located in the rain shadow of the Cascade Mountain range. AID's annual average precipitation is 12 to 15 inches. The average high temperature for July is 85 degrees Fahrenheit, and average low temperature for December is 26 degrees Fahrenheit. The land within AID is slightly undulating. The Arnold Canal Diversion is at 3,925 feet above sea level. There is approximately 60 feet of elevation loss between the diversion and the end of the Main Canal.</td></tr>
<tr><td rowspan="3">Land Use (Planning Area)</td><td colspan="2">Use</td><td>Acres</td></tr>
<tr><td colspan="2">Irrigated Land</td><td>1,475</td></tr>
<tr><td colspan="2">Non-irrigated Land</td><td>300</td></tr>
<tr><td rowspan="4">Land Ownership (Planning Area)</td><td colspan="2">Owner</td><td>Percentage</td></tr>
<tr><td colspan="2">Private</td><td>99.2%</td></tr>
<tr><td colspan="2">State-Local</td><td>0.2%</td></tr>
<tr><td colspan="2">Federal</td><td>0.6%</td></tr>
<tr><td>Population and Demographics</td><td colspan="3">The project would be constructed in Deschutes County, Oregon. In 2015, the population of Deschutes County was 166,622. The population growth rate between 2000 and 2015 was 14 percent. The population of the State of Oregon grew by 8 percent in the same period.</td></tr>
<tr><td rowspan="4">Population and Demographics</td><td></td><td>Deschutes County</td><td>Oregon</td></tr>
<tr><td>Population 2015</td><td>166,622</td><td>3,939,233</td></tr>
<tr><td>Unemployment Rate</td><td>4.1%</td><td>4.1%</td></tr>
<tr><td>Median Household Income</td><td>$51,223</td><td>$51,243</td></tr>
<tr><td>Relevant Resource Concerns</td><td colspan="3">Resource concerns identified through scoping were water conservation and quality, groundwater, aquatic and fish resources, soils, land use, visual resources, cultural resources, socioeconomics, wetlands, terrestrial wildlife, public safety, and vegetation resources.</td></tr>
</table>

Alternatives	
Alternatives Considered	Eight alternatives were initially considered; six were eliminated from full analysis because they did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or because they became unreasonable due to cost, logistics, existing technology, social, or environmental reasons. The No Action Alternative and Piping Alternative were analyzed in full.
No Action Alternative (Future without Federal Investment)	Under the No Action Alternative, construction activities associated with the project would not occur and AID would continue to operate and maintain its existing system in its current condition. The need for the project would still exist; however, the District would only modernize its infrastructure on a project-by-project basis as funding became available. This funding is not reasonably certain to be available under a project-by-project approach at the large scale necessary to modernize the District's infrastructure.
Proposed Action (Future with Federal Investment)	Under the Piping Alternative, AID would pipe 13.2 miles of the Main Canal. The Piping Alternative has been identified as the National Economic Efficiency (NEE) plan and is the Preferred Alternative.
Mitigation, Minimization, and Avoidance Measures	Consultation between the District, NRCS as the lead federal agency, Tribal Historic Preservation Office (THPO), Oregon State Historic Preservation Office (SHPO), and consulting parties including affiliated tribes for compliance with Section 106 of the National Historic Preservation Act (NHPA) would occur prior to project implementation. Ground disturbances would be limited to only those areas necessary to minimize effects on soil, vegetation, and land use. Where possible, construction activities would avoid or minimize effects on agricultural lands by staying within the existing right-of-way and easements. Stormwater best management practices (BMPs) would be employed during and after construction, and construction schedules would minimize disturbance to wildlife and the public. After construction, disturbed areas would be graded and replanted with a mix of native grasses and forbs to reduce the risk of erosion and spread of noxious weeds. Following project implementation, the District's conveyance system would be more efficient and by enacting similar practices to that of the District's current and historic use of water, AID would divert only the volume of water needed by patrons. Therefore, AID would decrease their diversion rate accordingly, leaving any water that the District does not divert in the Deschutes River available for use by junior water right holders. Additionally, to reduce effects on junior water right holders, AID would voluntarily reduce their maximum diversion rate and identify 120 cubic feet per second (cfs) as the District's pre-project maximum diversion rate for the purposes of any water right administrative processes.

Project costs	**PL 83-566 funds**		**Other funds**		**Total**	
Construction	$24,900,000	65%	$13,451,000	35%	$38,351,000	100%
Engineering	$430,000	75%	$143,000	25%	$573,000	100%
SUBTOTAL COSTS	$25,330,000	65%	$13,594,000	35%	$38,924,000	100%
Technical Assistance	$2,025,000	100%	$0	0%	$2,025,000	100%
Relocation	Not Applicable					

Real Property Rights	Not Applicable					
Permitting	$0	0%	$1,168,000	100%	$1,168,000	100%
Project Administration	$507,000	79%	$135,000	21%	$642,000	100%
Annual O&M	Not Applicable					
TOTAL COSTS	**$27,862,000**	**65%**	**$14,897,000**	**35%**	**$42,759,000**	**100%**

Project Benefits	
Project Benefits	Implementation of the Preferred Alternative would improve water delivery reliability for AID's patrons; save an estimated 32.5 cfs of water (10,526 acre-feet) from seepage loss during the irrigation season; provide up to 10,123 acre-feet of water to North Unit Irrigation District (NUID); release and protect an estimated 10,123 acre-feet for instream uses below Wickiup Reservoir during the non-irrigation season; reduce AID's operation and maintenance (O&M) costs; and improve public safety.
Number of Direct Beneficiaries	In total, 149 patrons would directly benefit from the project.
Other Beneficial Effects-Physical Terms	The Preferred Alternative would have beneficial effects on agricultural water availability, water quality, and fish and wildlife habitat.

Damage Reduction Benefits	**Proposed Project**
Reduced North Unit Irrigation District Agricultural Damage	$1,489,000
Other- Reduced Operation and Maintenance	$210,000
Other-Avoided Damage from Infrastructure Failure	$17,000
Other- Pumping Cost Savings	$4,000
Other- Instream Value	$42,000
Other- Oregon Spotted Frog Support	$39,000
Total Quantified Benefits	$1,801,000
Benefit to Cost Ratio	1.82

Period of Analysis			
Installation Period (years)	7		
Project Life	100 years		
Funding Schedule			
Year	**PL 83-566**	**Other Funds**	**Total**
2022-2029	$27,862,000	$14,897,000	$42,759,000
Environmental Effects			
The Preferred Alternative would be planned, designed, and installed to have long-term net-beneficial effects on water quantity, water quality, Endangered Species Act (ESA)-listed species and their habitats, and other aquatic species that have similar environmental requirements. Other long-term net-beneficial effects would include improving ecosystem services and public safety. Implementation of the Preferred Alternative to improve water conservation, water delivery reliability, and public safety may result in minor, unavoidable, short-term adverse effects such as impacts to soils and vegetation along the Main Canal. Most short-term adverse effects would result from construction activities in the project area. There would be long-term minor adverse effects on artificial wetland habitat within the project area. Opportunistic hydrophytic vegetation growing along 12.2 miles[1] of canal would be permanently removed. However, following construction, BMPs for ecological restoration would be followed and there would be an increase in native, upland vegetation in the project area, returning the project area to a more natural state. Loss of existing artificial wetland and riparian habitat would be offset by enhancement of naturally functioning wetland and riparian habitat in the Deschutes River. Other long-term minor effects include potential changes in wildlife distribution patterns and alterations to the visual landscape following elimination of 13.2 miles of the open Main Canal and flume. Construction would occur outside the primary nesting period for migratory birds of concern. Should an active nest be found, construction would be paused and consultation with a local U.S. Fish and Wildlife Service (USFWS) biologist would occur. After construction, disturbed areas above buried pipelines would be revegetated and recontoured to blend in with the existing landscape. For the flume, the new elevated pipe would have a similar design and contrast to the landscape as the existing flume.			
Major Conclusions	Implementation of the Preferred Alternative would improve water delivery reliability for AID's patrons, save an estimated 10,526 acre-feet of water from seepage loss, provide up to 10,123 acre-feet to NUID, release and protect up to 10,123 acre-feet below Wickiup Reservoir for instream uses during the non-irrigation season, reduce AID's O&M costs, and improve public safety.		
Areas of Controversy	There have been no areas of controversy identified.		
Issues to be Resolved	None		

[1] The project length is 13.2 miles and includes an existing 1-mile long flume. Therefore, opportunistic hydrophytic vegetation would be permanently removed along 12.2 miles.

Evidence of Unusual Congressional or Local Interest	Comments during the scoping period were received from the USFWS and local non-governmental organizations and individuals.
Compliance	Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes _X_ No____

Arnold Irrigation District

Infrastructure Modernization Project

Final Watershed Plan-Environmental Assessment

Deschutes County, Oregon

December 6, 2022

United States Department of Agriculture, Natural Resources Conservation Service – Lead Federal Agency in cooperation with the Deschutes Basin Board of Control and Arnold Irrigation District
Prepared by Farmers Conservation Alliance

Project costs	PL 83-566 funds		Other Funds		Total	
Construction	$23,088,000	75%	$7,695,000	25%	$30,783,000	100%
Engineering	$222,000	75%	$74,000	25%	$296,000	100%
Subtotal Costs	$23,310,000	75%	$7,769,000	25%	$31,079,000	100%
Technical Assistance	$2,412,000	100%	$0	0%	$2,412,000	100%
Relocation	Not applicable					
Real Property Rights	Not applicable					
Permitting	$0	0%	$932,000	100%	$932,000	100%
Project Administration	$476,000	100%	$0	0%	$476,000	100%
Annual O&M	Not applicable					
TOTAL COSTS	**$26,198,000**	**75%**	**$8,701,000**	**25%**	**$34,899,000**	**100%**

Funding Schedule			
Year	**PL 83-566**	**Other Funds**	**Total**
2022—2028	$26,198,000	$8,701,000	$34,899,000

Table D22. Preferred Alternative Costs.

Feature	Diameter (inches)	Quantity	Units	Unit Cost	Subtotal [1]
Pipe	48	18,624	foot	$152	$6,687,100
Pipe	54	29,994	foot	$124 to $185 [2]	$9,322,500
Pipe	60	14,252	foot	$137	$4,479,900
Turnout	N/A	88	each	$10,000	$880,000
Energy Dissipator	48	1	each	$75,000	$75,000
Energy Dissipator	16	1	each	$15,000	$15,000
Energy Dissipator	10	2	each	$10,000	$20,000
Energy Dissipator	8	1	each	$5,000	$5,000
				Subtotal	**$21,484,500**
				Engineering/Survey (3%)	$644,800
				Construction Management/General Contractor (10%)	$2,148,500
				Contingency (30% for pipe and 10% for energy dissipators and turnouts) [3]	$7,058,700
				Pipe Inlet Structure	$75,600
				Two SCADA systems	$133,600
				Total	**$31,545,700**

[1] Subtotals are rounded to nearest $100 and include a variable construction cost multiplier for installation based on the pipe size. Multipliers range from 1 to 2.35 and are from installation costs of other piping projects in the Deschutes Basin.
[2] The unit cost is a range because it includes pipe with different pressure ratings (10 to 30 pounds per square inch).
[3] Since the Preferred Alternatives costs were estimated using a 10 percent design, the following have not been evaluated or may need further evaluation as the full design is developed: detailed design elements; geotechnical evaluations (if necessary. For this reason, including a cost contingency is imperative in estimating costs.

Works of Improvement Phases	Installation Cost - PL 83-566					
	Construction	Engineering (FA)	Project Administration	Technical Assistance	Project Admin Total	Total Public Law 566
1	$7,068,000	$69,000	$146,000	$736,000	$882,000	$8,019,000
2	$8,432,000	$80,000	$174,000	$869,000	$1,043,000	$9,555,000
3	$2,920,000	$28,000	$60,000	$314,000	$374,000	$3,322,000
4	$4,668,000	$45,000	$96,000	$493,000	$589,000	$5,302,000
TOTAL COSTS	$23,088,000	$222,000	$476,000	$2,412,000	$2,888,000	$26,198,000

Installation Cost - Other Funds							Total
Construction	Engineering (FA)	Project Administration	Technical Assistance	Permitting	Project Admin Total	Total Other	
$2,356,000	$23,000	$0	$0	$285,000	$285,000	$2,664,000	$10,683,000
$2,810,000	$93,667*	$0	$0	$340,000	$340,000	$3,243,667*	$12,798,667*
$973,000	$9,000	$0	$0	$118,000	$118,000	$1,100,000	$4,422,000
$1,556,000	$15,000	$0	$0	$189,000	$189,000	$1,760,000	$7,062,000
$7,695,000	$74,000	$0	$0	$932,000	$932,000	$8,701,000	$34,899,000

- $66,667 match for Engineering TA

Estimated Installation Cost, Water Resource Project Measures

Phase	Unit	Number	PL 83-566	Other Funds	Total
1	Feet	17,022	$8,019,000	$2,664,000	$10,683,000
2	Feet	23,175	$9,555,000	$3,243,667	$12,798,667
3	Feet	9,492	$3,322,000	$1,100,000	$4,422,000
4	Feet	13,276	$5,302,000	$1,760,000	$7,062,000
TOTAL PROJECT	Feet	62,966	$26,198,000	$8,701,000	$34,899,000

Conserved Water at Full Season

Phase	Unit	Total	Unit	Total
1	CFS	11.2	AF	3,819
2	CFS	12.5	AF	4,286
3	CFS	3.5	AF	1,149
4	CFS	5.3	AF	1,829
TOTAL PROJECT	CFS	32.5	AF	11,083

BRYANT
LOVLIEN
& JARVIS
EST. 1915
ATTORNEYS AT LAW

ATTORNEYS

John D. Sorlie
Mark G. Reinecke
Melissa P. Lande
Paul J. Taylor
Jeremy M. Green
Heather J. Hansen
Garrett Chrostek
Lindsay E. Gardner
Katherine L. Rowe
Makenzie A. Christy
Dustin D. Hawkins
Courtney E. Osborn

April 22, 2022

Becky Williams
Oregon Water Resources Department
725 Summer Street, NE, Suite A
Salem, OR 97301

RE: Grant Application for Arnold Irrigation District (Main Canal Piping Project: Phases 1-4)
Areas Affected by Piping Project / Legal Authority for Activities in those Areas

Dear Becky:

Pursuant to your request, the purpose of this letter is to provide OWRD (the "Department") with information about the area affected by Arnold Irrigation District's ("Arnold") Main Canal piping project grant application and the sources of Arnold's legal authority for operations, maintenance, and improvement of its canals and laterals in the affected area.

Arnold is an Oregon irrigation district organized and existing under Oregon Revised Statutes, Chapter 545. For nearly 120 years, Arnold has been a steward of critical water resources in Central Oregon. It holds certificated water rights-including rights to live flow and storage water-in a trust relationship with its patrons and delivers water proportionately to patrons who hold water rights within Arnold's boundaries.

Arnold's easement rights with respect to its Main Canal (the affected area) originate from the Carey Act (Law of August 18, 1894, Ch. 301, § 4, 28 Stat. 422 (1894), 43 USCA § 641) which encouraged settlement of the western United States by allowing private companies to erect irrigation systems.

The related federal Right of Way Act of 1891 states:

> "The right of way through the public lands and reservations of the United States is granted to any canal ditch company, irrigation or drainage district formed for the purpose of irrigation or drainage, and duly organized under the laws of any State or Territory, . . . to the extent of the ground occupied by the water of any reservoir and of any canals and laterals and fifty feet on each side of the marginal limits thereof , and, upon presentation of satisfactory showing by the applicant, such additional rights of way as the Secretary of the Interior may deem necessary for the proper operation and maintenance of said reservoirs, canals, and laterals; also the right to take from the public lands adjacent to the line of the canal or ditch, material, earth, and stone necessary for the construction of such canal or ditch. . .".

43 U.S. Code Section 946.

{00037345-01466042;2}

The existence and scope of Carey Act irrigation canal rights of way (easements) were confirmed in Federal Court when Judge Ann Aiken ruled that the irrigation district in that case possessed irrigation rights of way pursuant to the Carey Act and related federal and state statutes and "conversion of [an] irrigation canal to a pipeline is encompassed within the scope of [the] easement." S*walley Irrigation District v. Gary Clement Alvis, et al,* U.S. Dist. Ct. for Oregon, Civ. No. 04-1721-AA (2008).

In a currently pending case, Judge Michael McShane ruled similarly denying property owners request for a preliminary injunction finding that "[B]ecause the Irrigation District's granted easement [Carey Act] is to provide water to irrigate farms and ranches, then the project is reasonably necessary to accomplish this goal." *Smith, et al v. Tumalo Irrigation District, et al*, U.S Dist. Ct. for Oregon, Civ. No. 6:20-cv-00345-MK, Opinion & Order dated November 13, 2020.

Oregon law provides additional support for Arnold's right to pipe its canals. The Carey Act contract between the State of Oregon and the Contractor often anticipated that the Contractor (subsequently the Irrigation District) would promulgate rules and regulations to manage the system. ORS 545.221(c) authorizes districts to "[E]stablish equitable bylaws, rules and regulations for the administration of the district and for the distribution and use of water among the landowners." Arnold maintains such written rules and regulations.

Also, pursuant to ORS 545-221(1)(d), Oregon irrigation districts including Arnold are authorized "to perform all acts necessary to fully carry out the purposes of the Irrigation District Law." Arnold enacts policies to maintain and improve its delivery system to ensure its ability to provide water for its patrons while achieving compliance with state and federal laws. Finally, pursuant to ORS 545.287, irrigation districts in Oregon are authorized to construct, repair and maintain irrigation system improvements.

The enclosed Carey Act map for Arnold Irrigation District reflects that the entire Main Canal (the affected area) is within the Carey Act boundaries. The Main Canal piping project, which includes Phases 1, 2, 3, and 4, is entirely within the Carey Act boundaries.

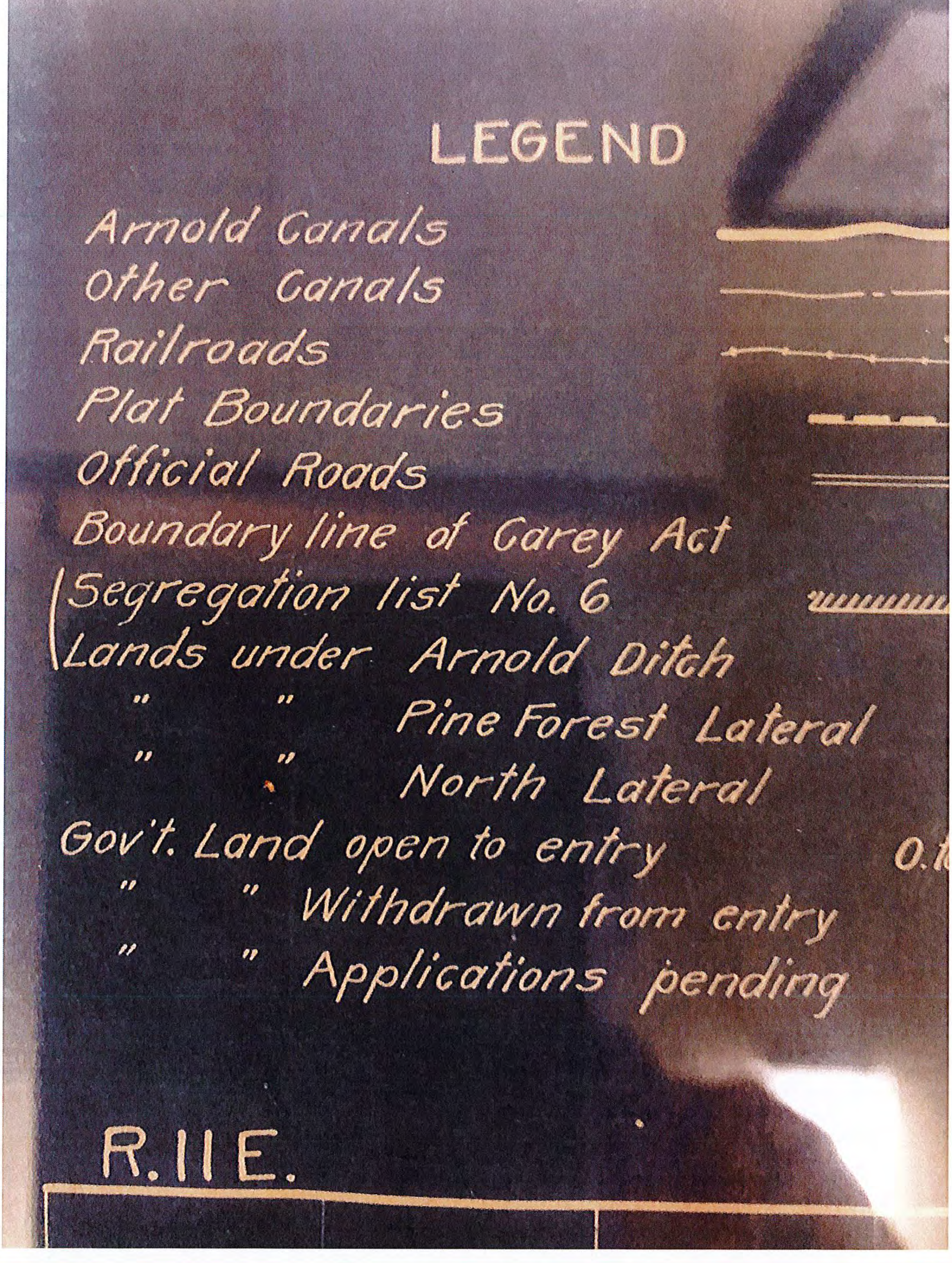
To summarize, Arnold Irrigation District seeks to pipe its Main Canal with grant funds provided by the State of Oregon and others and the Main Canal is located within a right of way (easement) granted to Arnold through federal and state legislation and related contracts. The *Swalley* and *Tumalo* federal court case confirmed that such canals can be piped even if the owner of the dominant estate objects.

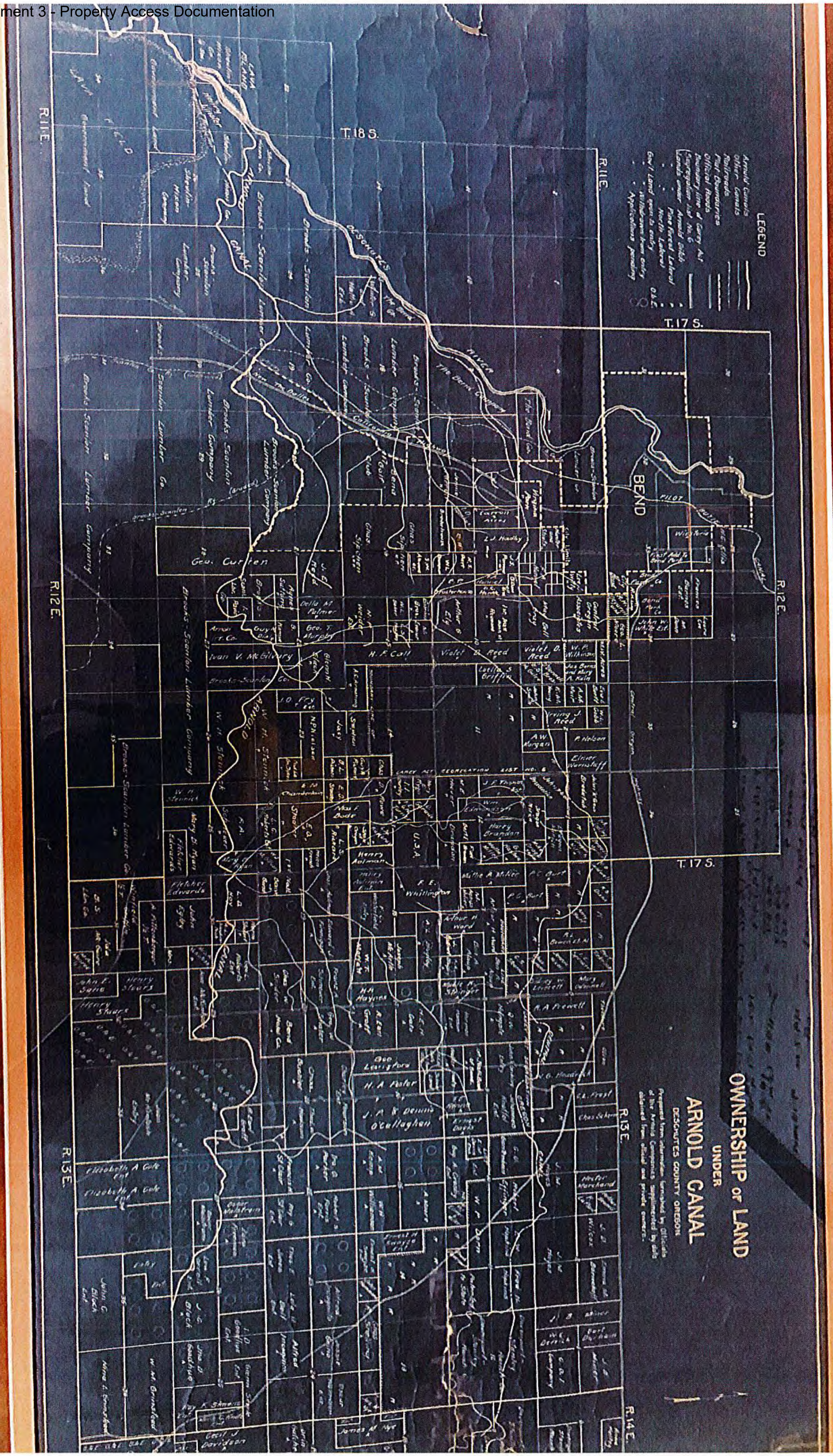
If you need any additional information, please let me know.

Sincerely,

MARK G. REINECKE
Attorney for Arnold Irrigation District

Enclosure (Arnold Irrigation District "Carey Act" Map)
cc: Arnold Irrigation District


LEGEND
Arnold Canals
Other Canals
Railroads
Plat Boundaries
Official Roads
Boundary line of Carey Act
Segregation list No. 6
Lands under Arnold Ditch
" " Pine Forest Lateral
" " North Lateral
Gov't. Land open to entry
" " Withdrawn from entry
" " Applications pending
R. 11 E.


OWNERSHIP OF LAND
UNDER
ARNOLD CANAL
DESCHUTES COUNTY OREGON
LEGEND
BEND
DESCHUTES
T.18 S.
T.17 S.
R.11 E.
R.12 E.
R.13 E.
R.14 E.
Geo. Curtten
Ivan V. McGilvery
H. F. Call
Violet D. Reed
Brooks-Scanlon Lumber Company
H. A. Foster
Elizabeth A. Cole
Henry Shears

Rights of way to ditch companies.

SEC. 18. That the right of way through the public lands and reservations of the United States is hereby granted to any canal or ditch company formed for the purpose of irrigation and duly organized under the laws of any State or Territory, which shall have filed, or may hereafter file, with the Secretary of the Interior a copy of its articles of incorporation, and due proofs of its organization under the same, to the extent of the ground occupied by the water of the reservoir and of the canal and its laterals, and fifty feet on each side of the marginal limits thereof; also the right to take, from the public lands adjacent to the line of the canal or ditch, material, earth, and stone necessary for the construction of such canal or ditch: *Provided*. That no such right of way shall be so located as to interfere with the proper occupation by the Government of any such reservation, and all maps of location shall be subject to the approval of the Department of the Government having jurisdiction of such reservation, and the privilege herein granted shall not be construed to interfere with the control of water for irrigation and other purposes under authority of the respective States or Territories.

Proviso.

Not to interfere with Government occupation.

Approval

Arnold Irrigation District

Infrastructure Modernization Project

Final Watershed Plan-Environmental Assessment

Deschutes County, Oregon

August 4, 2022

United States Department of Agriculture, Natural Resources Conservation Service – Lead Federal Agency in cooperation with the Deschutes Basin Board of Control and Arnold Irrigation District

Prepared by Farmers Conservation Alliance

Watershed Plan-Environmental Assessment for the Arnold Irrigation District - Infrastructure Modernization Project

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

Sponsoring Local Organization: Deschutes Basin Board of Control (lead sponsor) and Arnold Irrigation District (AID) (co-sponsor).

Authority: This Watershed Plan-Environmental Assessment (Plan-EA) has been prepared under the Authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law [PL] 83-566). The Plan-EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, PL 91-190, as amended (42 United States Code [U.S.C.] 43221 et seq.).

Abstract: This document is intended to fulfill requirements of NEPA and to be considered for authorization of PL 83-566 funding of the Arnold Irrigation District Infrastructure Modernization Project (project). The project seeks to improve water conservation, water delivery reliability, and public safety for irrigation infrastructure in Oregon's Deschutes Basin. The project would include piping approximately 11.9 miles of AID's Main Canal. Total estimated project costs are $34,899,000 of which $8,701,000 would be paid by the sponsors and other non-federal funding sources. The estimated amount to be paid through NRCS PL 83-566 funds is $26,198,000, which includes $23,310,000 for construction costs, $2,412,000 for technical assistance, and $476,000 for project administration.

Comments: NRCS completed this Final Plan-EA in accordance with NEPA and NRCS guidelines and standards. Comments submitted in response to this Notice of Availability must be received within 30 days of the date of publication. Submit comments and inquiries to: Ron Alvarado, State Conservationist, USDA/NRCS, 1201 NE Lloyd Blvd, Suite 900, Portland, OR 97232, (503) 414-3200, or ron.alvarado@usda.gov.

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Office of Management and Budget Fact Sheet

Summary Watershed Plan-Environmental Assessment Document For Arnold Irrigation District Infrastructure Modernization Project Upper Deschutes Basin Subwatersheds: Lava Island Falls-Deschutes River, Overturf Butte-Deschutes River, Deschutes Junction, and Odin Falls-Deschutes River Deschutes County, Oregon Oregon 2nd Congressional District	
Authorization	PL 83-566 Stat. 666 as amended (16 U.S.C. 1001 et seq.) 1954
Lead Sponsor	Deschutes Basin Board of Control and Arnold Irrigation District (co-sponsor)
Proposed Action	The Arnold Irrigation District (AID or the District) Infrastructure Modernization Project is an agricultural water conveyance efficiency project. The proposed action would pipe 11.9 miles of AID's Main Canal, upgrade 88 turnouts, and install Supervisory Control and Data Acquisition (SCADA) in two locations.
Purpose and Need	The purpose of this project is to improve water conservation in District-owned infrastructure, improve water supply management and delivery reliability to District patrons, and improve public safety on up to 11.9 miles of the District-owned Main Canal. Federal assistance is needed to support the District in addressing water loss in District infrastructure, District water delivery and operation inefficiencies, diminished instream flows that limit fish and aquatic habitat, and public safety risk caused by open canals.
Description of the Preferred Alternative	Under the Preferred Alternative, AID would pipe 11.9 miles of the Main Canal, upgrade 88 turnouts, and install SCADA in two locations.
Project Measures	Under the Preferred Alternative, project sponsors would install 11.9 miles of pipe ranging in size from 48 to 60 inches in diameter and install two SCADA locations to improve operational efficiency. Additionally, 88 turnouts would be upgraded to pressurized delivery systems. Construction of the Preferred Alternative would occur over 6 years.

Resource Information

Subwatersheds	12-digit Hydrologic Unit Code	Latitude and Longitude	Subwatershed Size (acres)	Planning Area Within Subwatershed (acres)
Lava Island Falls-Deschutes River	170703010405	43.99453392, -121.456721	12,518 acres	114
Overturf Butte-Deschutes River	170703010406	43.98818452, -121.359427	31,374 acres	172
Deschutes Junction	170703010801	44.07052471, -121.268003	47,339 acres	857
Odin Fall-Deschutes	170703010805	44.1377907, -121.2207872	66,358 acres	613

<table>
<tr><td>Subwatershed Total Size</td><td colspan="3">157,582 acres</td></tr>
<tr><td>Arnold Irrigation District Size</td><td colspan="3">4,384 acres</td></tr>
<tr><td>Climate and Topography</td><td colspan="3">The proposed project is located in the rain shadow of the Cascade Mountain range. AID’s annual average precipitation is 12 to 15 inches. The average high temperature for July is 85 degrees Fahrenheit, and average low temperature for December is 26 degrees Fahrenheit. The land within AID is slightly undulating with variation in slope. The District’s Main Canal diversion is at 3,925 feet above sea level. There is approximately 60 feet of elevation loss between the diversion and the end of the Main Canal.</td></tr>
<tr><td rowspan="3">Land Use (Planning Area)</td><td colspan="2">Use</td><td>Acres</td></tr>
<tr><td colspan="2">Irrigated Land</td><td>1,475</td></tr>
<tr><td colspan="2">Non-irrigated Land</td><td>281</td></tr>
<tr><td rowspan="4">Land Ownership (Planning Area)</td><td colspan="2">Owner</td><td>Percentage</td></tr>
<tr><td colspan="2">Private</td><td>99.2%</td></tr>
<tr><td colspan="2">State-Local</td><td>0.2%</td></tr>
<tr><td colspan="2">Federal</td><td>0.6%</td></tr>
<tr><td>Population and Demographics</td><td colspan="3">The proposed project would be constructed in Deschutes County, Oregon. In 2020, the population of Deschutes County was 198,253. Between 2000 and 2020 the County’s population grew by 25.7 percent. The population of the State of Oregon grew by 10.6 percent in the same time period.</td></tr>
<tr><td rowspan="4">Population and Demographics</td><td></td><td>Deschutes County</td><td>Oregon</td></tr>
<tr><td>Population 2020</td><td>198,253</td><td>4,237,256</td></tr>
<tr><td>December 2020 Unemployment Rate (U.S. Bureau of Labor Statistics, 2022)</td><td>6.9%</td><td>6.3%</td></tr>
<tr><td>Median Household Income 2019</td><td>$67,043</td><td>$62,818</td></tr>
<tr><td>Relevant Resource Concerns</td><td colspan="3">Resource concerns identified through scoping included water conservation and quality, groundwater, aquatic and fish resources, soils, land use, visual resources, cultural resources, socioeconomics, wetlands, terrestrial wildlife, public safety, and vegetation resources.</td></tr>
<tr><td colspan="4">Alternatives</td></tr>
<tr><td>Alternatives Considered</td><td colspan="3">Nine alternatives were initially considered; seven were eliminated from full analysis because they did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or because they became unreasonable due to cost, logistics, existing technology, or social or environmental reasons. The No Action Alternative and Piping Alternative were analyzed in full.</td></tr>
</table>

No Action Alternative (Future without Federal Investment)	Under the No Action Alternative, construction activities associated with the proposed project would not occur and AID would continue to operate and maintain its existing system in its current condition. The need for the project would still exist; however, the District would only modernize its infrastructure on a project-by-project basis as funding became available. This funding is not reasonably certain to be available under a project-by-project approach at the large scale necessary to modernize the District's infrastructure.
Preferred Alternative	Under the Piping Alternative, AID would pipe up to 11.9 miles of the Main Canal. To improve water delivery reliability for patrons, AID would also install two SCADA locations. The Piping Alternative has been identified as the National Economic Efficiency (NEE) Alternative and is also the Preferred Alternative.
Mitigation, Minimization, and Avoidance Measures	Consultation between the District, Natural Resources Conservation Service (NRCS) as the lead federal agency, Tribal Historic Preservation Office (THPO), Oregon State Historic Preservation Office (SHPO), and consulting parties including affiliated tribes for compliance with Section 106 of the National Historic Preservation Act (NHPA) has occurred. Ground disturbances would be limited to only those areas necessary to minimize effects on soil, vegetation, and land use. Where possible, construction activities would avoid or minimize effects on agricultural lands by staying within the existing right-of-way (ROW) and easements. Trees within the AID ROW and easements greater than 2 feet in diameter would be avoided during construction and retained to the extent possible. Trees would be removed only if they prevented construction activities from occurring, if they posed a safety threat to construction crews, or if their roots could interfere with the pipe. The width of the construction area would be clearly flagged along both sides of the canal prior to beginning construction to ensure that construction would stay within these boundaries. Stormwater best management practices (BMPs) would be employed during and after construction, and construction schedules would minimize disturbance to wildlife and the public. After construction, disturbed areas would be recontoured and replanted with a mix of native grasses and forbs to reduce the risk of erosion and spread of noxious weeds. Following project implementation, the District's conveyance system would be more efficient, and by enacting similar practices to that of the District's current and historical use of water, AID would divert only the volume of water needed by patrons. Therefore, AID would decrease its diversion rate accordingly and leave any water that the District does not divert in the Deschutes River available for use by junior water right holders. Additionally, to reduce effects on junior water right holders, AID would voluntarily reduce its maximum diversion rate and identify 118 cubic feet per second (cfs) as the District's season 3 pre-project maximum diversion rate and 106 cfs as the District's season 2 pre-project maximum diversion rate for the purposes of any water right administrative processes.

Project costs	**PL 83-566 funds**		**Other Funds**		**Total**	
Construction	$23,088,000	75%	$7,695,000	25%	$30,783,000	100%
Engineering	$222,000	75%	$74,000	25%	$296,000	100%
Subtotal Construction Costs	$23,310,000	75%	$7,769,000	25%	$31,079,000	100%
Technical Assistance	$2,412,000	100%	$0	0%	$2,412,000	100%

Relocation	Not applicable					
Real Property Rights	Not applicable					
Permitting	$0	0%	$932,000	100%	$932,000	100%
Project Administration	$476,000	100%	$0	0%	$476,000	100%
Annual O&M	Not applicable					
TOTAL COSTS	**$26,198,000**	**75%**	**$8,701,000**	**25%**	**$34,899,000**	**100%**

Project Benefits	
Project Benefits	Implementation of the Preferred Alternative would improve water delivery reliability for AID patrons; save an estimated 32.5 cfs of water (11,083 acre-feet) from seepage loss during the irrigation season; pass up to 10,862 acre-feet of water to North Unit Irrigation District (NUID); release and protect up to 10,446 acre-feet for instream uses below Wickiup Reservoir during the non-irrigation season; reduce AID operation and maintenance (O&M) costs; and improve public safety.
Number of Direct Beneficiaries	All 646 patrons within AID would benefit from the proposed project.
Other Beneficial Effects-Physical Terms	The Preferred Alternative would have beneficial effects on agricultural water availability, water quality, and fish and wildlife habitat.

Damage Reduction Benefits	**Proposed Project Annualized Benefits**
Reduced North Unit Irrigation District Agricultural Damage	$1,407,000
Other- Reduced Operation and Maintenance	$211,000
Other-Avoided Damage from Infrastructure Failure	$3,000
Other- Instream Value	$41,000
Other- Oregon Spotted Frog Support	$37,000
Total Quantified Annualized Benefits	$1,699,000
Benefit to Cost Ratio	2.0

Period of Analysis	
Installation Period (years)	6
Project Life	100 years

Funding Schedule			
Year	**PL 83-566**	**Other Funds**	**Total**
2022–-2028	$26,198,000	$8,701,000	$34,899,000

Environmental Effects	
The Preferred Alternative would be planned, designed, and installed to have long-term net-beneficial effects on agricultural production, ecosystem services, and public safety. Implementation of the Preferred Alternative to improve water conservation, water delivery reliability, and public safety may result in minor, unavoidable short-term effects such as impacts to soils and noxious weeds along the Main Canal. Most short-term adverse effects would result from construction activities in the project area. There would be long-term minor effects on wetland habitat within the project area. Opportunistic hydrophytic vegetation growing along 11.9 miles of canal would be permanently removed as a result of the construction activities. However, following construction, BMPs would be followed and disturbed areas would be recontoured and seeded with native vegetation, which would result in an increase in native upland vegetation in the project area. Other long-term minor effects include potential changes in wildlife distribution patterns, reduction in groundwater recharge, and disturbance to vegetation. Construction would occur outside the primary nesting period for migratory birds of concern. Should an active nest be found, construction would be paused and consultation with a local U.S. Fish and Wildlife Service (USFWS) biologist would occur. After construction, disturbed areas above buried pipelines would be revegetated and recontoured to blend in with the existing landscape. BMPs would be implemented to minimize effects on trees. A moderate long-term effect would occur to visual resources. The visual change would be localized to properties adjacent to the project area. Following construction and revegetation, the revegetated corridor would blend in with the natural landscape	
Major Conclusions	Implementation of the Preferred Alternative would improve water delivery reliability for AID patrons, save an estimated 11,083 acre-feet of water from seepage loss, pass up to 10,862 acre-feet to NUID, release and protect up to 10,446 acre-feet below Wickiup Reservoir for instream uses during the non-irrigation season, reduce AID's O&M costs, and improve public safety.
Areas of Controversy	Property value, canal lining, groundwater, and loss of trees.
Issues to be Resolved	None.
Evidence of Unusual Congressional or Local Interest	Comments during the scoping and public comment period were received from USFWS, U.S. Army Corps of Engineers, Oregon Water Resources Department, local non-governmental organizations, and individuals.
Compliance	Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes__X__ No____

1 Introduction

Aging infrastructure, growing population, shifting rural economies, and changing climate conditions have increased pressure on water resources across the western United States. Within the Deschutes Basin, irrigated agriculture is the main out-of-stream water use and relies on primarily 100-year-old infrastructure to divert, store, and deliver water to farms and ranches. In recent years, the improvement of water resources has been a coordinated focus among the eight irrigation districts within the Deschutes Basin, with the goal of addressing environmental needs for instream flows while still delivering enough water to district patrons (Figure 1-1).

Arnold Irrigation District (herein referred to as AID or the District) operates 39 miles of canals and laterals in the Deschutes Basin. Most of this infrastructure consists of open, earthen canals. AID's Main Canal loses up to an estimated 32.5 cubic feet per second (cfs) of water during the irrigation season (11,083 acre-feet annually) due to seepage into the porous volcanic geology and evaporation. This water never reaches District patrons and farms.

Over the years, AID has pursued infrastructure upgrades to provide a permanent solution to system-wide water losses. Although some improvements have been made, aging and outdated infrastructure continues to contribute to water delivery insecurity for out-of-stream users and limits streamflow due to the need to divert more water than is delivered; this affects water quality and aquatic habitat along the Deschutes River. The Main Canal has become a public safety risk to more people as the surrounding areas have urbanized. Aging infrastructure also affects the financial stability of AID and its patrons as AID must find new approaches to fund growing maintenance needs.

Improving irrigation infrastructure offers an opportunity to conserve water, increase the reliability of water delivery to patrons, enhance streamflow and habitat conditions for fish and aquatic species in the Deschutes Basin, reduce risks to public safety from open irrigation canals, and reduce operation and maintenance (O&M) costs for the District.

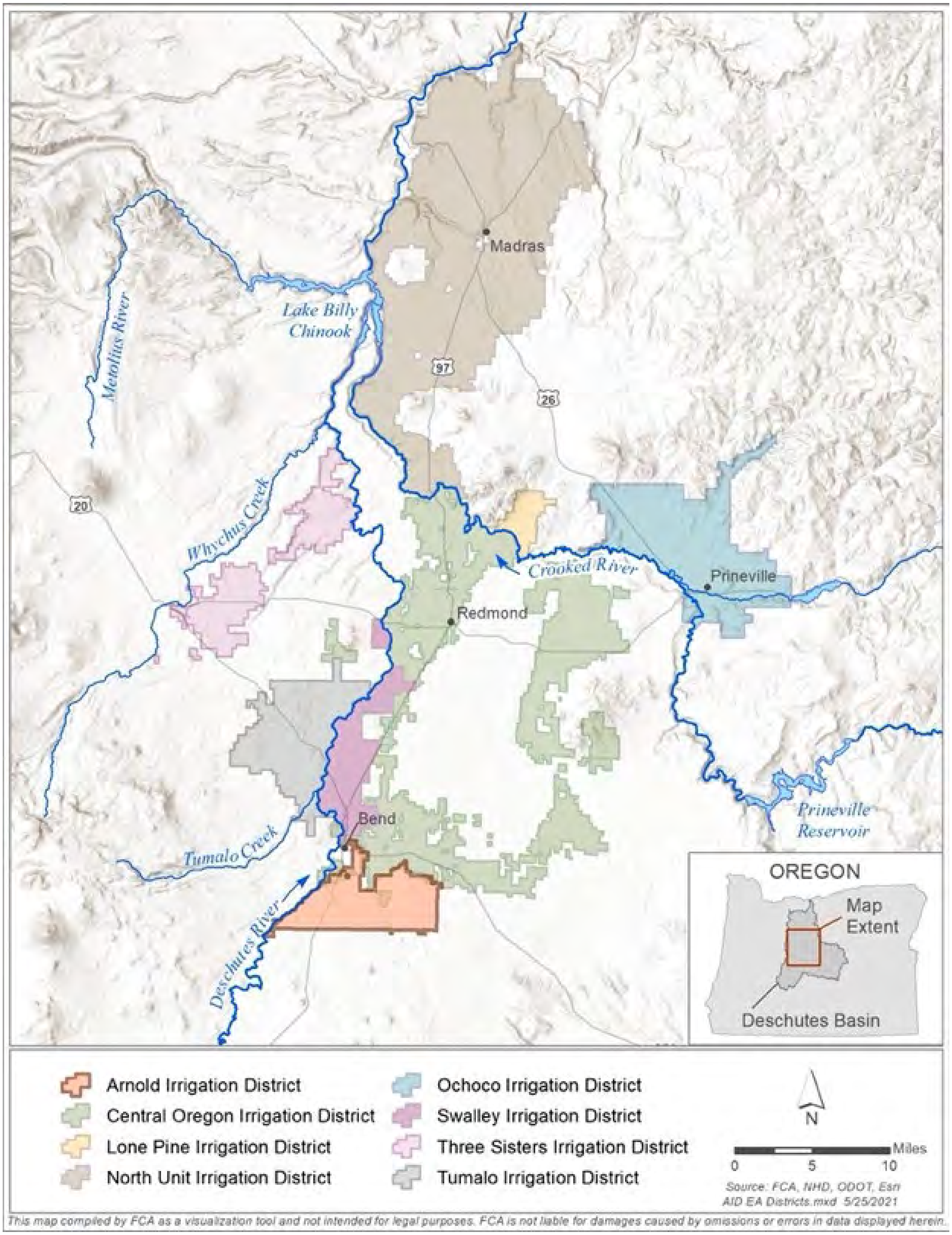


Figure 1-1. Irrigation districts within the Deschutes Basin.

1.1 Planning Area

The District is located south of Bend in Deschutes County, Oregon. The District contains 4,384 irrigated acres used by 646 patrons. The main point of diversion is on the Deschutes River (River Mile [RM] 174.5). The planning area is based on the irrigation problem area[1] and is identified as the tax lots traversed by the proposed project (Table 1-1, Figure 1-2). See Appendix E.14 for a map of tax lots included in the planning area.

Table 1-1. Arnold Irrigation District Planning Area.

Subwatershed Name	12-Digit Hydrologic Unit Code	Subwatershed Size (acres)	Planning Area Falling within the Subwatersheds (acres)
Lava Island Falls-Deschutes River	170703010405	12,518	114
Overturf Butte-Deschutes River	170703010406	31,374	172
Deschutes Junction	170703010801	47,339	857
Odin Falls-Deschutes River	170703010805	66,358	613
Total		**157,589**	**1,756**

[1] The "planning area" referred to in this Plan-EA is equivalent to the term "watershed area" as defined by the National Watershed Program Manual (NWPM) 506.60.TTT (NRCS 2015a). The term "planning area" is used in this Plan-EA in an effort to reduce confusion between the NWPM 506.60.TTT watershed area definition and watershed areas as defined by hydrologic unit codes.

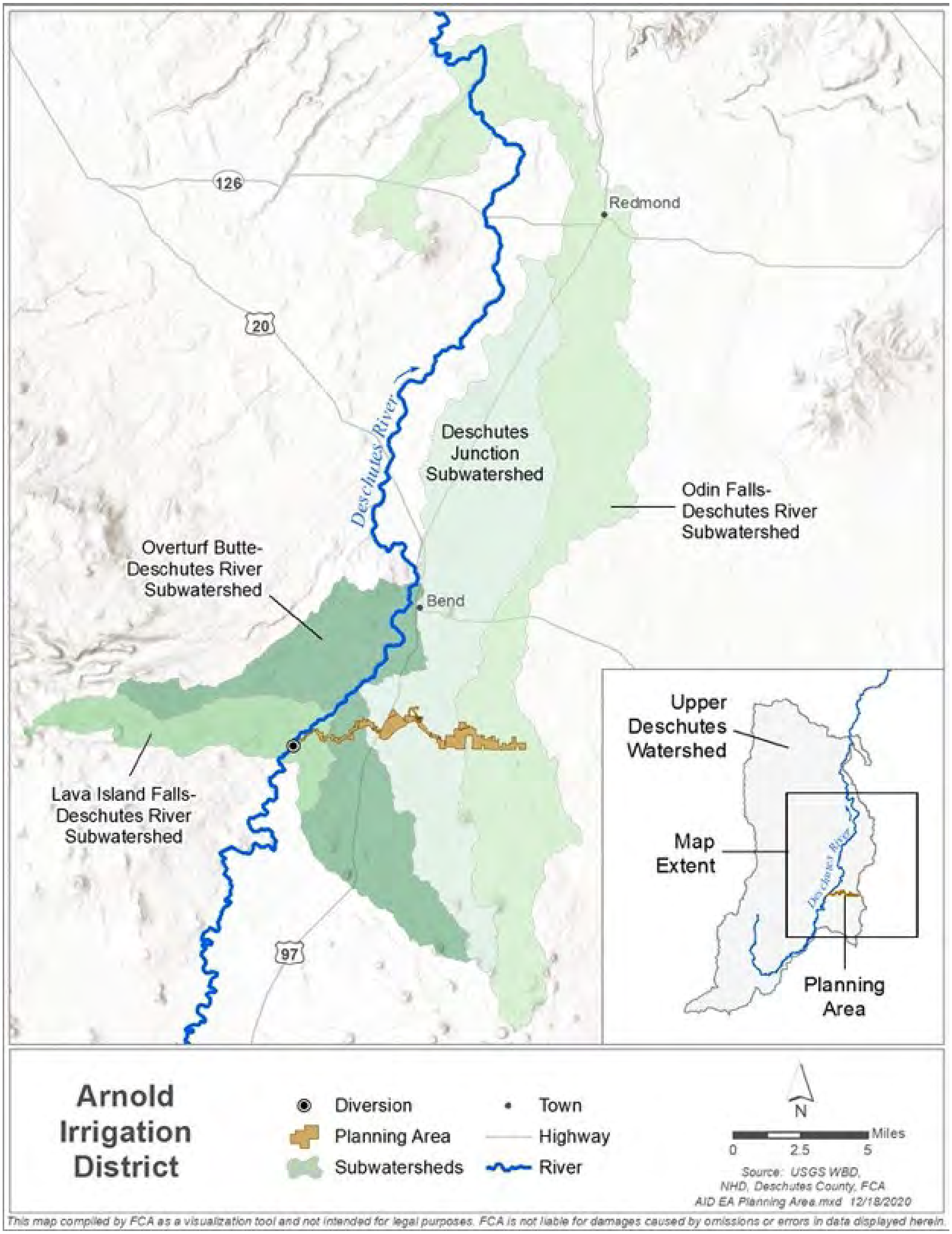


Figure 1-2. The Arnold Irrigation District planning area.

1.2 Project Area

The project area is located in a portion of the planning area. The project area describes the area where the AID Infrastructure Modernization Project would occur (Figure 1-3). The proposed project includes 11.9 miles of the Main Canal, which is only a portion of the District's total conveyance system. The project area consists of the District right-of-way (ROW) and easements that contain these 11.9 miles of the Main Canal. The existing water conveyance infrastructure in the project area consists of earthen dug canal and two siphons.

1.3 Current Infrastructure

The District diverts water from the Deschutes River at the Arnold Main Canal Diversion (herein referred to as the Main Canal) on the Deschutes River (RM 174.5). The diversion has a radial gate that regulates the intake flow rate and a vertical flat-plate fish screen that keeps fish and debris out of the District's conveyance system. The Oregon Water Resources Department (OWRD) gauge number 14065500 measures inflows into the conveyance system; AID is in the process of adding remote measurement and control systems just below its fish screen. The Main Canal conveys water generally northeast, starting with an approximately 1-mile-long flume and trestle system and then transitioning to a typical earthen and rock substrate open canal. After the flume, the Main Canal runs approximately 12.2 miles from west to east. Along the way, it delivers water directly to patrons and to multiple laterals.

AID has already piped approximately 22 percent of its system—primarily laterals that are not part of the project area. Patron turnouts from the Main Canal are gate-regulated and weir-measured by AID field staff. An additional six private direct withdrawals from the Deschutes River irrigate 30 acres of the District.

The Main Canal loses up to an estimated 32.5 cfs of water during the irrigation season (11,083 acre-feet annually) due to a combination of seepage related to the condition of the distribution system, the porous nature of the underlying geology, and evaporation.[2] Water loss associated with specific sections of the Main Canal is detailed in the District's System Improvement Plan (Crew, 2017; also see Appendix E.4).

[2] Evaporation generally contributes to water losses from canals in the Deschutes Basin with evaporation rates varying throughout the basin (USGS 2001). However, the two site-specific water loss studies completed for AID calculated losses in the Main Canal from both seepage and evaporation but do not differentiate between what loss is a result of evaporation versus seepage.

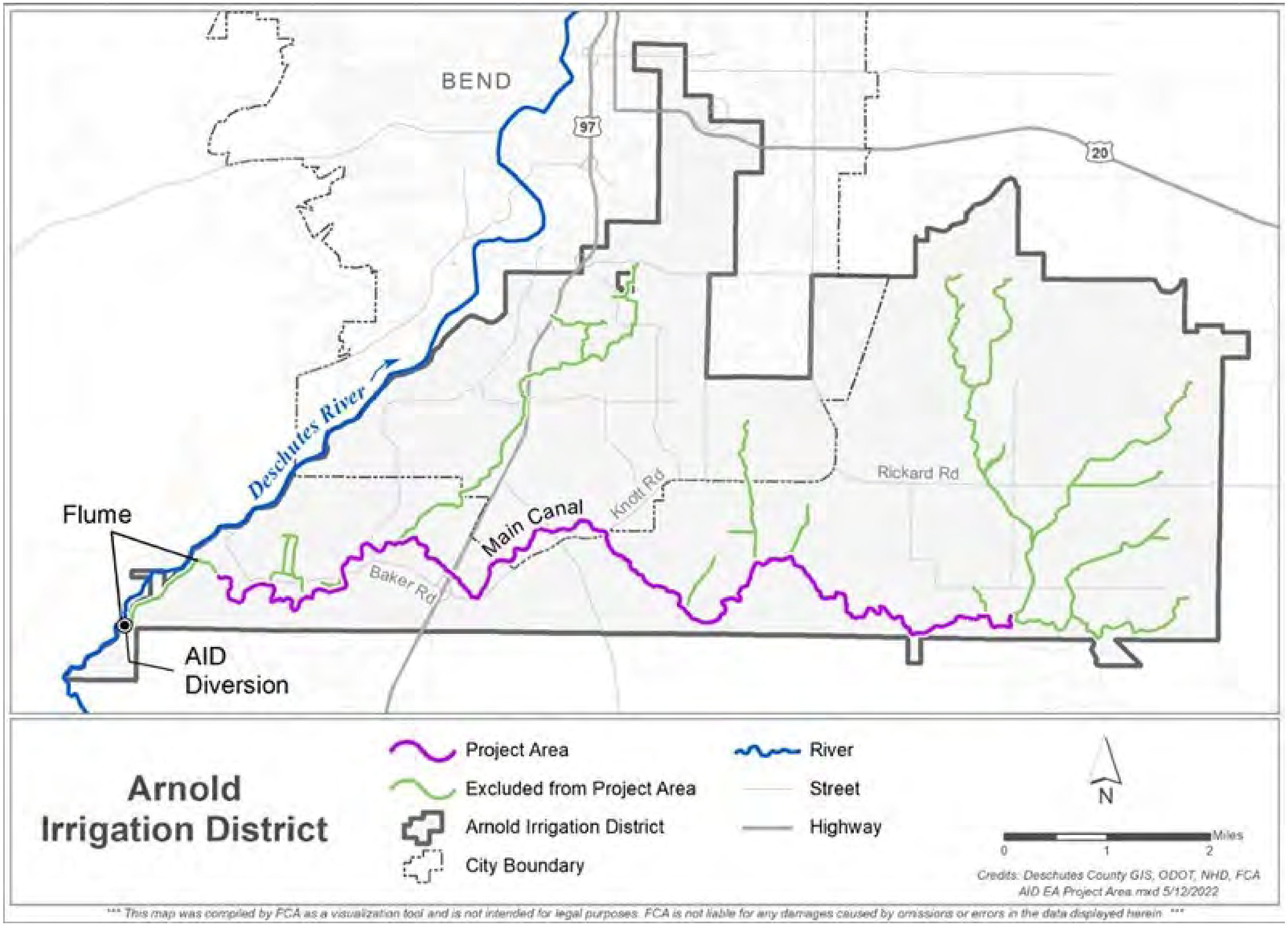


Figure 1-3. Arnold Irrigation District Infrastructure Modernization Project area.

1.4 Decision Framework

This Final Watershed Plan-Environmental Assessment (Plan-EA) has been prepared to assess and disclose the potential effects of the proposed action. This Plan-EA is required to request federal funding through the Watershed Protection and Flood Prevention Program, Public Law (PL) 83-566, which was authorized by Congress in 1954 (herein referred to as PL 83-566).

The Natural Resources Conservation Service (NRCS) is the lead federal agency for this Plan-EA and is responsible for the review and issuance of a decision in accordance with the National Environmental Policy Act (NEPA). NEPA requires that projects using federal funds be evaluated for effects on the quality of the human environment and natural environment (individually or cumulatively). When a proposed project is not likely to result in significant impacts, but the activity has not been categorically excluded from NEPA, an agency can prepare an Environmental Assessment. If it is determined that the project would result in significant effects on the human or natural environment, an environmental impact statement must be prepared (Whether to prepare an environmental impact statement, 2021; Environmental assessment, 2010; When to prepare an environmental assessment (EA), 2008).

NRCS has determined the need for a Plan-EA to analyze the effects of the proposed action under PL 83-566 watershed authority and determine if the project, as proposed, significantly affects the quality of the human and natural environment. The proposed action would be completed over the course of 6 years in four different phases. This document presents an analysis in sufficient detail to allow implementation of the proposed action within the designated project area.

If a Finding of No Significant Impact is issued and the Plan-EA authorized, prior to the implementation of each project phase, an onsite Environmental Evaluation review would occur using the form NRCS-CPA-52, Environmental Evaluation Worksheet. The Environmental Evaluation process would determine if that particular project phase meets applicable project specifications and whether the site-specific environmental effects for that phase are consistent with those as described and developed in this Plan-EA. This process provides information for the Responsible Federal Official to determine if the proposed action has been adequately analyzed and if the conditions and environmental effects described in the Plan-EA are still valid. This Plan-EA would be supplemented if it is determined through the onsite Environmental Evaluation that additional analysis is needed.

Additionally, the continued feasibility of a project is monitored and documented in the project files every 5 years in accordance with NEPA requirements in the Title 190, General Manual, Part 410. Factors to be considered in determining the continued feasibility are economic, environmental, and social defensibility and the sponsoring local organization commitment to continue the project. Modifications to this Plan-EA and project are prepared as necessary.

This Plan-EA has been prepared in accordance with the 1978 Council on Environmental Quality regulations for implementing NEPA (CEQ Regulations for Implementing the Procedural Provisions of NEPA, 2005), U.S. Department of Agriculture (USDA) NEPA regulations (When to prepare an environmental assessment (EA), 2021), NRCS Title 190 General Manual Part 410, and the NRCS National Environmental Compliance Handbook Title 190 Part 610.

This Plan-EA has been prepared in accordance with the guidelines in the 2015 NRCS National Watershed Program Manual (NWPM; USDA-NRCS, 2015a) and the 2014 NRCS National Watershed Program Handbook (USDA-NRCS, 2014). It has also been prepared in accordance with the Principles and Requirements issued in March 2013 along with Interagency Guidelines and Agency Specific Procedures established in DM 9500-013. These documents comprise the Principles, Requirements, and Guidelines (PR&G; USDA-NRCS 2017a). The PR&G revise and replace the 1983 Principles and Guidelines. The PR&G constitute the comprehensive policy and guidance for federal investments in water resources. Some considerations and analyses in this Plan-EA are strictly NRCS program requirements; they are not required by NEPA. These differences are identified throughout this Plan-EA.

2 Purpose and Need for Action

The purpose of the proposed project is to improve water conservation in District-owned infrastructure, improve water supply management and delivery reliability to District patrons, and improve public safety on up to 11.9 miles of the District-owned Main Canal.

Federal assistance is needed to support AID in addressing water loss in District infrastructure, water delivery and operation inefficiencies, diminished instream flows that limit fish and aquatic habitat, and public safety risks caused by open canals. These topics are discussed in Section 2.1.

In addition to meeting the above purpose and need, to meet NRCS requirements for a federal investment in a water resources project, the proposed project must meet the Federal Objective set forth in the Water Resources Development Act of 2007, promote the Federal Objective and Guiding Principles (as identified in the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments [PR&G; USDA-NRCS 2017a]), and be an authorized project purpose under Sections 3 and 4 of PL 83-566. See Appendix E.8 for more information on the Guiding Principles.

Per the Federal Objective, water resource investments—including the proposed action—put forth in this Plan-EA should "reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems" (USDA-NRCS, 2013). Additionally, the project should seek to achieve the following Guiding Principles as identified by the federal government: Healthy and Resilient Ecosystems, Sustainable Economic Development, Floodplains, Public Safety, Environmental Justice, and Watershed Approach (USDA-NRCS, 2017a). See Appendix E.8 for more information on the Guiding Principles.

The proposed project would be eligible for funding under the PL 83-566 requirement "Authorized Project Purpose (v), Agricultural Water Management"[3] due to the proposed project's focus on irrigation water conservation and more reliable agricultural water supply delivery.

2.1 Watershed Problems and Resource Concerns

2.1.1 Water Loss in District Conveyance Systems

Currently, during the irrigation season, the District's Main Canal loses up to approximately 32.5 cfs of water (11,083 acre-feet annually) to seepage through the porous underlying geology and evaporation. This water never reaches farms. Details on water losses and demands can be found in Appendix E.4 of this Plan-EA and the District's System Improvement Plan (Crew, 2017).

[3] A description of Authorized Purposes can be found in 390-NWPM, Part 500, Subpart A, Section 500.3B (NRCS 2015a).

2.1.2 Water Delivery and Operations Inefficiencies

Over the years, AID has developed rigorous measurement and management methods that have greatly increased efficiency; however, high seepage loss rates make it challenging to deliver the patrons' desired delivery rate throughout the irrigation season and cause delivery shortages during the peak season (May 15 through September 14).

The District's earthen Main Canal experiences failure from sinkholes, tree roots, and burrowing animals. To repair the canal, AID must stop the delivery of irrigation water—often at times for multiple days. Additionally, in the current open canal system, all patrons are required to request changes to water deliveries 24 to 36 hours in advance. Changes to water deliveries in this manner are inefficient and unresponsive to immediate need and may affect deliveries to other patrons.

Operating and maintaining the Main Canal also requires staff to clean the canal, adjust flows to patrons, clean debris from trash racks, and repair sinkholes. Overall, the Main Canal does not transport and deliver water as precisely, accurately, or efficiently as a modernized system would.

2.1.3 Instream Flow for Fish and Aquatic Habitat

Compared with the natural hydrologic regime, the Deschutes River and its tributaries experience extreme seasonal streamflow variability due to the storage and diversion of water for agricultural use. Resource agencies have identified streamflow as a primary concern in the Deschutes River (Upper Deschutes Watershed Council [UDWC], 2014). Reservoir operations lead to low winter streamflow and high summer streamflow in the Deschutes River upstream from the District's diversion. The combined diversions of the eights major irrigation districts and the cities that divert water in or near Bend lead to low spring, summer, and fall streamflow in the Deschutes River downstream of the District's diversion.

The Deschutes River and its tributaries support a variety of sensitive species; three are currently listed as threatened under the Endangered Species Act (ESA; see Section 4.9.2). Past and ongoing efforts support these species and their habitats;[4] however, lawful irrigation-related activities continue to limit streamflow and negatively affect fish and aquatic habitat.

Current irrigation activities have the potential to result in incidental "take" [5] of ESA-listed species in the Deschutes River and its tributaries. The eight irrigation districts of the Deschutes Basin and the City of Prineville (the applicants) have together developed and submitted the *Deschutes Basin Habitat Conservation Plan* (HCP; AID et al., 2020) to the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS); the HCP includes irrigation activity conservation measures. The conservation measures set the streamflow rates in the Deschutes River and its tributaries that the applicants must meet to benefit ESA-listed species. USFWS provided a final permit decision on December 31, 2020, which adopts the HCP and enables the applicants to avoid the unauthorized take of ESA-listed species by issuing incidental take permits. As of May 2022,

[4] Past and ongoing efforts have included the 2016 Settlement Agreement, Upper Deschutes River Basin Study Work Group, Deschutes Basin Habitat Conservation Plan, and ongoing water conservation projects.

[5] ESA defines "take" to include actions such as the harassment, harm, pursuit, hunting, shooting, wounding, killing, trapping, capture, collection, or attempts to engage in any such conduct of ESA-listed species.

NMFS has yet to issue a final permit decision. To meet the requirements set forth in the HCP, the applicants must identify mechanisms that would enable them to keep water instream.

Additionally, the Deschutes River is listed as an impaired waterway under Section 303(d) of the Clean Water Act (CWA) because it does not meet one or more of the State of Oregon's water quality standards for salmon and trout, as well as other beneficial uses throughout the year (see Section 4.8).

2.1.4 Risks to Public Safety

The open Main Canal poses a risk to public safety. In addition to multiple instances of injury in the District, at least 10 deaths have occurred in other irrigation district canals near AID infrastructure (The Bulletin, 2014; KTVZ, 2014; Chu 2004; Cliff 2008; Flowers 2004; Golden, 2007; Minoura, 2007). The District's location in a partly urbanized area heightens the potential for an accident as the Main Canal passes through urban areas, rural residences, private lands, and irrigated fields.

During the summer, water depths in the Main Canal range between 2 to 6 feet with water moving through the canal at up to 3 feet per second. These conditions make it difficult for a healthy, strong adult to stand in or climb out of the canal without assistance. A child or non/weak-swimmer would have an even higher risk of drowning in a canal with these attributes. If a person or animal falls into a canal, they could have serious difficulty gaining hold on the banks to climb out due to the volume and speed of the moving water. Currently, barriers or fences are not present at the top bank of the canal. The failure of the earthen canal and risk of localized flooding is also a concern for AID. The District experiences sinkholes on a regular basis including a most recent one in May 2021.

From 2010 to 2020, Deschutes County was the fastest growing county in Oregon (Population Research Center, 2021). Public safety risks associated with the open canal will continue to grow as the county's population grows.

2.2 Watershed and Resource Opportunities

The following resource opportunities would be realized through the implementation of the proposed project.

- Improve streamflow, water quality, habitat, and habitat availability in the Deschutes River downstream from Wickiup Reservoir by protecting water saved instream during the non-irrigation season.
- Support and maintain existing agriculture through enhanced water supply reliability and improved water management.
- Minimize the potential for flooding, injury, and loss of life associated with the open District Main Canal.
- Reduce AID's O&M involved in delivering irrigation water to District patrons.

3 Scope of the Plan-EA

3.1 Agency, Tribal, and Public Outreach

Federal, state, local agencies and representatives, as well as non-governmental organizations, received an invitation to participate in scoping this Plan-EA. Advertisements announcing the scoping period and associated scoping meeting were placed in a local newspaper in addition to multiple online locations including the NRCS website, the AID website, and the Deschutes Basin Board of Control's website (see Section 7). Additionally, the District notified patrons and properties adjacent to the flume and Main Canal of the scoping meeting and invited comments on the scope of the Draft Plan-EA.

NRCS conducted tribal consultation with the Tribal Historic Preservation Office (THPO) in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments*, to maintain NRCS's government-to-government relationship between Native villages and tribes. NRCS sent a letter to the Confederated Tribes of Warm Springs (CTWS) on June 16, 2021 notifying them about the availability of the Draft Watershed Plan-EA and requesting input.

3.2 Scoping Meeting

A scoping meeting was held on April 17, 2019, at Elk Meadow Elementary School in Bend. Presenters at the meeting included Tom Makowski, NRCS; Shawn Gerdes, AID; Raija Bushnell, Farmers Conservation Alliance (FCA); and Margi Hoffmann, FCA. The presentations covered the financial assistance available through PL 83-566, the project purpose and need, the Plan-EA process, and ways in which the public could get involved. After the presentations, attendees asked questions and provided comments for the public record. One hundred and twenty people attended the meeting; this does not include staff from AID, NRCS, and FCA.

3.3 Scoping Comments

Scoping comments were accepted from April 3 to May 15, 2019. Comments were submitted at the public meeting on April 17, 2019, and by email, online comment, mail, and phone.

Table 3-1 presents comment topics received and where the comments are addressed in this Plan-EA.

Table 3-1. Public Scoping Comment Summary.

Comment Topic	Section Where Topic is Discussed
Request for information on land ownership and land use of the canal and if this will change after the project	Section 6.2
Importance of mitigation for removing the flume	Based on comments received during the public comment period and additional analyses performed during and following that period, AID and NRCS removed the flume from the proposed action and Preferred Alternative.
Request for numbers of public safety incidents	Section 4.3
Effect on vegetation and trees	Section 6.6.2
Concern for who would be responsible for maintaining trees and vegetation that die after piping	Section 6.6.2
Effect on aesthetics	Section 6.7.2
Concern for groundwater and aquifer recharge and water availability for private wells	Section 6.8.2.3
Concern for property values of the adjacent landowners	Appendix D.1 (NEE), Section 6.4.2
Amount of water conserved by project, mechanism by which water would be conserved, and how the conserved water would be distributed in the Deschutes River	Section 6.8.2
Request to permanently commit 100 percent of water conserved through the project instream	Section 6.8.2
Importance of instream flows for the health of the Deschutes River and the associated fish, aquatic species, and general wildlife	Sections 4.8 and 4.9
Concern that seepage loss numbers in the Preliminary Investigative Report are incorrect	Appendix E.4
Request for Section 12 consultation with U.S. Fish and Wildlife Service	Section 7
Effect on riparian habitat	Section 6.10.2

Comment Topic	Section Where Topic is Discussed
Effect on wildlife including mammals, insects, and birds	Section 6.11.2
Concern for building along a Wild and Scenic Waterway	Section 6.12.2
Importance of scenic value of open canal to residents	Section 4.7
Request for additional alternative analyses including canal lining, on-farm efficiency, piping private laterals, duty reductions, and water leasing programs	Section 5
Concern for how the project will be funded and if patrons' costs will increase after the project is implemented.	Section 8.7
Effect of construction on property owners	Section 6.7.2
Concern that trespassers will walk above pipe and access private property after the project is implemented	Section 5.3.2

3.4 Identification of Resource Concerns

Concerns about the following resources were identified through scoping comments: cultural, socioeconomic, soil, vegetation, visual, surface water, groundwater, aquatic, wetland, and terrestrial wildlife. Table 3-2 provides a summary of resource concerns and their relevance to the proposed action. Resource concerns determined not relevant were eliminated from detailed study; resource concerns determined relevant were carried forward for analysis.

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

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Air			
Air Quality		X	Oregon Department of Environmental Quality air quality data indicates that the entire project area is in attainment for all criteria pollutants. Emissions from equipment associated with construction activities would occur; however, such emissions are considered negligible when compared to background levels and the application of BMPs.
Soils			
Soils	X		Construction of the proposed project could affect soils.
Prime Farmlands	X		Prime farmlands occur in the project area and could be affected by the proposed project.
Geology		X	The are no active fault lines around the project area.
Human Environment			
Environmental Justice		X	The proposed action is not located near any racial, socioeconomic, or environmental justice groups, and therefore would comply with EO 12898.
Cultural and Historic Resources	X		Consultation with SHPO, THPO, and other consulting parties including affiliated tribes is required for compliance with Section 106 of NHPA.
Ecologically Critical Areas		X	The project area does not cross ecologically critical areas.
Land Use	X		Construction and operation of the proposed project could affect land use.
National Parks, Monuments, and Parklands		X	None occur in the project area or would be affected by the project.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Natural Areas		X	The project does not cross any Natural Area as defined and identified in Oregon's 2020 plan (OPRD, 2020).
Noise		X	No relevant impact to noise. With implementation of BMPs, noise impacts during construction would be negligible and temporary.
Public Safety	X		Drowning risk in the open canal could be beneficially affected.
Recreation		X	No trails or parks occur in the project area. Any changes in instream flows would not be large enough to affect the quality, access, or participation in river recreation.
Scenic Beauty and Visual Resources	X		Visual resources in the project area could be affected where the open canal would be altered.
Scientific Resources		X	Scientific resources would not be affected by the project.
Socioeconomics			
Local and Regional Economy	X		The proposed action involves an expenditure of public funds, which could affect the local and regional economy.
National Economic Efficiency (NEE)	X		A NEE Analysis has been completed as required by DM 9500-013, Guidance for Conducting Analyses Under the PR&G (USDA-NRCS, 2017a).
Vegetation			
Forest Resources		X	The project area does not cross any forest resources.
Invasive Species/Noxious Weeds	X		With implementation of BMPs, the spread of noxious weeds during construction would be avoided. Invasive aquatic vegetation that occurs within canals could be reduced in the project area.
Mature Trees	X		Direct and indirect effects on mature trees could occur.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Special Status/Threatened or Endangered Plant Species		X	None have been observed in the project area, and no designated critical habitat occurs in that area.
Water			
Coastal Zones		X	None present.
Groundwater Quantity, Aquifer Recharge	X		Construction and operation of the proposed project could affect aquifer recharge.
Regional Water Resources Plans		X	The proposed action does not consider altering the management of any regional water resources.
Sole Source Aquifers		X	The proposed action would have no effect on sole source aquifers.
Surface Water Quality	X		The proposed action could affect surface water quality by increasing flow in the Deschutes River.
Surface Water Quantity	X		The proposed action could affect surface water quantity by increasing flow in the Deschutes River.
Water Rights	X		The proposed action could affect District water rights.
Wild and Scenic Rivers	X		The proposed action would have no effect on the Wild and Scenic River or State Scenic Waterways designation or the free-flowing condition of the designated reaches downstream from Wickiup Dam (RM 226.8) to Lake Billy Chinook (RM 120.0).
Wetlands and Riparian Areas			
Wetlands and Riparian Areas	X		Wetlands and riparian areas could be affected by project construction activities or changes in water levels.
Floodplain Management		X	Construction and operation of the project would not occur in the 100-year floodplain.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Fish and Wildlife			
Coral Reefs		X	None present.
Endangered Species	X		Oregon spotted frog, bull trout, steelhead, or their habitats are known to occur in waterbodies (not including ditches/irrigation canals) that could be affected by the proposed project.
Essential Fish Habitat (EFH)		X	Since the proposed project would not adversely affect EFH, consultation under the Magnuson Stevens Act is not anticipated to be required.
Fish and Fish Habitat	X		The proposed action could affect fish habitat within waterbodies associated with District operations.
General Wildlife and Wildlife Habitat	X		Construction and operation of project components could affect wildlife near District operations.
Invasive Animal Species	X		Invasive bull frogs may occur within canal habitats.
Migratory Birds and Eagles	X		Migratory birds and eagles could occur within the project area.
Ecosystem Services			
Provisioning Services	X		Provisioning services supported by water quantity, quality, and availability could be impacted by the proposed action.
Regulating Services	X		Regulating services supported by water quantity, quality, and availability could be impacted by the proposed action.
Cultural Services	X		Cultural services supported by water quantity, quality, and availability could be impacted by the proposed action.

BMP = best management practice; EFH = Essential Fish Habitat; EO = Executive Order; NEE = National Economic Efficiency; NHPA = National Historic Preservation Act; PR&G = Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments; SHPO = State Historic Preservation Office; THPO = Tribal Historic Preservation Officer

4 Affected Environment

The following sections describe the existing ecological, physical, biological, economic, and social resources of the project area and areas that could be affected by the operation of the District system. The project area is defined in Section 1.2. Per requirements of the PR&Gs (USDA-NRCS, 2017a), where applicable, this Plan-EA describes the ecosystem services associated with each resource. Ecosystem services refer to the benefits that people and their communities derive from their natural environment in which they live. Availability of water for consumption, buffering against crop failure through pollination, and providing places in which people value living are all examples of benefits that flow from nature to people. Because these ecosystem services contribute to people's "health, wealth, and well-being" but often cannot be quantified in the same way as services sold in marketplaces, federal investment into projects that could impact ecosystems and natural resources require an ecosystem services assessment to illuminate how management decisions will enhance, sustain, or degrade the benefits that nature provides (USDA-NRCS, 2017a; Olander et al., 2018). An assessment of links between ecological function and social well-being helps to ensure that beneficial and detrimental ecological impacts of a project are recognized and that detrimental impacts are minimized to the extent possible (European Environment Agency [EEA], 2019).

Per federal guidance, this Plan-EA assesses ecosystem services based on three of the four service categories (USDA-NRCS, 2017a):

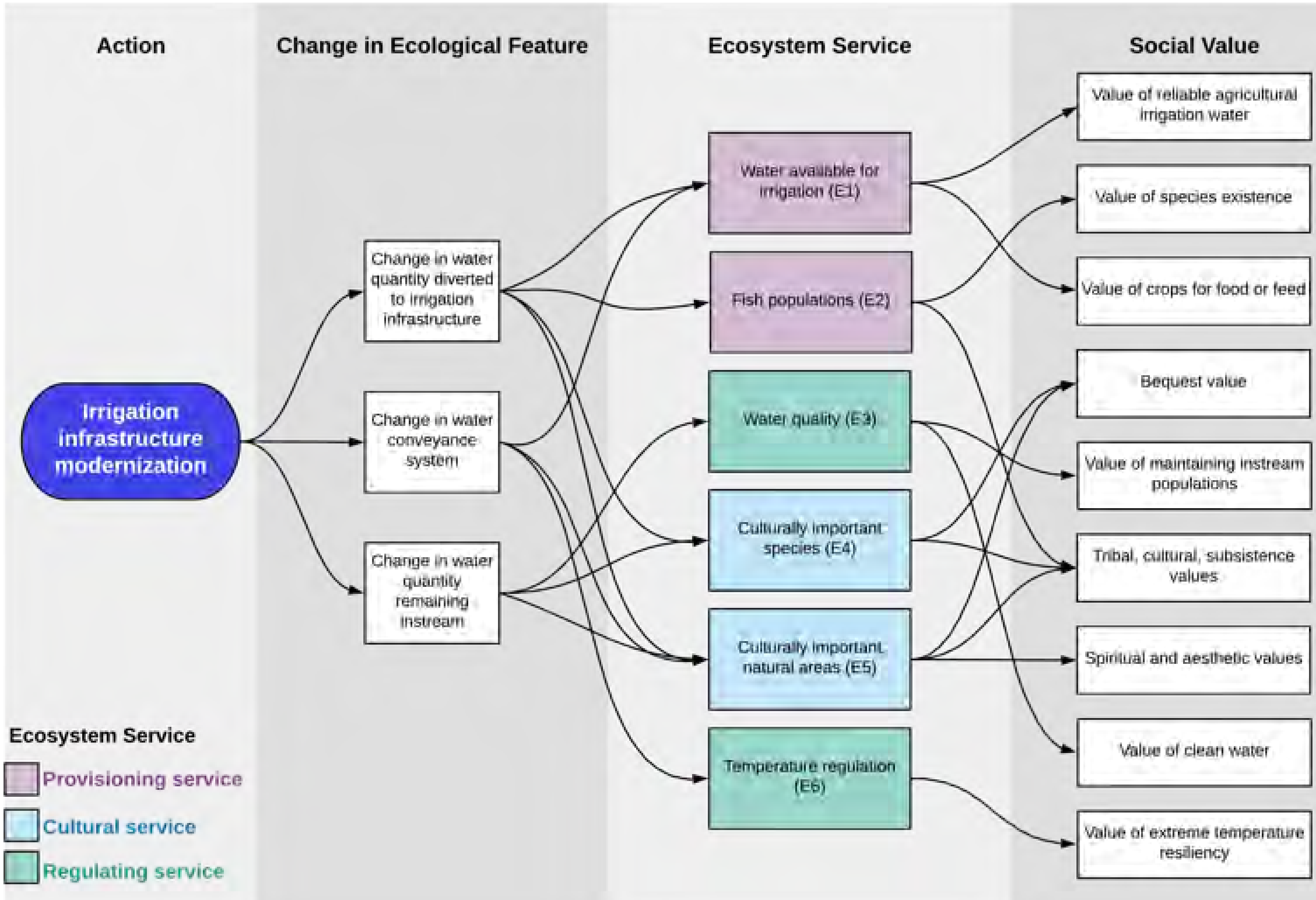
1. Provisioning services: Tangible goods provided for direct human use and consumption, such as food, fiber, water, timber or biomass.

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

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

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

Figure 4-1 shows a concept diagram that highlights the ecosystem services that interact with District operations, and it supports discussion in Section 6. The diagram links an action that would modernize District infrastructure with potentially impacted ecosystem features and the provisioning, regulating, and cultural services that these ecosystems provide to people. Supporting services are not evaluated in this Plan-EA because they give rise to and support the final ecosystem services: provisioning, regulating, and cultural (EEA, 2019; USDA- National Agricultural Statistics Service [NASS], 2017).



Note: 1. E1 through E6 refer to ecosystem services 1 through 6. These services are referenced and explained in more detail throughout Sections 4 and 6.
2. Ecosystem services concept diagram developed by Farmers Conservation Alliance

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

4.1 Cultural Resources

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

There are no National Register-listed historic properties within the project area based on a review of the Oregon Historic Sites Database. The District hired a cultural resource specialist to complete site surveys for historic and archaeological resources in the project area, which included surveys of the irrigation canals and related infrastructure. Please see Section 6.1.2 for a description of the survey findings and the consultation between NRCS, SHPO, THPO, and affiliated tribes for compliance with Section 106 of NHPA.

4.2 Land Use

4.2.1 Land Ownership

Ninety-nine percent of the project area is privately owned. The District has a ROW underlying all of the infrastructure in the project area. The District additionally has easements underlying some of the infrastructure in the project area. The District's ROW was granted under the Carey Desert Land Act of 1894. Under the Carey Act, the District's ROW extends 50 feet on each side of the canal from the toe of the bank for a total width of 100 feet plus the width of the canal (see Appendix C for a map). Over the course of the last 100 years, there have been re-negotiations in specific areas concerning District easements. AID re-maps and re-surveys its infrastructure and easements on an ongoing basis to track changes over time. The Carey Act ROW underlies all infrastructure that is part of the proposed project.

4.2.2 Land Use

Within the project area, land use is entirely related to irrigation conveyance for agriculture. The project area crosses lands both served by and not served by AID. In the eastern half of the District, the project area crosses and is adjacent to rural residential lands; agricultural lands growing alfalfa/grass hay, pasture, and turf; and undeveloped land covered in western juniper (*Juniperus occidentalis*), ponderosa pine (*Pinus ponderosa*), and scrub-shrub species. Deschutes County has zoned a large proportion of the agricultural land and rural land that the project area crosses as Exclusive Farm Use. On the agricultural lands that the project area serves, farmers typically get two to three cuttings per year on hay and pasture grass. Table 4-1 presents information about crops grown in the District.

Table 4-1. Crops Grown in Arnold Irrigation District.

Crop	Total Acreage	Percent Acreage
Alfalfa/grass hay	1,600	36%
Grass (pasture, turf, etc.)	1,600	36%
Lawn/garden, misc.	1,184	28%
Total	**4,384**	**100%**

Source: AID, 2013

In the western half of the District, the project area crosses more developed land including residential areas such as Deschutes River Woods (DRW), a census-designated place and unincorporated community. Approximately 1.3 miles of the project area crosses land that falls within the Bend urban growth boundary (UGB). This boundary is set to control urban sprawl and encroachment on agricultural and rural lands by mandating that the area inside the UGB be used for higher-density urban development.

The proposed action also has the potential to indirectly affect agricultural lands in NUID as result of potential water savings. NUID serves 961 patrons and approximately 59,000 acres of productive farmland. The primary crop types in NUID are alfalfa, hay, bluegrass seed, winter grain, carrot seed, and pasture. Approximately 55 percent of the U.S. domestic market and 45 percent of the global market carrot seed production is grown in Jefferson County, with most of it occurring in the Culver and Madras areas that fall within NUID (Oregon State University, 2020). In 2012, the Jefferson County's agricultural commodity sales contributed more than $260 million to the Central Oregon economy (Headwaters Economics, 2017).

4.2.3 Ecosystem Services

Agricultural land receiving water from District infrastructure provides ecosystem services categorized as *Provisioning service, Water available for irrigation* (see Figure 4-1 [E1]). As described in Section 1.3, water from the Deschutes River is diverted into the District's irrigation conveyance system and delivered to patrons for agricultural purposes. Provision of this water allows lands to be maintained for agricultural production. Feed grasses including hay and pasture contribute to the production of meat and dairy products. This water may also be used to grow crops for food for people.

4.3 Public Safety

The open canal in the project area poses a risk to public safety when it carries water. During the summer months when irrigation water is flowing at peak volume in the canal, water depths can reach to 6 feet with water moving through the canal at up to 3 feet per second. These conditions result in areas of deep, swift water that can make it difficult for a child or an adult to get to safety and can result in tragic outcomes. Some area residents use the property alongside the project area for walking; however, it is private property. The District's ROW and easements are only for maintaining irrigation infrastructure and conveying irrigation water. Public use of the property alongside the District's canal is not a purpose of the District's ROW and easements, nor does the District have the authority to grant public access.

Within the District, cars have crashed into the canal (C. Wills, personal communication, December 12, 2019). The risk of localized flooding from canal failure caused by sinkholes, rodents, tree roots, and from water breaching the canal banks due to debris blockage is also a concern for AID.

In other districts in Central Oregon, drowning deaths, or near drowning instances, have occurred in 1996, 1997, 2004, 2007, 2008, and 2014 in addition to multiple instances of injury (The Bulletin, 2014; KTVZ, 2014; Chu, 2004; Cliff, 2008; Flowers, 2004; Golden, 2007; Minoura, 2007).

Wildfire in Central Oregon and in the wildland urban interface and rural areas where the project area is located has become an increasing concern to the public over the last decade. Factors that have contributed to the recent wildfires include fire suppression that has led to fuels buildup, increased use of wildlands, altered climate regimes, and expansion of communities into the wildland urban interface (USDA U.S. Forest Service [USFS] Western Wildland Environmental Threat Assessment Center, 2021).

The USFS Oregon Wildfire Risk Explorer defines wildfire risk as "both the likelihood of a wildfire and the expected impacts of a wildfire on highly valued resources and assets." Data from the USFS Oregon Wildfire Risk Explorer shows that 22 percent of the land in the watershed planning area is considered to have a very high wildfire risk, 20 percent is considered high, and 12 percent is considered to have moderate risk (USFS ODF, 2018). See Appendix E.10 for additional information regarding wildfire risk.

The project area is primarily in the Deschutes County Rural Fire Protection District #2 with a few small sections of the project area falling outside of this fire district. The fire protection district relies on hydrants with reliable water (water available at all times) located on public roads as its primary source of water for fighting fires. The fire protection district considers canals, cisterns, and ponds as secondary sources of water for fighting fires (L. Medina, personal communication, October 21, 2021).

4.4 Socioeconomic Resources

The project area falls within Deschutes County, Oregon, and the socioeconomic region of influence includes the planning area and the communities of Bend and DRW, a census-designated place.

4.4.1 Population

Generally, the socioeconomic region of influence has seen consistent population growth over the past 10 years (2010 to 2020). Table 4-2 provides more information on the population and population growth within the socioeconomic region of influence and Oregon.

Ethnicity and race for the socioeconomic region of influence can be seen in Table 4-3. Deschutes County, Bend, and DRW are majority white (around 95 percent of the population). The socioeconomic region of influence has lower proportions of all other races, as well as people identifying as Hispanic or Latino, as compared with the state of Oregon.

Table 4-2. Population by State, County, and City.

Indicator	Oregon	Deschutes County	Bend	DRW
Population in 2020 (number of people)	4,237,256	198,253	99,178	5,532
Population Growth 2010–2020	10.6%	25.7%	29.4%	9%

Source: U.S. Census Bureau, 2021

Table 4-3. Race by State, County, and City.

Indicator	Oregon	Deschutes County	Bend	DRW
Total Population in 2020 (number of people)	4,327,256	198,253	99,178	5,532
Two or More Races	4%	2.8%	3.4%	1.4%
One Race	96%	97.2%	96.6%	98.6%
• White	86.7%	94.1%	92.5%	96.2%
• Black or African American	2.2%	0.6%	0.6%	0.3%
• American Indian and Alaska Native	1.8%	1.1%	0.5%	1.2%
• Asian	4.9%	1.3%	1.8%	0.9%
• Native Hawaiian and Other Pacific Islander	0.5%	0.2%	0%	0%
Hispanic or Latino (of any race)	13.4%	8.3%	9.2%	7%
Not Hispanic or Latino	86.6%	91.7%	90.8%	93%

Source: U.S. Census Bureau, 2021

4.4.2 Area Employment and Income

In 2018, health care and social assistance, retail trade, and accommodation and food services were the most common employment sectors in Deschutes County. The county also has more people in agricultural, forestry, and fishing and hunting industries as compared to other counties in Oregon (DataUSA, 2022). In 2017 the market value of agricultural products sold in Deschutes County was approximately $28.8 million (USDA-NASS, 2017).

Household income and the number of persons living below the poverty level are summarized in Table 4-4. Income in the socioeconomic region of influence is above the Oregon median household income. The percentage of persons in poverty falls both below and above the state values depending on the location. Bend and the broader Deschutes County area have lower percentages of people in poverty, while DRW has a poverty percentage greater than that for the state.

Table 4-4. Income and Poverty by State, County, and City.

Indicator	Oregon	Deschutes County	Bend	DRW
Median Household Income (in 2019 dollars), 2015–2019	$62,818	$67,043	$65,662	$65,361
Persons in Poverty	11%	8.1%	10.3%	16.1%

Source: U.S. Census Bureau, 2021

4.4.3 Environmental Justice Communities

Areas with over 50 percent or "meaningfully greater" representation of minority or low-income communities are considered environmental justice communities (Council on Environmental Quality, 1997), and their propensity to experience disproportionally adverse effects from a given action must be analyzed within NEPA documents per EO 12898.

As seen in Table 4-3 and Table 4-4, the socioeconomic region of influence generally has a lower proportion of minority groups and low-income populations relative to the state. One exception is DRW, which has a greater proportion of persons in poverty as compared to the rest of the state.

4.4.4 Property Value along the Main Canal

Within the watershed planning area, there are approximately 400 tax lots adjacent to the project area. Based on comments received during the scoping period and the public comment period, many of these landowners view the currently open Main Canal as having a direct effect on their property value. Limited literature is available looking at the effects of western agricultural irrigation canals on property value. Review of available literature as well as additional analyses of properties specifically in the planning area and properties in nearby irrigation districts, showed that properties adjacent to canals can have property values higher than properties not on a canal (see the NEE Analysis in Appendix D.1 and Appendix E.12 for additional information).

4.5 Soils

The Wanoga Series are the predominant soils in the project area (90 percent of the project area; USDA-NRCS, 2015b). These soils are moderately deep, well drained, and formed from volcanic ash. In 2019, AID found 15 sinkholes in the Main Canal that ranged from softball size to 8 feet by 6 feet (C. Wills, personal communication, December 12, 2019). Sinkholes develop from the seepage of irrigation water and canal soils into the underlying porous rock. Tree roots and burrowing animals have also caused canal failure.

4.5.1 Farmland Classification

NRCS developed technical soil groups that are associated with a particular soil type and a soil's rating for agricultural commodity production (USDA-NRCS, 2015b). NRCS soil groupings within the project area are nearly all farmland of statewide importance (97 percent of the project area; see Appendix E.2).

4.6 Vegetation

4.6.1 General Vegetation

The District lies in the Ponderosa Pine/Bitterbrush Woodland ecoregion Level IV (Thorson et al., 2003). Over the past 100 years, land use changes have altered much of the vegetation within the District. The increased presence of urban development, roads, irrigated agriculture, land management, and livestock grazing are the primary causes of change in the plant communities. The introduction of cheatgrass (*Bromus tectorum*) has also threatened the survival and diversity of native perennial grasses and forbs while increasing the risk of severe wildfire in the project area and adjacent undeveloped lands.

AID allows the establishment of vegetation within its easements and ROW as long as that vegetation does not interfere with operation and maintenance of District infrastructure (AID, 2012). On the side of the canal with the maintenance road, AID mows, grades, and clears its easements and ROW the during the non-irrigation season as needed to maintain access to its irrigation infrastructure. These activities limit vegetation establishment. On the side of the canal without a maintenance road, AID conducts little vegetation management.

Where vegetation has been allowed to grow within the District's easements and ROW, vegetation typically includes ponderosa pine, western juniper, big sagebrush (*Artemisia tridentata*) and low sagebrush (*Artemisia arbuscula*), and bunchgrass (*Poaceae* spp.) (INR Portland & Oregon Biodiversity Information Center, 2014). Some trees within the project area, and in properties adjacent to the project area, may rely on canal seepage as a water source.

In some sections of the project area, hydrophytic (water-loving) vegetation has established along the top of the canal bank; it primarily includes bulrush (*Scirpus* spp.), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and willow (*Salix* spp.).

AID does not allow vegetation to develop long-term within the canal.

4.6.2 Special Status Species

Within Deschutes County, three special status vegetation species potentially occur: federal-candidate whitebark pine (*Pinus albicaulis*), Oregon-threatened pumice grape-fern (*Botrychium pumicola),* and federal species of concern, Oregon-threatened Peck's milkvetch (*Astragalus peckii)* (Center for Biological Diversity, 2019; Oregon Department of Agriculture [ODA], 2019). The project area does not support elevation or habitat requirements for these species, and there are no reports of species presence within the project area based on information from the Oregon Biodiversity Information Center database, the Oregon Department of Agriculture identification of species population centers, or AID observations.

4.6.3 Common and Noxious Weeds

The Deschutes Basin Board of Control determines a weed to be noxious if it is "injurious to public health, agriculture, recreation, wildlife, or any public or private property," and "impacts and displaces desirable vegetation." Furthermore, it is recognized that certain noxious weeds are so pervasive that they have been classified by Oregon Revised Statute (ORS) 569.350 to be a menace to public welfare (ODA, 2017). The noxious and common weeds known to occur in the project area, along with their corresponding weed categories (Deschutes County, 2017), are listed in Appendix E.3.

4.7 Visual Resources

Within the project area, the Main Canal consists of an open earthen canal that lies flat against the landscape. In some portions of the Main Canal, the water surface in the canal is a few feet lower than the landscape level and the canal banks are part of the landscape.

The project area adjacent to the canal includes a dirt or gravel maintenance road that AID uses for canal and vegetation maintenance (see Section 4.6). Herbaceous vegetation, grasses, shrubs, and trees growing within the project area can obscure the view of the canal from adjacent lands. The open canal and project area are visible from residences as well as at public road crossings (see Figure 4-2).

The view of the canal changes throughout the year. The District's irrigation season typically extends from April through October; during this time, the canal carries water. From November through March, the canal does not carry water and is typically dry with a few puddles remaining in low-lying areas. AID provides "stock runs," water delivered through the system to fill patrons' ponds for livestock, several times outside of the irrigation season.

Although the canal is not a naturally formed waterway, many property owners that live adjacent to the canal consider it an aesthetic amenity and derive enjoyment from the view of the canal and wildlife that occur in the project area. Comments received during the scoping and public comment periods indicate that a view of the canal and surrounding vegetation (e.g., from a yard) enhances the aesthetic value of properties adjacent to the project area. Trees growing in the project area and on land immediately adjacent to the project area were also identified as an important aspect of the scenic quality enjoyed from properties adjacent to the project area. See Section 4.8.6 for information on the cultural services that the Arnold Main Canal provides.

Figure 4-2. A view of the Main Canal and maintenance road within the project area from Knott Road looking northeast. Some residents have installed fences for safety purposes and do not have direct views of the canal from their property.

The western side of the project area passes through residential areas in DRW (see Figure 4-3), while the eastern side of the project area passes through agricultural and undeveloped lands. In residential areas where homes are located along the canal, some homes have direct views of the canal. Other homes located along the canal do not have views of the canal because homeowners have installed fences between the canal and their homes (see Figure 4-2).

In agricultural and undeveloped areas, there are a few rural residences adjacent to the project area. Some rural residences have views of the canal, but vegetation obscures the canal in many locations.

Figure 4-3. The Main Canal passing residential homes in Deschutes River Woods, located west of Brookswood Boulevard.

4.8 Water Resources

4.8.1 Arnold Irrigation District Water Rights and Operations

AID delivers water to irrigate 4,384 acres. Of that total acreage, 1,475 acres receive water directly from the Main Canal. The remaining irrigated lands receive water through lateral canals that branch off the Main Canal. AID has already piped approximately 22 percent of its system—primarily laterals that are not part of the project area. Patron turnouts from the Main Canal are gate-regulated and weir-measured by AID field staff. Water loss associated with the laterals is detailed in the District's System Improvement Plan (Crew, 2017). Water loss associated with the Main Canal is discussed in Sections 2.1.1 and 6.8.2 of this Plan-EA, Appendix E.4, and the District's System Improvement Plan (Crew, 2017).

AID diverts both live flow and stored water from the Deschutes River at the Arnold Canal Diversion (RM 174.5) near Bend to meet its patrons' water needs. AID's primary source of water is live flow. AID diverts this water under Certificate 74197, which has a priority date of February 1, 1905, for 25 cfs and a priority date of April 25, 1905, for 125 cfs. The duty[6] under this water right is 15.42 acre-feet per irrigation season (see Appendix E.4 for more information on historical AID diversion rates). AID also holds 5,000 acre-feet of stored-water rights in Crane Prairie Reservoir, which is located upstream from the AID diversion on the Deschutes River (S. Johnson, personal communication, May 12, 2022). AID's stored-water right can be used throughout the irrigation season and is used on an as-needed basis to supplement the live-flow water right.

[6] Duty is the maximum volume allowed per acre per irrigation season.

Water for the District is conveyed from Crane Prairie Reservoir, east through the Deschutes River, through Wickiup Reservoir, and then north through the Deschutes River to the Arnold Canal Diversion at RM 174.5 (see Figure 4-4).

AID's live-flow water right identifies three seasons; each has different delivery rates (see Table 4-5). These delivery rates are lower in season 1 and season 2 than in season 3. To meet demands during the late summer and fall, AID may supplement live flow with stored water to address reduced live-flow availability caused by drought or prolonged heat.

Table 4-5. Delivery Rates and Irrigation Season Dates per Water Right Certificate 74197.

Season	Start Date	End Date	Start Date	End Date	Season Duration (days)	Priority Date	Certificated Diversion Flow Rates (cfs)	Percent of Full Certificated Rate
1	April 1	April 30	Oct. 1	Nov. 1	62	2/1/1905	14.33	41%
						4/25/1905	71.63	41%
2	May 1	May 14	Sept. 15	Sept. 30	30	2/1/1905	18.73	53%
						4/25/1905	93.68	53%
3	May 15	Sept. 14	N/A	N/A	122	2/1/1905	25.00	100%
						4/25/1905	125	100%

cfs = cubic feet per second; N/A = not applicable

Historically, AID has diverted water based on water rights, water availability, and patron demand. Table 4-6 demonstrates the 20th percentile, 50th percentile, and 80th percentile of AID's diversion rates throughout the 2000 through 2021 water years (OWRD, 2022).

Table 4-6. AID Historical Diversion Rates Throughout the 2000–2021 Water Years.

Season	Month	20th Percentile (cfs)	50th Percentile (cfs)	80th Percentile (cfs)
1	April	49	64	77
2	May 1–14	76	84	90
3	May 15–31	80	87	93
	June	81	88	93
	July	86	93	98
	August	85	94	98
	Sept 1–14	78	87	93
2	Sept 15–30	71	80	86
1	October	58	66	74

Source: OWRD, 2022.

4.8.2 North Unit Irrigation District Water Rights and District Operations

North Unit Irrigation District (NUID) provides irrigation water to nearly 59,000 agricultural acres in Jefferson County, Oregon. NUID diverts natural flow from the Deschutes River and stored water released from Wickiup Reservoir at its diversion in Bend, Oregon (RM 164.8). Wickiup Reservoir, located on the Deschutes River 60 miles southwest of Bend, has a maximum capacity of 200,000 acre-feet.

NUID also operates a pumping plant on the Crooked River. This pumping plant is located where NUID's Main Canal crosses the Crooked River. It provides water for both primary and supplemental use in NUID.

NUID historically sourced approximately 70 percent of its annual water supply from storage in Wickiup Reservoir (NUID, n.d.). With the HCP now in effect, winter flow releases from Wickiup Reservoir to meet minimum streamflow requirements set by the HCP in the Deschutes River are expected to result in a decline in storage water availability for NUID patrons (AID et al., 2020). This decline in stored-water availability is estimated to reduce water supply availability to NUID starting year 8 of the HCP (i.e., January 2028) in normal to very dry years and in year 13 of the HCP (i.e., January 2033) in all water-type years. It is estimated that following year 13 of the HCP, the increased winter releases will reduce water supply storage in Wickiup Reservoir in a normal water year by 75,017 acre-feet—a 40 percent reduction (AID et al., 2020).

4.8.3 Surface Water Hydrology

Table 4-7 and Figure 4-4 present waterbodies associated with AID operations. The upstream end of Lake Billy Chinook, at the confluence of the Deschutes, Crooked, and Metolius rivers, serves as the downstream boundary of the area associated with AID operations.

Table 4-7. Waterbodies Associated with AID Operations.

Name	Reach	Size	Tributary To	Project Nexus
Crane Prairie Reservoir	Not applicable	55,300 acre-feet	Not applicable	AID holds stored-water rights in this reservoir.
Deschutes River	Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 233.5)	Not applicable	Not applicable	Releases from Crane Prairie Reservoir affect flows in this reach.
Wickiup Reservoir	Not applicable	200,000 acre-feet	Not applicable	NUID holds stored-water rights in this reservoir. AID irrigation water is conveyed through Wickiup Reservoir.
Deschutes River	Wickiup Reservoir (RM 226.8) to Arnold Canal Diversion (RM 174.5)	Not applicable	Columbia River	Releases from Crane Prairie and Wickiup reservoirs are developed to meet streamflow rates set forth in the HCP in this reach.
Deschutes River	Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook (RM 120.0)	Not applicable	Columbia River	AID's diversion affects flows in this reach.

AID = Arnold Irrigation District; HCP = *Deschutes Basin Habitat Conservation Plan*; NUID = North Unit Irrigation District; RM = River Mile

Historically, the spring-fed Deschutes River had relatively consistent streamflow seasonally and annually (Deschutes River Conservancy [DRC], 2012). Hydrologic conditions in the Deschutes River have changed with the construction and operation of reservoirs, dams, and diversions on the river and its tributaries. Water is now managed for irrigation use; this results in lower flows downstream from reservoirs during the storage season (i.e., late fall, winter, and early spring), higher flows downstream from reservoirs during the irrigation season (April through October), and lower flows downstream from irrigation diversions during the irrigation season (see Appendix E.4 for more information on historical flows in the Deschutes River).

In November 2020, AID, seven other irrigation districts in the Deschutes Basin, and the City of Prineville finalized the Deschutes Basin HCP to support the issuance of incidental take permits by USFWS and NMFS under Section 10(a)(1)(B) of the federal ESA of 1973, as amended. The HCP identifies streamflow rates that will be maintained in the Deschutes River by the Deschutes Basin irrigation districts (AID et al., 2020; see Appendix E.4.8 for a summary of the operation measures set forth by the HCP). These rates increase over time as discussed in the following subsections.

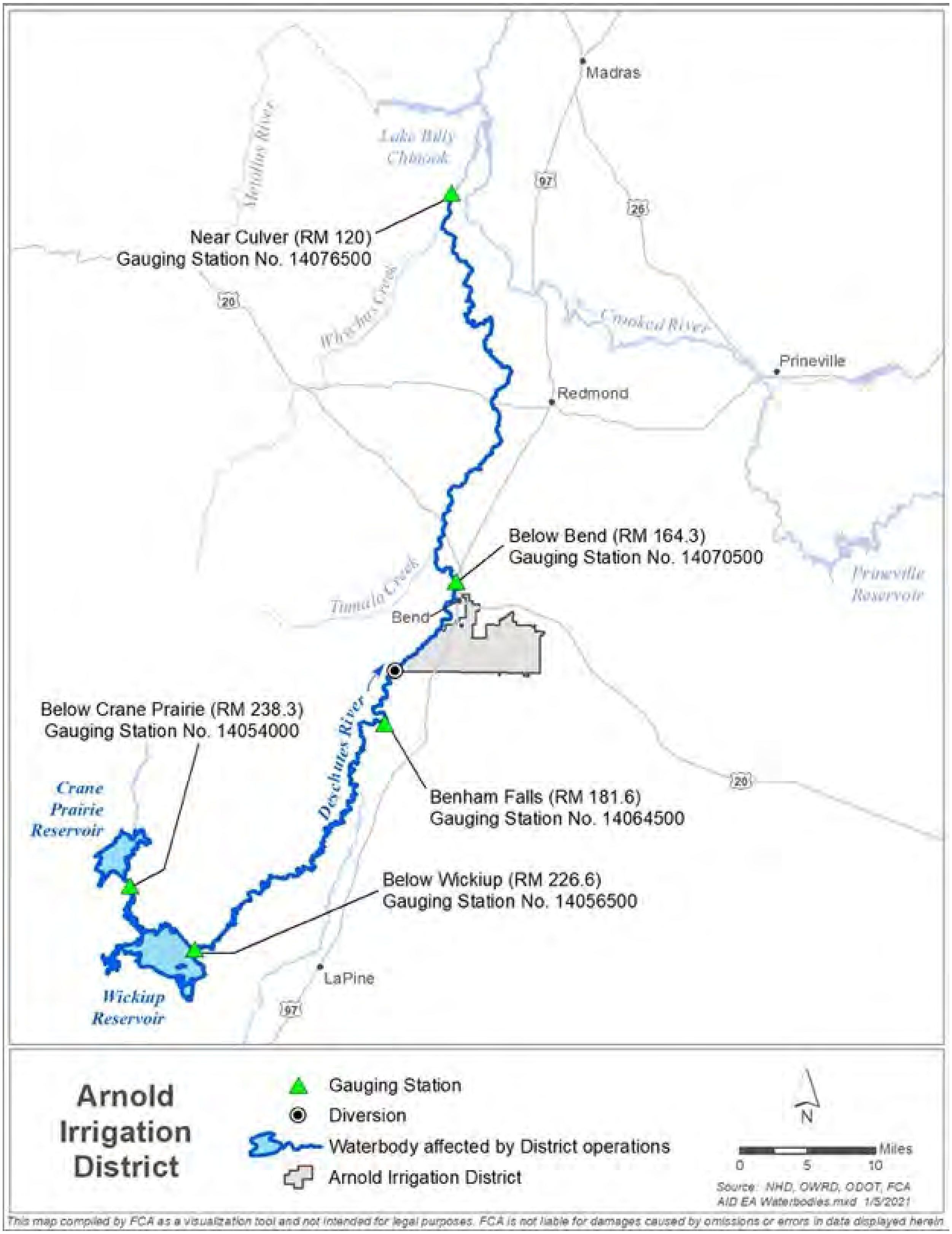


Figure 4-4. Waterbodies and gauging stations associated with District operations.

4.8.3.1 Crane Prairie Reservoir

Crane Prairie Reservoir relies on snowmelt, flows from the Deschutes River (which comes out of Little Lava Lake), and precipitation for inflow. Crane Prairie Dam is operated in coordination with Wickiup Dam and Reservoir, in accordance with the HCP. Storage and releases are directed by the OWRD regional watermaster and executed by Central Oregon Irrigation District (COID) personnel.

4.8.3.2 Wickiup Reservoir

Wickiup Reservoir is 5 miles downstream from Crane Prairie Dam and relies on snowmelt, releases from Crane Prairie Reservoir, and precipitation for inflow. Throughout the year, water is released from Wickiup Reservoir as directed by the OWRD regional watermaster in accordance with the HCP and through an accounting arrangement whereby the storage accounts for COID, NUID, Lone Pine Irrigation District (LPID), and AID are balanced over the course of the irrigation season.

During the irrigation season, water released from Wickiup Dam is conveyed through the Deschutes River to COID's, AID's, and NUID's diversions in Bend (see Figure 4-4). During the non-irrigation season, water released from the dam is conveyed down the Deschutes River to Lake Billy Chinook (RM 120.0). The HCP (AID et al., 2020) limits reservoir operations, and a summary of the operation measures set forth by the HCP can be found in Appendix E.4.8.

4.8.3.3 Deschutes River (RM 238.5) to the Arnold Canal Diversion (RM 174.5)

Reservoir releases, tributary inflows, irrigation diversions, and groundwater interactions drive streamflow in the reaches of the Deschutes River from Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 233.5) and from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5). Appendix E.4 provides more information on flows in this reach of the Deschutes River. As described in the prior subsection, streamflow rates in this reach are set forth in the HCP, which are summarized in Appendix E.4.8.

Figure 4-5 and Figure 4-6 display the Deschutes River's daily average baseline streamflow following the 2016 Settlement Agreement.[7] Data for streamflow following the 2016 Settlement Agreement represents the October 2016 through September 2020 water years.

[7] In 2016, as part of an interim agreement until the finalization of the HCP, AID and other districts that store water in Crane Prairie and Wickiup reservoirs agreed to maintain a minimum of 100 cfs in the Deschutes River outside the irrigation season (*Center for Biological Diversity et al. v. U.S. Bureau of Reclamation* and AID et al. 2016). This agreement is referred to as at the 2016 Settlement Agreement and was maintained until the finalization of the HCP in 2020 (AID et al., 2020).

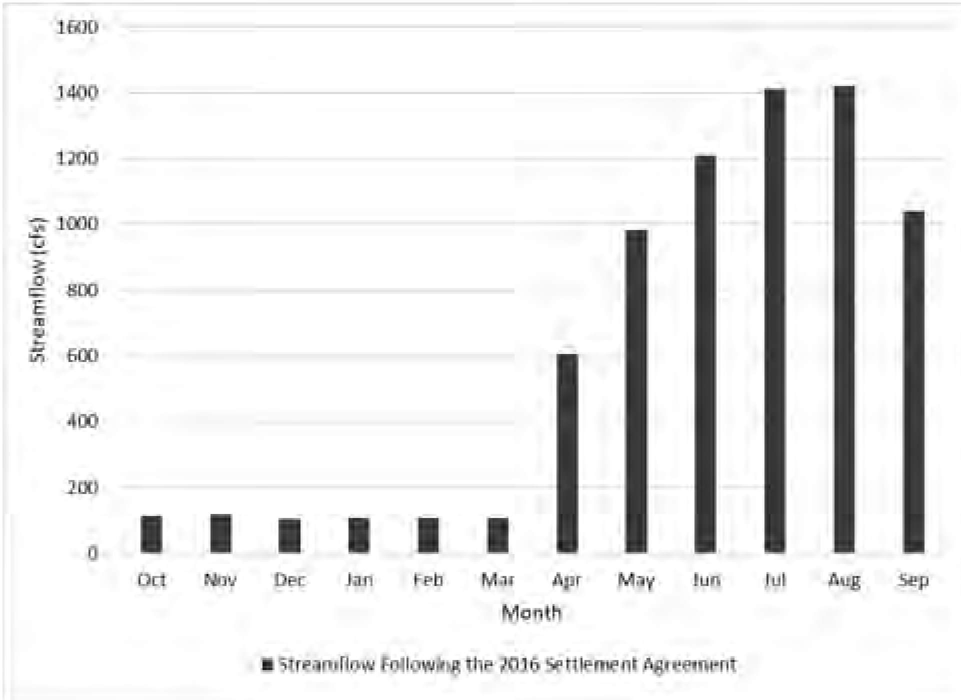


Figure 4-5. Streamflow in the Deschutes River downstream from Wickiup Reservoir at OWRD Gauge No. 14056500.

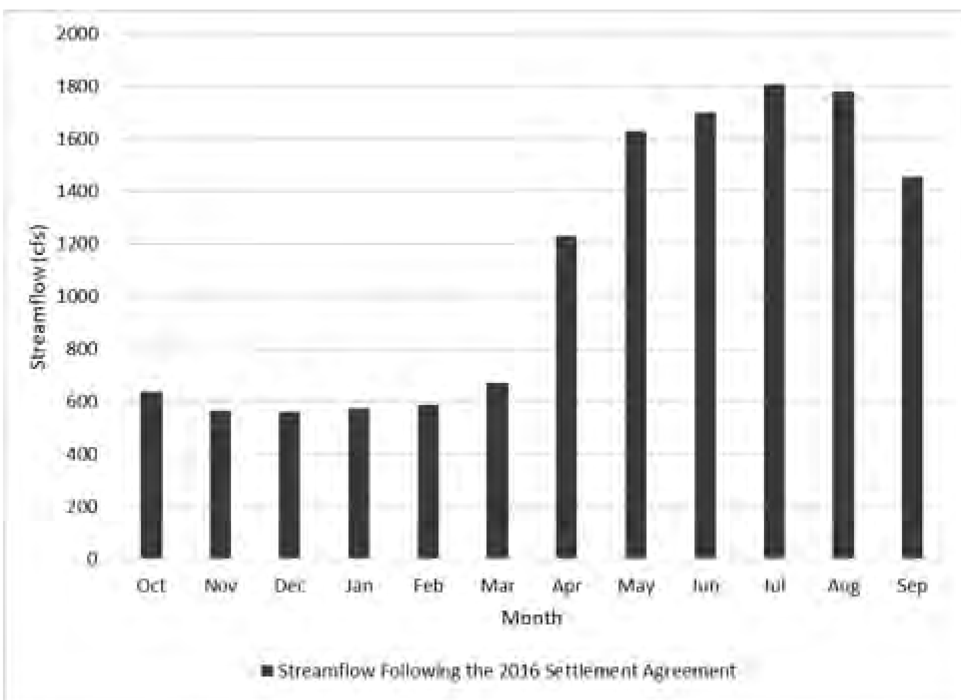


Figure 4-6. Daily average streamflow in the Deschutes River at Benham Falls at OWRD Gauge No. 14064500.

4.8.3.4 Deschutes River, Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook (RM 120.0)

Central Oregon, Arnold, Lone Pine, North Unit, and Swalley irrigation districts divert water from the Deschutes River near Bend; this influences streamflow patterns in the Deschutes River between the Arnold Canal Diversion (RM 174.5) and Lake Billy Chinook (RM 120.0). Historically, these irrigation districts maintained a minimum of 30 cfs instream in this reach during the irrigation season under a voluntary agreement. Extensive conservation efforts by the irrigation districts and their partners starting in the 2000s have enhanced streamflow during the irrigation season, maintaining approximately 130 cfs downstream from their diversions during the summer irrigation season. Appendix E.4 provides more information on flows in this reach of the Deschutes River.

Figure 4-7 displays the Deschutes River streamflow downstream from Bend. The figure demonstrates the daily average baseline streamflow following the 2016 Settlement Agreement (October 2016 to September 2020).

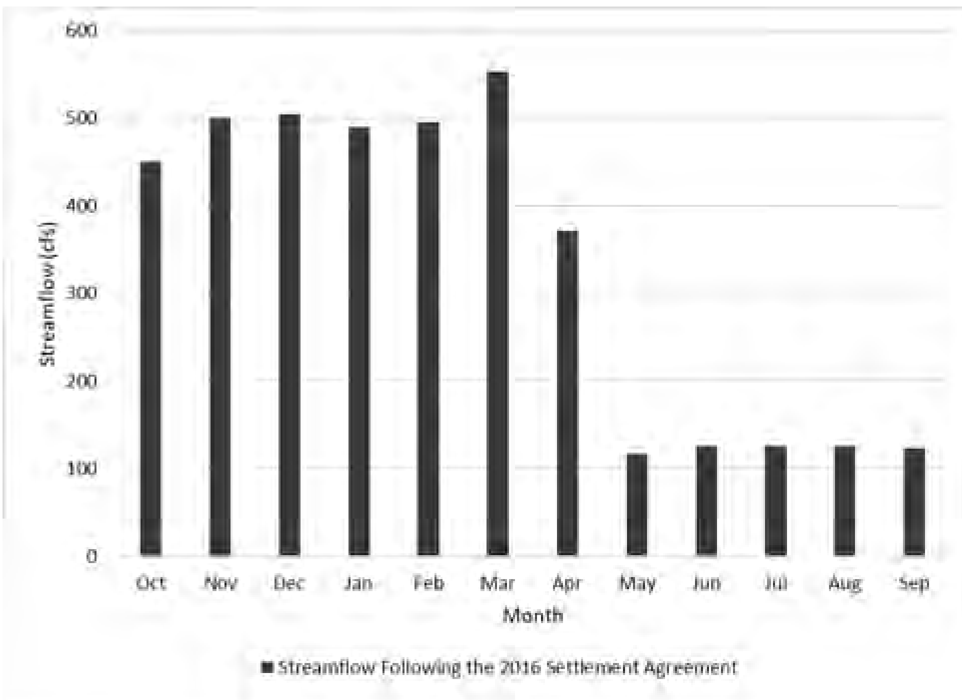


Figure 4-7. Daily average streamflow in the Deschutes River downstream from Bend at OWRD Gauge No. 14070500.

The Oregon Department of Fish and Wildlife's (ODFW) pending water right in this reach requests a year-round flow of 250 cfs; this provides one target for the streamflow that is needed for fish and wildlife and their habitat quality, as well as for recreation from North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0; see Appendix E.4).

4.8.3.5 Drainage Courses

AID does not allow its canal and lateral system to be intentionally used for stormwater management. Any interception of stormwater associated with overland flow in the area adjacent to the AID conveyance system is incidental to the purpose of conveying water for irrigation. Due to the geology and climate of the area, these occurrences are minimal.

4.8.4 Surface Water Quality

The Oregon Department of Environmental Quality (DEQ) maintains a list of all surface waters in the state that are considered impaired because they do not meet water quality standards under Section 303(d) of the CWA (Congressional declaration of goals and policy, 2021). The 2012 Section 303(d) list is effective for CWA purposes. Waterbodies associated with AID operations are included on Oregon's Section 303(d) list for not meeting state water quality standards for aquatic weeds or algae, temperature, dissolved oxygen, pH, sedimentation, turbidity, chlorophyll a, *E. coli*, and biological criteria (see Table 4-8).

Water management in the Deschutes Basin has altered seasonal streamflow patterns; this has increased streamflow above historical levels in some reaches and decreased streamflow below historical levels in others. Low streamflow impacts water quality in the Deschutes River by exacerbating temperature and dissolved oxygen problems. In addition, water quality often dictates the spread and extent of invasive aquatic species (McCormick et al., 2009), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River. The following sections describe existing Section 303(d)–listed impairments in the waterbodies associated with District operations. DEQ is required to develop total maximum daily loads for rivers and streams in the upper Deschutes Basin (these impairments may extend upstream or downstream of the reaches included in Table 4-8).

Table 4-8. Impaired Waterbodies Associated with District Operations.

Name	Listed Reach (River Miles)	Parameters Included on Oregon's Section 303(d) List
Crane Prairie Reservoir	Not applicable	Aquatic weeds or algae
Deschutes River	Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 226.8)	Temperature
Wickiup Reservoir	Not applicable	Aquatic weeds or algae
Deschutes River	Wickiup Reservoir Dam (RM 226.8) to North Canal Dam (RM 164.8)[1]	Temperature Dissolved oxygen pH Sedimentation Turbidity Chlorophyll a
Deschutes River	North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0)	Temperature Dissolved oxygen

Source: DEQ, 2012
RM = River Mile
[1] The Arnold Canal Diversion is located at RM 174.5 in the Deschutes River.

4.8.5 Groundwater

AID and its associated operations lie within the upper Deschutes Basin. Within the basin, precipitation in the Cascade Range provides 3,500 cfs of annual groundwater recharge. Inflows from outside the basin provide an additional 850 cfs of recharge. Canal seepage across the region provides approximately 411 cfs of additional recharge based on 2008 data (Gannett et al., 2001; Gannett & Lite, 2013). Since the publication of the Gannet and Lite (2013) groundwater level change analysis, subsequent canal lining and piping projects have reduced recharge from canal seepage.

Due to the highly permeable geology of the area, groundwater levels and stream discharge are associated with movement of water between surface and groundwater systems. The rivers, streams, and irrigation canals in the upper Deschutes Basin all show seepage losses indicative of the area's permeable geology (Gannett et al., 2001). AID's Main Canal loses an estimated 32.5 cfs of water during the irrigation season (11,083 acre-feet annually)[8] due to a combination of seepage related to the condition of the distribution system, the permeable nature of the underlying soil and rock, and evaporation.

Gannett et al. (2001; 2017) mapped stream reaches in the upper Deschutes Basin as either losing reaches or gaining reaches. The reach of the Deschutes River from near Sunriver to Bend was mapped as a losing reach. Thus, canal seepage loss in the District is not returning to this reach of the river. Furthermore, groundwater flow, estimated from simulated 2013 groundwater hydraulic head[9] data, is in a northeasterly direction from the District (Gannett et al., 2017). The model results provide evidence that groundwater underlying the District flows eastward away from the Deschutes River before bending northward where it travels along paths to discharge locations north of Redmond, Oregon.

Cascade Range aquifers in the upper Deschutes Basin have experienced a general drying trend since the 1950s. Climate oscillations remain the primary driver of these declines (Gannett et al., 2001; Gannett et al., 2003). A U.S. Geological Survey study investigated the influence of canal lining and piping, groundwater pumping, and climate on water-level trends in the region between 1997 and 2008 (Gannett & Lite, 2013). The study predicted an approximate 5- to 14-foot decline in groundwater levels in the central part of the basin, which lies north of the proposed project area. The study found that 60 to 70 percent of the measured decline was associated with climate variations, 20 to 30 percent of the measured decline was associated with increased groundwater pumping, and 10 percent was associated with canal lining and piping. At the basin scale, natural climate-induced fluctuations in groundwater discharge largely mask the effects of development on discharge from the regional aquifer (Gannett et al., 2001).

To use groundwater in the Deschutes Basin, a groundwater rights application must be completed under the OWRD Deschutes Basin Groundwater Mitigation program pursuant to Oregon

[8] This loss is derived from a loss assessment performed in 2016 and is representative of the District's annual losses during the peak irrigation season when diversion rates are typically highest (May 15 to September 14). See Appendix E.4 for information on water loss in the system.

[9] Groundwater hydraulic head is the level to which groundwater will rise in a well and is dependent on both elevation and pressure. Groundwater flows from areas of high hydraulic head to low hydraulic head.

Administrative Rule (OAR) 690-505-0500. The mitigation program is part of OWRD's goal to limit groundwater use by imposing restrictions to new users obtaining groundwater rights and was developed to provide for new groundwater uses while maintaining scenic waterway and instream water right flows in the Deschutes Basin.

4.8.6 Ecosystem Services

Water flowing through the Deschutes River provides the following ecosystem services.

Provisioning service, Water available for irrigation (see E1on Figure 4-1): As described in Sections 1.3 and 4.8.3, water from the headwaters of the Deschutes Basin is stored, conveyed, and diverted and affects flow in the upper and middle reaches of the Deschutes River. This water provides irrigation for food and feed and maintenance of agricultural lands.

Regulating service, Water quality (see E3 on Figure 4-1): The amount of water instream affects water quality including temperature, turbidity, sediment, and pollutants. In general, low streamflow challenges a waterbody's ability to resist warming because less water heats faster than more water. Because of this property, greater instream flow can help to keep water cool—an important factor for temperature-sensitive aquatic species living in these stream habitats (see Section 4.9). In cold winter months, however, the banks of waterbodies with low streamflow are susceptible to freeze-thaw cycles that can increase bank erosion and increase sediment in the water. Section 4.8.4 describes surface water quality in the waterbodies associated with District operations.

Water flowing through the District's Main Canal provides the following ecosystem services.

Cultural service, Culturally important areas (see E5 on Figure 4-1): To some residents along the District's Main Canal, the canal brings a sense of tranquility and enjoyment. As identified during the public comment period of this Plan-EA, residents indicated that they receive aesthetic and spiritual enjoyment from the canal. Residents enjoy seeing and hearing the water in the canal during the irrigation season and the wildlife that the canal attracts as a water source. Some residents have built structural and landscape features designed to view the canal.

Regulating service, temperature regulation (see E6 on Figure 4-1): Water flowing through the District's Main Canal during the irrigation season may provide a small local cooling effect on the surrounding properties when air temperatures are high, which typically occurs during the day. It is also possible that water in the canal may lead to a small, local warming effect if air temperatures are cooler than the water. Canal temperature regulation is dependent on the relative temperatures of the canal water and air temperature (Jacobs et. al., 2020). Temperature data to assess the temperature-regulating effects of the canal on properties adjacent to the District's Main Canal is unavailable.

4.9 Fish and Aquatic Resources

The affected environment for fish and aquatic species includes waterbodies that are associated with AID operations (see Table 4-7). These waterbodies include Crane Prairie and Wickiup reservoirs, the Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5), and the Deschutes River from the Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook

(RM 120.0). The Pelton Round Butte Dam creates Lake Billy Chinook through the impoundment of the Crooked, Deschutes, and Metolius rivers.

The Deschutes Basin is part of 10 million acres of lands ceded to the United States by the CTWS. Under rights reserved by federal treaty, tribal members harvest salmon and steelhead from the rivers of the Deschutes Basin. Tribal fishing opportunity has become severely restricted because of fish passage barriers, low fish abundance, and the need to protect weak or threatened stocks (CTWS, 2020). CTWS, ODFW, Portland General Electric (PGE), and local partners are actively engaged in efforts to recover fish populations through fish passage barrier removal, habitat restoration, hatchery supplementation, research and monitoring, and harvest management (PGE, n.d.).

4.9.1 General Fish and Aquatic Species

The District's canals do not support resident or anadromous fish or threatened and endangered aquatic species. Fish screens were installed in 2001 at the Arnold Canal Diversion on the Deschutes River (RM 174.5). These fish screens separate water diverted for consumptive use from debris and water left instream. The screens also prevent any fish from entering the District's irrigation conveyance system by returning fish to the river downstream of the diversion.

Fish and aquatic species documented in the waterbodies associated with District operations are listed in Appendix E.5. The summer steelhead salmon (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and sockeye salmon (*Oncorhynchus nerka*) in these waterbodies are part of a reintroduction effort that began in 2009 to mitigate for blocked fish passage at the Pelton Round Butte Dam Complex (ODFW & CTWS, 2008). Chinook and sockeye salmon are unable to navigate Steelhead Falls, which creates the uppermost distribution limit for salmon in the Deschutes River at RM 128.0. Summer steelhead are able to pass upstream of Steelhead Falls but are unable to navigate upstream of Big Falls at RM 132.0. Big Falls is considered the uppermost limit of anadromous fish distribution in the Deschutes River (ODFW, 1996).

Low streamflow and water quality impairments are recognized as key limiting factors for fish populations in the basin (NMFS, 2009). Low streamflow and elevated water temperatures in the middle Deschutes River during the irrigation season negatively affect salmonid growth and survival (Recsetar et al., 2012). Availability of cold-water refugia for temperature-sensitive fish species is of key importance when river temperatures rise above acceptable standards. Water temperatures that are out of the normal range for a given fish species can increase physiologic stress, increase susceptibility to predators, and influence growth rates, feeding, metabolism, and development. Water quality impairments, including temperature, in waterbodies associated with District operations are described in Section 4.8.4.

In addition to fish, other aquatic species are potentially found within or along waterbodies that are associated with District operations. These other aquatic species include bullfrog (*Lithobates catesbeianus*), western toad (*Anaxyrus boreas*), Pacific treefrog (*Pseudacris regilla*), and long-toed salamander (*Ambystoma macrodactylum*). The western toad, Pacific treefrog, and long-toed salamander are native to Oregon and may be present in open irrigation canals and adjacent banks where there is suitable vegetation (S. Wray, personal communication, November 17, 2017). The bullfrog is an invasive species that was introduced to Oregon in the early 1900s. Bullfrogs are voracious predators that eat any animal they can swallow. The International Union for Conservation of Nature (IUCN) lists all of these amphibians as species of least concern for Conservation of Nature (IUCN, 2017).

Two species of mollusks may be found in waterbodies associated with District operations: western pearlshell mussel (*Margaritifera falcata*) and western ridged mussel (*Gonidea angulata*). The western ridged mussel is currently ranked as vulnerable by IUCN (2017) and is recognized as a species of greatest conservation need by the State of Oregon (The Oregon Conservation Strategy [OCS], 2016). The western pearlshell mussel is ranked as near threatened by IUCN (2017).

4.9.2 Federally Listed Fish and Aquatic Species

A list of fish and aquatic species protected under the ESA (Endangered Species Act Amendments of 1982, 2020), as amended in 1998, that are known or expected to occur in waterbodies associated with District operations was obtained using the USFWS Environmental Conservation Online System Information for Planning and Consultation (IPaC) System. IPaC indicated that three federally listed fish and aquatic species—Oregon spotted frog (*Rana pretiosa*), bull trout (*Salvelinus confluentus*), and Middle Columbia River steelhead salmon (*Oncorhynchus mykiss*)—are or may be found in the waterbodies associated with AID operations (USFWS, 2021). None of these species are known to occur within the irrigation canals within the project area.

Oregon spotted frog

USFWS lists Oregon spotted frog as threatened under the ESA. The Oregon spotted frog and its designated critical habitat occur in the Deschutes River upstream of Bend (RM 173.0) and in Crane Prairie and Wickiup reservoirs (see Figure E-1 in Appendix E.5). USFWS has identified Primary Constituent Elements (PCEs) for Oregon spotted frog critical habitat (Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Oregon Spotted Frog, 2016). They represent the biological and physical features that are essential to the conservation of a species and describe habitat components that support one or more life stages of the species. PCEs for Oregon spotted frog describe areas that have appropriate water depths and refuge from predators, aquatic connectivity, and absence of non-native predators. A detailed list of Oregon spotted frog critical habitat PCEs is provided in Appendix E.5.

Bull trout

USFWS lists bull trout as threatened under the ESA. Bull trout are known to be present in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) (ODFW, 1996, 2005). Designated critical habitat for bull trout also occurs in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) (see Figure E-1 in Appendix E.5). The PCEs for bull trout describe habitat that has aquatic connectivity, complex habitat structure, water temperatures ranging from 2 degrees Celsius to 15 degrees Celsius, natural variability in streamflow, a sufficient food base, and the absence of non-native predatory and competing fish (Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Bull Trout, 2005). A detailed list of critical habitat PCEs for bull trout is provided in Appendix E.5.

Middle Columbia River steelhead

Steelhead populations listed as threatened under the ESA are present within waterbodies affected by District operations (see Figure E-2 in Appendix E.5). However, the population in the Deschutes River (Middle Columbia River steelhead) is classified as a non-essential experimental population under Section 10(j) of the ESA, and critical habitat is not designated (Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead Above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon, 2011). Because of this classification and because the non-essential experimental population is located outside of a National Wildlife Refuge System and a National Park System, the population is treated as "proposed for listing" under ESA Section 7 (Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead Above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon, 2011; Endangered and Threatened Species: Designation of Experimental Populations Under the Endangered Species Act, 2016).

4.9.3 State-Listed Species

ODFW maintains a list of native wildlife species in Oregon that have been determined to be either threatened or endangered according to criteria set forth by OAR 635-100-0105 (ODFW, 2021). There are no state-listed threatened, endangered, or candidate fish or aquatic species known to occur within the waterbodies associated with District operations or in the irrigation canal within the project area.

4.9.4 Ecosystem Services

Fish and aquatic species in the Deschutes River provide the following ecosystem services.

Provisioning service, Fish Populations (see E2 on Figure 4-1): The waterbodies associated with District operations provide year-round trout fishing opportunities (ODFW, 2019). Brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) in the Deschutes River provide recreational anglers with opportunities to harvest fish for consumption.

Cultural service, Culturally important species (see E4 on Figure 4-1): People's values for species conservation may arise from personal use (i.e., enjoying seeing the species or its habitat), personal beliefs and moral ethics (i.e., believing protecting a species and its habitat is the right thing to do), altruism (i.e., believing a resource should be protected so that others can use it or benefit from it), or a desire to bequest the resource (i.e., believing a resource should be protected for future generations). To many residents of Central Oregon, the conservation of fish and aquatic life has come to represent the restoration of the Deschutes River ecosystem. In addition, members of the CTWS have fishing rights and rely on the Deschutes River fisheries for subsistence. Culturally important fish and aquatic species in the Deschutes River ecosystem include species such as salmon, bull trout, and steelhead for both subsistence and cultural values, as well as Oregon spotted frog for cultural values.

4.10 Wetlands and Riparian Areas

Wetlands and riparian areas affected by District operations occur in the project area, and there are 111.8 miles of natural waterbodies associated with District operations.

Wetlands perform a number of valuable functions including water storage, water filtration, and biological productivity. They can also support complex food chains that provide sources of nutrients to plants and animals and provide specialized habitat for a wide variety of aquatic and terrestrial species. Wetlands in the area associated with the proposed action may be subject to federal or state regulations depending on their characteristics. Within the State of Oregon, wetlands are managed under two regulations: the Oregon Removal-Fill Law and the CWA, a federal statute.

The U.S. Army Corps of Engineers (USACE) administers Section 404 of the CWA with the oversight of the U.S. Environmental Protection Agency (EPA). This law regulates the dredge or fill of wetlands and other waters over which the USACE has jurisdiction (or "jurisdictional wetlands").

Section 404 of the CWA defines wetlands as "those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Final Rule for Regulatory Programs of the Corps of Engineers, 1986).

The Oregon Department of State Lands (DSL) implements the Removal-Fill Law (ORS 196.800-990), which regulates the removal or fill of material in wetlands or waterways and requires any person who plans to remove or fill material within waters of the state to obtain a permit from DSL.

Per the Oregon Removal-Fill statute, OAR 141-085-0515(9), an irrigation ditch is not jurisdictional under Oregon Removal-Fill permitting if it meets both of the following (DSL, 2013):

- The ditch is operated and maintained for the primary purpose of irrigation.
- The ditch is dewatered[10] outside of the irrigation season except for isolated puddles in low areas.

On July 24, 2020, USACE and EPA signed a memorandum providing a clear, consistent approach regarding the application of the exemptions from the regulation under Section 404(f)(1)(C) of the CWA for the construction or maintenance of irrigation ditches and for the maintenance of drainage ditches. An "irrigation ditch" is defined as a ditch that either conveys water to an ultimate irrigation use or place of use or that moves and/or conveys irrigation water away from irrigated lands. Should the irrigation ditch not occur in waters of the United States, the proposed activity is not prohibited by nor regulated under Section 404 of the CWA.

Riparian areas are transition zones between waterbodies and adjacent upland areas, and they support hydrophytic vegetation that is dependent upon the hydrology of the waterbody. Section 404 of the CWA defines riparian areas as "areas next to or substantially influenced by water. These may include areas adjacent to rivers, lakes, or estuaries" (Clean Water Rule: Definition of "Waters of the United States," 2015). Riparian areas are typically associated with high water tables due to the close

[10] "Dewatered" means that the source of the irrigation water is turned off or diverted from the irrigation ditch. A ditch that is dewatered outside of the irrigation season may be used for temporary flows associated with stormwater collection, stock water runs, or fire suppression.

proximity to aquatic ecosystems, certain soil characteristics, and a range of vegetation that requires free water or conditions that are moister than normal (Oakley et al., 1985).

4.10.1 Wetland and Riparian Areas along the Project Area

AID typically delivers water through its system during the irrigation season between April 1 and November 1. AID may also occasionally deliver water through the system outside of the irrigation season for stock water, and water may be present as standing water following rain or snow events. Hydrophytic plants and riparian features can be found along the banks of the Main Canal within the project area as the hydrology provided by the canal can create favorable growing conditions during a portion of the year. This vegetation on the canal banks may provide habitat for wildlife in the area (see Section 4.11). However, AID actively manages vegetation in its easement as part of maintaining its canal and maintenance road; this includes periodically clearing vegetation along its canals and canal banks.

The National Wetland Inventory[11] (NWI) geographic information systems data (USFWS, n.d.) was used as a first-step approach in identifying and evaluating potential wetlands in the project area. Through an analysis of NWI data and examining aerial imagery, no potential sites were identified as Freshwater Emergent Wetlands within or adjacent to the project area that could be affected by implementation of the proposed project. At the time of writing this Plan-EA, this information has not been field-verified.

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

Wetlands are found within and sporadically adjacent to Crane Prairie Reservoir, Wickiup Reservoir, and the 111.8 miles of Deschutes River associated with District operations. The types of wetlands include marshes and wet meadows that are dominated by herbaceous plants and swamps dominated by herbaceous plants, shrubs, or trees (UDWC, 2003). Riparian areas of varying size and quality also occur adjacent to natural waterbodies associated with District operations. Low streamflow in late fall, winter, and early spring, associated with upstream reservoir storage, limit riparian vegetation in the Deschutes River (DRC, 2005). Low streamflow along these reaches can expose the channel bed and riverbanks; this increases erosion and fine sediment delivery following freeze-thaw processes and increases spring streamflow (DRC, 2005). Because streamflow is strongly correlated with critical physical and biological characteristics of the river, it influences the functions of associated riparian areas (National Research Council, 2002). As riparian areas become hydrologically disconnected from their adjacent stream channels with reduced streamflow, they lose many of their ecological functions.

[11] The NWI code uses the Cowardin classification system. For further information about Cowardin classifications, refer to *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).

4.11 Wildlife Resources

4.11.1 General Wildlife

Generally, wildlife present within the project area consists of habitat generalists or edge species with the ability to adapt to or exploit the agricultural environment. These species are tolerant to disturbance and include deer, coyote, skunk, grey squirrel, raccoon, ducks, and red-tailed hawk (Blair, 1996; Ditchkoff et al., 2006; McKinney, 2002; Shochat et al., 2006). Additional species that may be found in the project area include, but are not limited to, mice and other rodents, snakes, lizards, and various avian species (see Section 4.11.2).

Wildlife within the project area may use the canal system as a water source and dispersal corridor. Additionally, where not cleared, vegetation along the canal can provide food, cover, and breeding sites for many wildlife species throughout the year. Interaction between large ungulates and open canals sometimes results in wildlife injury or death if the animal falls into the open canal and is unable to find its way out (G. Jackal, personal communication, November 15, 2019).

4.11.2 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act Species

There are a variety of avian species with the potential to occur within the project area, some of which are protected under the Migratory Bird Treaty Act (MBTA) or the Bald and Golden Eagle Protection Act (BGEPA). Appendix E.6 includes a list of MBTA/BGEPA species potentially occurring within the project area. Although migratory birds are known to travel through the project area and its vicinity, limited habitat is provided within the project area due to AID maintenance activities that remove vegetation on an annual basis.

USFWS maintains a database of known golden and bald eagle nesting sites. One section of the project area near Horse Butte Road is approximately 0.6 mile from a golden eagle nesting area, and a second section of the project area near Knott Road is approximately 1.9 miles from a golden eagle nesting area (E. Weidner, personal communication, December 17, 2019, and February 13, 2020). Coordination with a USFWS biologist regarding MBTA/BGEPA species is ongoing (E. Weidner, personal communication, November 25, 2019, and March 2, 2022).

4.11.3 Federally Listed Species

A review of available USFWS data showed that the gray wolf (*Canis lupus*) "is known or expected to be on or near the project area" (USFWS, 2021). Although the gray wolf is listed as federally endangered throughout the species' range, which includes the project area, only two locations of known wolf activity occur in Oregon: the Rogue area in southern Oregon and areas surrounding La Grande in northeast Oregon. There is no known wolf activity in the project area (E. Weidner, personal communication, November 25, 2019; USFWS, 2021). Federally listed aquatic species are discussed in Section 4.9.2.

4.11.4 State-Listed Species

ODFW maintains a list of native wildlife species in Oregon that have been determined to be either threatened or endangered according to criteria set forth by OAR 635-100-0105 (ODFW, 2021). There are no state-listed terrestrial wildlife species known to occur within the project area.

4.12 Wild and Scenic Rivers

The affected environment for Wild and Scenic Rivers includes two sections of the Deschutes River that are part of the federal Wild and Scenic Rivers system (PL 90-542; Wild and Scenic Rivers Act, 2020):

- The Deschutes River from Wickiup Reservoir (RM 226.8) to the Bend UGB at the southwest corner of Section 13, T18S, R11E (approximately RM 172.0) is classified as Scenic[12] and Recreational[13] with Outstandingly Remarkable Values (ORVs) including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, and Vegetation. This section of the Deschutes River has no sections classified as Wild (USDA, 1996).

- The Deschutes River from Odin Falls (RM 139.9) to the upper end of Lake Billy Chinook (RM 120.0) is classified as Scenic with its ORVs including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, Hydrology, Botanical/Ecological, and Wilderness (U.S. Department of the Interior Bureau of Land Management [BLM], 1992).

Two maps of the Wild and Scenic reaches are provided in Appendix C. Additional information regarding the ORVs is provided in Appendix E.7.

The overall goals of the Wild and Scenic River Management Plans (USDA, 1996; BLM, 1992) are to maintain the current character of the river area and provide long-term protection and enhancement of its ORVs. Additional goals include protecting and enhancing instream and land-based biological, cultural, and physical resources and providing for appropriate recreational use and public access while maintaining the wild and scenic nature of the river (USDA, 1996; BLM, 1992).

The AID diversion is located on the Deschutes River at RM 174.5. This section of the Deschutes River is classified as a Scenic River Area. Within this area, all new structures, improvements, and development shall comply with the Land Management Rules as described in OAR 736-40-035 and OAR 736-40-040(1)(b)(B).

In addition to the federally designated Wild and Scenic River sections, several reaches of the Deschutes River within the area associated with District operations are designated Oregon State Scenic Waterways (ORS 390.826). These locations, with specific exclusions and classifications, are detailed in Table 4-9.

[12] The section from the north boundary of Sunriver to Lava Island Camp is classified as Scenic: "those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads" (USDA, 1996).

[13] The section from Wickiup Dam to the northern boundary of Sunriver and the section from Lava Island to the Bend UGB are classified as Recreational: "those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past" (USDA, 1996).

Table 4-9. Designated Oregon Scenic River Waterways Associated with District Operations.

Waterbody	Classification	Reach
Upper Deschutes River	Scenic River Area[1]	From RM 224.5 to RM 204.0, except for Pringle Falls (RM 217.5 to RM 216.5)
	Scenic River Area	From the Deschutes National Forest boundary in Section 20, T19S, R11E (approximately RM 184.8) to the Bend UGB (approximately RM 172.0)
	River Community Area[2]	From RM 226.4 to approximately RM 224.5; from RM 217.5 to RM 216.8; from RM 204.0 to about RM 199.0; and from RM 172.0 to RM 171.0
	Recreational River Area[3]	From RM 190.6 to approximately RM 184.8
Middle Deschutes River	Scenic River Area	From Deschutes Market Road (approximately RM 157.0) to the south boundary of the Wilderness Study Area (approximately RM 131.0), except for the Clines Falls Dam and powerhouse between State Highway 126 Bridge (RM 144.9) and RM 144.0 and the Crooked River Ranch River Community Area (RM 129.9 to RM 131.5)
	River Community Area	From RM 164.0 to approximately RM 161.0; from RM 131.5 to RM 129.9; and from RM 125.25 to RM 124.3
	Recreational River Area	From the northern Bend UGB (RM 161.0) to Tumalo State Park (RM 158.0)
	Natural River Area[4]	From the south boundary of the Wilderness Study Area at approximately RM 131.0 to Lake Billy Chinook (RM 120.0), except for RM 129.9 to RM 131.5

Source: ORS 390.826
RM = River Mile; UGB = Urban Growth Boundary
[1] Those designated scenic waterways or segments with related adjacent lands and shorelines still largely primitive and largely undeveloped, except for agriculture and grazing, but accessible in places by roads. These classified areas will be administered to maintain or enhance their high scenic quality, recreational value, and fishery and wildlife habitat, while preserving their largely undeveloped character and allowing continuing agricultural uses.
[2] Those designated areas of a scenic waterway where density of structures or other developments already exist and preclude application of a more restrictive classification.
[3] Those designated scenic waterways that are readily accessible by road or railroad and that allow a wide range of compatible, river-oriented, public, outdoor-recreation opportunities to the extent that these do not substantially impair the natural beauty of the scenic waterway or diminish its aesthetic, fish and wildlife, scientific, and recreational values.
[4] Those designated scenic waterways that are generally inaccessible except by trail or the river with related adjacent lands and shorelines essentially primitive. These classified scenic waterways will be administered to preserve their natural, wild, and primitive condition, essentially unaltered by the effects of humans, while allowing compatible recreational uses, other compatible existing uses, and protection of fish and wildlife.

4.12.1 Ecosystem Services

The Wild and Scenic Deschutes River provides the following ecosystem service:

Cultural service, Culturally important natural areas (see E5 on Figure 4-1): People's values for natural areas may arise from personal use (i.e., enjoying the area for recreation, scenic quality, or the environmental value it provides), personal beliefs and moral ethics (i.e., believe protecting a natural area is the right thing to do), altruism (i.e., believing a resource should be protected so that others can use it or benefit from it), and/or a desire to bequest the resource (i.e., believing a resource should be protected for future generations). Similar to the conservation of special status species, to many residents of Central Oregon, the conservation of the Deschutes River has come to represent the restoration of the Deschutes River ecosystem.

5 Alternatives

5.1 Formulation Process

The Preliminary Investigative Report published during scoping considered multiple alternatives. The formulation of alternatives followed the Council on Environmental Quality's regulations for implementing NEPA and requirements of the PR&Gs. Scoping comments were also incorporated into the alternatives formulation process.

When formulating an alternative, it was first determined whether the alternative met the project purpose and need (see Section 2) and if it met the PR&G requirement of achieving the Federal Objective (see Section 2) and Guiding Principles (see Appendix E.8). The alternative was further analyzed for four criteria: completeness, effectiveness, efficiency, and acceptability (USDA-NRCS, 2017a; see Appendix D.2). The following alternatives were initially considered during formulation but were eliminated from further analysis because they did not meet the formulation criteria: conversion to dryland farming, fallowing farm fields, market-based approaches to include voluntary duty reduction, exclusive or partial use of groundwater, on-farm efficiency upgrades and piping private laterals, and the Piping Alternative with sections of open canal. Appendix D.2 provides further description of the alternatives eliminated during formulation.

5.2 Alternative Eliminated from Detailed Study

The following subsection describes an alternative that met the formulation criteria but was not analyzed in detail as a viable alternative after further consideration.[14]

5.2.1 Canal Lining

Under the Canal Lining Alternative, the bottom and sides of 11.9 miles of the Main Canal would be covered with a geomembrane liner and shotcrete to prevent water from seeping into the underlying soils and rock. This alternative would require earthwork with heavy equipment to modify and reshape the existing canal bed to accommodate the lining material. Earthwork would involve removing sharp volcanic rock from the bed of the canal and shaping and smoothing the sides of the canal to ensure that the slope meets NRCS engineering standards (USDA-NRCS, 2017b). Currently, the side slope in some areas of the canal is too steep to meet NRCS engineering standards (USDA-NRCS, 2017b).

After reshaping the canal, a geomembrane liner would be installed to cover the bottom and sides of the canal.

Trees and other vegetation within approximately 7 feet of the edge of the canal on both sides would be removed to install the membrane. An anchor trench approximately 1 foot wide by 1 foot deep would be dug along the canal approximately 7 feet beyond the edge of the canal. The liner would

[14] Alternatives that do not address the purpose and need for action, do not achieve the Federal Objective (Section 2) and Guiding Principles (Appendix E.8), or become unreasonable because of cost, logistics, existing technology, or social or environmental reasons may be removed from consideration (NWPM 501.37; NRCS, 2015a; NRCS, 2017a).

extend from the canal edge into the trench where the liner would be covered and weighted by fill material to anchor the liner in place. Finally, a layer of shotcrete would be applied on top of the geomembrane liner in the canal. The shotcrete would be 6 inches thick to protect the liner from freeze-thaw movement and damage from animals and debris.[15]

This alternative would increase water velocity in the canal because the shotcrete cover would be a smoother surface than the existing underlying rock and dirt (Scoby, 1939). The smoother surface would make the sides of the canal slippery, and the increased water velocity and decreased friction could make it and more difficult for anyone who might accidently fall in the water to be able to climb out.

The Canal Lining Alternative would meet the project purpose of conserving water. Water loss in a lined system where the geomembrane liner is covered with a shotcrete cover is estimated to be 5 percent based on studies of canal lining (Swihart & Haynes, 2002).[16] Therefore, lining would reduce water loss from seepage in the Main Canal by up to 95 percent or approximately 10,529 acre-feet annually (see Appendix E.4 for information on how water loss was calculated). Lined canals, however, are vulnerable to tears or cracks in the lining even with a shotcrete cover. Seepage from torn or cracked lined canals is similar to that from unlined canals. The alternative would not meet the project purpose of improving public safety because the canal would still be open and accessible to the public.

Canal lining has a varying lifespan and can require extensive maintenance to continue operating at high efficiency (Swihart & Haynes, 2002). For example, cracks in the shotcrete are likely to develop in the first few years following installation due to freeze-thaw cycles and would require a regular maintenance program to seal the cracks. The District would likely need to hire an extra field staff person for this maintenance, which would include sand blasting, removal of vegetation, and patching the cracks with sealant. This maintenance would require equipment purchases, appropriate training, and recurring materials costs. Additionally, the District would need to continue to remove debris (primarily pine needles and cones) from the canals to prevent blockages and flooding. Due to these additional costs, this alternative assumes a 25 percent increase in equipment, maintenance, and labor costs as compared to AID's current operating budget (S. Johnson, personal communication, November 15, 2021).

In cooperation with the Bureau of Reclamation (Reclamation), the District lined ten 500-foot-long sections of canal with different lining technologies in 1991 and 1992 as part of the Deschutes Canal-Lining Demonstration Project. Reclamation revisited the test sites periodically to inspect their

[15] Shotcrete thickness was recommended by Kevin Crew, P.E., of Black Rock Consulting based on experience and climate in Central Oregon (K. Crew, personal communication, November 29, 2021). This assumption also aligns with NRCS Conservation Practice Standard 468, Lined Waterway or Outlet (USDA-NRCS, 2017b).

[16] Swihart and Haynes (2002) estimated 5 percent water loss in AID's lined canals in 1998, 6 years after the lining was installed. However, based on existing widespread cracking in the shotcrete cover and holes in the geomembrane liner, current rates of seepage are likely greater. To be conservative, a 5 percent water loss (as compared to the Piping Alternative) was used to calculate potential water savings.

condition. The most recent inspection occurred in 2017—25 years after lining installation. Of the 10 sites, 5 were considered failed and 5 were considered in excellent condition (Baumgarten, 2019). The study did not conduct a water loss assessment.

However, in 2021, 30 years after lining installation, AID determined that the five lined sections considered to be in excellent condition in 2017 have degraded at an accelerated pace and that their lining is no longer effective at conveying water (see Appendix D.3 for photos of the existing lined sections). There is widespread cracking in the shotcrete above and below the waterline. In some areas, the shotcrete is broken in pieces, leaving the underlying membrane exposed. In other areas, there are holes in the exposed lining where silt and sediment has collected, forcing the lining upward and impeding water flow in the canal. Many low-lying areas within these five lined sections do not retain water in the non-irrigation season; this indicates water loss due to seepage. AID determined that many test sections would require significant maintenance or complete replacement of the shotcrete and liner.

Based on the findings from the Reclamation 25-year report and the AID's experience, the design life for the Canal Lining Alternative was estimated to be approximately 30 years. A 30-year design life would require full replacement of the geomembrane liner and shotcrete after every 30 years. These expenses would be the responsibility of AID and its patrons and would likely exceed the AID's financial resources.

The initial capital costs of canal lining were estimated based on the size of the existing open canal, earthwork to reshape the canal, materials, and installation of the liner and shotcrete. The estimated capital cost for canal lining is $40,853,000.

The estimated capital costs, replacement costs, and annual O&M costs are $77,629,000 (2022 dollars) over 100 years. Based on this cost, canal lining was eliminated from further study (see Appendices D.3 and D.4 for cost details and assumptions).

5.3 Alternatives Description

Of the project alternatives that were considered for AID's Infrastructure Modernization Project, two were selected for further evaluation and are discussed in the following sections. These alternatives include only AID-owned infrastructure.

5.3.1 No Action Alternative (Future without Federal Investment)

Under the No Action Alternative, AID would continue to operate and maintain its existing system in its current condition. This alternative assumes that modernization of the rest of the AID system would not be reasonably certain to occur. The No Action Alternative is a near-term continuation of AID standard operating procedures under the HCP requirements. See Appendix E.4.8 for further description of what the instream flows would be under the HCP.

The No Action Alternative would not meet the project purpose and need. There would be no improvement to water loss from seepage in District infrastructure, water delivery reliability for patrons, public safety, or streamflow and habitat conditions for fish and aquatic species. Since no water would be conserved or permanently allocated instream, the No Action Alternative would not achieve the Federal Objective to protect the environment. Similarly, the No Action Alternative would not accomplish the Healthy and Resilient Ecosystem Guiding Principle or the Sustainable Economic Development Guiding Principle (USDA-NRCS, 2017a).

5.3.2 Piping Alternative (Future with Federal Investment)

Under the Piping Alternative, federal funding through PL 83-566 would be available, and AID would pipe 11.9 miles of its Main Canal and install SCADA in two locations (see Figure 5-1). Pipe would range in diameter from 48 to 60 inches, and 88 District turnouts would be upgraded to pressurized delivery that would include a meter (Crew, 2017). Pipe would be laid in the existing canal alignment. The proposed project would not modify the District's existing flume; piping would stop about 1,600 feet from the flume (see Figure 5-1).

A concrete check and pipe inlet structure would be installed at the inlet of the pipe (i.e., the western end of the pipe). The inlet structure would begin with a concrete waterway that is approximately 15 feet long and 17 feet wide. The inlet structure would also include a headwall at the pipe inlet that would be approximately 20 feet wide by 1 foot thick. The waterway and headwall would be approximately 10 feet tall; most of the structure would be situated belowground. Approximately 1 to 2 feet of the concrete structure would be visible aboveground.

To eliminate the potential for overflows, which could occur at the inlet of the pipe due to changes in irrigation demands that may not balance with diversion flows, AID would install SCADA improvements to remotely monitor flows. SCADA would be installed at the inlet of the pipe and at the terminus of the pipe (see Figure 5-1). At both locations, a flow-measuring device and SCADA components would be installed for remote monitoring. These components could include a water-level sensor, programmable logic controller, solar charging station, and radio controller. The programmable logic controller would be protected by an enclosure. The radio controller would report measurements to a computer at the AID office with SCADA software. The programmable logic controller (within the enclosure), solar charging station, and radio controller are expected to require no more than a 5-foot by 5-foot area adjacent to the canal. The tallest piece of equipment would be the radio controller's antenna, which could be 10 to 20 feet tall depending on the topography and line of sight between the SCADA sites to the District office.

Construction of the Piping Alternative would occur over 6 years in four phases. Each phase would take 2 or 3 years to complete with some construction phases overlapping in years (i.e., in 2023 construction would finish on Phase 1 and start for Phase 2). See Section 8.7.2 for a map and estimated timeline of the construction phases. Construction would start on the eastern end of the Main Canal with Phase 1 and generally move toward the west. Construction activities would be limited geographically to one or two phases at a time. Construction would be conducted during the non-irrigation season (October to April), and construction would begin as early as the 2022 non-irrigation season.

Pipe installation would require storage areas for pipe, construction equipment, and other materials. Areas that are within existing District ROW and easements, which have been previously disturbed, and that are accessible through existing access routes would be used when possible. The project area would be accessed from AID's existing maintenance road within the AID ROW. Limited sections of the existing maintenance road may require some improvements for use during construction. During the project, this road would be used primarily by the project contractors for construction of the phase for that area. A particular section of the maintenance road may be used to access another phase if that is the closest and most accessible area for the type of equipment or material that is needed for continued construction. After the project is complete, AID would continue to use the maintenance road for ongoing operation and maintenance.

The area disturbed during construction would be minimized to the extent practicable. While all construction would occur within existing AID ROW and easements, where practicable, construction would not occur across the full width of the ROW or easement. On the side of the canal with a maintenance road, construction is not foreseen to extend past the outer edge of the maintenance road. On this side of the canal, trees would be removed within the ROW or easement only if there were no other alternative to access the construction site, if the trees posed a safety threat to construction crews, or where the trees' roots could interfere with the pipe. On the side of the canal without a maintenance road, there would be minimal disturbance. Disturbance on the side of the canal without the maintenance road would consist of removing any trees that posed a safety threat to construction crews or trees whose roots could interfere with the pipe. No heavy equipment would be used on the side of canal without a maintenance road.

Construction of the Piping Alternative would include mobilization and staging of construction equipment, delivery of pipe to construction areas, excavation of trenches when necessary, fusing of pipelines, placement of pipe, compaction of backfill, concrete work for the inlet structure, SCADA installation, and restoration and reseeding of the disturbed areas. Pipe would be placed within the existing canal alignment and buried. The depth of cover would adhere to NRCS practice standards and backfill would be graded to meet the surrounding landscape.

Vegetation clearing before construction, vegetation and weed management during construction, and the reseeding after construction would be completed according to AID's current vegetation management practices and the NRCS *Oregon and Washington Guide for Conservation Seedings and Plantings* (USDA-NRCS, 2000).

O&M under the Piping Alternative would consist of an ongoing pipe inspection program that would systematically cover the entire system over a period of several years (most likely a 10-year cycle). During the irrigation season from April through October, maintenance work would be performed on an as-needed basis. SCADA system maintenance would occur on a regular schedule and on an as-needed basis throughout the year. Outside of the irrigation season, AID would perform system component maintenance or repairs to District meters, valves, and air and vacuum infrastructure, as well as to the inlet structure.

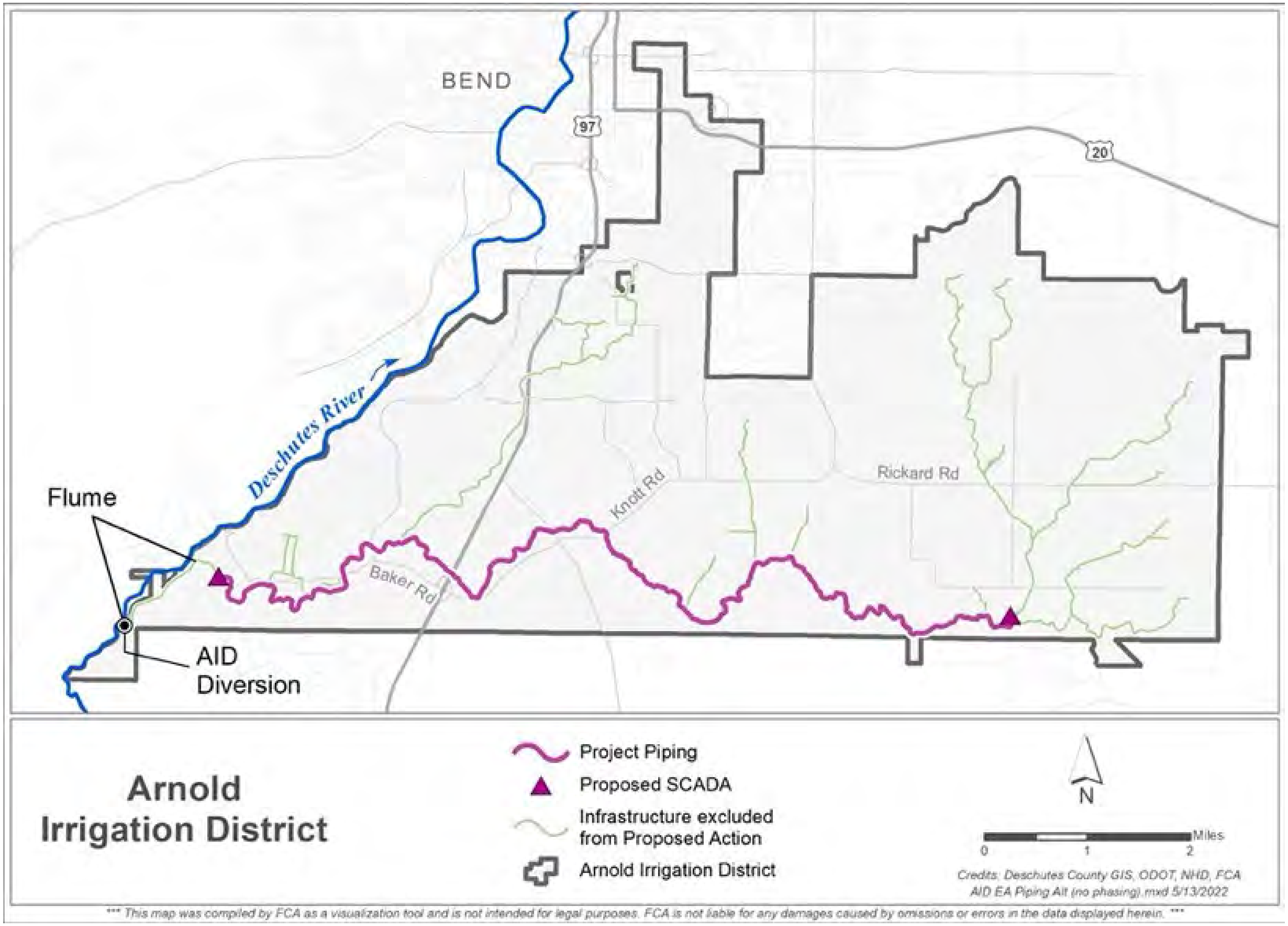


Figure 5-1. Overview of the Piping Alternative for the Arnold Irrigation District Infrastructure Modernization Project.

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

- **Improve water conservation**: This alternative would reduce water loss from canal seepage and evaporation by an estimated 32.5 cfs (11,083 acre-feet) of water throughout the irrigation season.
- **Increase water delivery reliability to patrons**: A piped system greatly increases conveyance efficiency and allows patrons to adjust their deliveries to take the amount of water that they need when they need it. This alternative would immediately improve water delivery reliability for the patrons directly served by the Main Canal including 1,475 acres of irrigated land.
- **Enhance streamflow and habitat conditions for fish and aquatic species**: Following the completion of the project and verification and measurement of the total water savings, AID would pass up to 10,862 acre-feet per year to NUID through the Deschutes River during the irrigation season.[17] In return, NUID would release an equal volume of water minus losses in the Deschutes River between the AID and NUID diversions[18] (up to 10,446 acre-feet per year) from Wickiup Reservoir into the Deschutes River during the non-irrigation season (see Section 6.8). Streamflow and habitat conditions along the Deschutes River would benefit from this protected water.
- **Improve public safety**: After completion, the project would improve public safety along 11.9 miles of the Main Canal. All open canal in the project area would be converted to buried pipe. This would decrease the risk of drowning, flooding, and other serious accidents associated with the currently open canal.
- **Reduce O&M costs**: A piped system would eliminate the need to inspect, repair, and remove obstructions from the open Main Canal. The Piping Alternative would also reduce the need for staff to manually adjust diversion amounts within the project area.

The Piping Alternative achieves the Federal Objective to protect the environment by protecting and restoring streamflow in the Deschutes River. By improving operational efficiencies and thereby conserving water and improving water quality in the Deschutes River, the Piping Alternative achieves the Federal Objective and Guiding Principle of sustainable economic development. Lastly, this alternative achieves the Guiding Principles of Healthy and Resilient Ecosystems by contributing to a more resilient ecosystem in the face of changing climate. The estimated project installation cost for the Piping Alternative would be $31,545,700. With additional project administration and

[17] AID anticipates that 100 percent of the project would be funded through PL 83-566 and other public or public-interest funding sources. If AID were to invest its own funds in the project, AID would pass an amount of conserved water in proportion to the amount of public and public-interest funding to NUID (i.e., if the project was funded with 90 percent public funding, then 90 percent of the conserved water sourced from live flow would be passed to NUID). AID would not apply to create new water rights for out-of-stream uses.

[18] Following estimations by OWRD, a 7 percent loss was accounted for in the Deschutes River between the AID and NUID diversions.

technical assistance costs, the total project cost would be $34,899,000.[19] Additional information regarding the costs and the net present value of the Piping Alternative can be found in Section 8.9 and Appendices D.3 and D.4.

5.4 Summary and Comparison of Alternatives

Table 5-1 compares the No Action Alternative (Future without Federal Investment) and the Piping Alternative (Future with Federal Investment). The table summarizes measures addressed as well as environmental, social, cultural, and economic effects.

Table 5-1. Summary and Comparison of Alternative Plans.

Item or Concern Major Features	No Action Alternative (Future without Federal Investment) Main Canal Remains Open	Piping Alternative (Future with Federal Investment) Pipe the Main Canal
Alternative Plans (alternatives are explained in USDA-NRCS [2013])		
Locally Preferred		✓
National Economic Efficiency		✓
Socially Preferred		✓
Environmentally Preferred		✓
Guiding Principles *(Checkmarks indicate that the Guiding Principles have been met.)*		
Healthy and Resilient Ecosystems		✓
Sustainable Economic Development		✓
Floodplains		Not applicable
Public Safety		✓
Environmental Justice		✓

[19] The Piping Alternative was priced using high density polyethylene as the piping material. The availability of piping materials, prices, and new products change over time. At the time of project implementation, a different piping material could be selected if the material (1) would meet the NEE requirements; (2) meet construction requirements; and (3) result in no change or a minor change to project effects described in Section 6 of this Plan-EA as determined through the decision framework outlined in Section 1.4. The NRCS state conservationist would possess the final discretion to select the appropriate piping material.

Item or Concern Major Features	No Action Alternative (Future without Federal Investment) Main Canal Remains Open	Piping Alternative (Future with Federal Investment) Pipe the Main Canal
Watershed Approach		✓
Provisioning Services – Tradeoffs		
Irrigation Water	No effect. Irrigation water diversions would remain the same.	Piping would help provide more secure and reliable irrigation water for AID patrons. The water saved from the project and passed to NUID would also support agricultural producers in NUID.
Instream Fish Species	No effect. Resident and anadromous fish populations would not be affected. Harvest of anadromous fish would continue to be available only when runs are sufficiently large to sustain fishing.	Up to 10,446 acre-feet of water released instream below Wickiup Reservoir into the Deschutes River during the non-irrigation season would have short-term beneficial effects on resident fish populations and their habitat in years 4–7 of the HCP. During the irrigation season, up to 10,862 acre-feet of water passed to NUID would secure any long-term beneficial effects on resident fish populations and their habitats in the 9.7 miles of the Deschutes River between the AID and NUID diversions.
Regulating Services – Tradeoffs		
Water Quality	No effect. Riverbanks in the winter would continue to be exposed and vulnerable to freeze-thaw cycles that facilitate bank erosion and sediment deposition into the water.	Up to 10,446 acre-feet of water protected instream below Wickiup Reservoir during the non-irrigation season would help improve water quality in the short term in years 4–7 of the HCP. The addition of this water may help to alleviate bank erosion and sediment deposition from vulnerable riverbanks.

Item or Concern Major Features	No Action Alternative (Future without Federal Investment) Main Canal Remains Open	Piping Alternative (Future with Federal Investment) Pipe the Main Canal
Temperature Regulation	No effect. The canal may continue to have potential local cooling or warming effects depending on the relative temperatures of the canal water and air temperature.	Any potential cooling or warming effect that the canal may have on the local environment would be eliminated.
Cultural Services – Tradeoffs		
Culturally Important Species	No effect on habitat supporting populations of threatened fish species. Habitat limitations for culturally significant anadromous fish would continue to affect fishing, community, health, cultural identity, subsistence, and religious tribal values.	Up to 10,446 acre-feet of water protected instream below Wickiup Reservoir during the non-irrigation season would help improve threatened fish and aquatic species habitat and populations in the short term in years 4–7 of the HCP. Improving populations would benefit cultural values such as tribal and religious values and bequest values.
Culturally Important Areas	Residents would continue to be able to hear and see the water running through the canal during the irrigation season. Any aesthetic or spiritual value that residents derive from the open canal would continue.	Residents would no longer see or hear water running through the open canal during the irrigation season. This action may have an adverse effect on the aesthetic and spiritual services that the open canal brings to some residents.
Installation Costs		
Federal PL 83-566	$0	$26,198,000
Local Only or Matching PL 83-566	$0	$8,701,000
Total	$0	$34,899,000
Average Annual Cost		
Installation [1]	$0	$838,000
OM&R [2]	$0	$14,000
Total	$0	$852,000
Annual Benefits [3]	$0	$1,699,000

Item or Concern Major Features	No Action Alternative (Future without Federal Investment) Main Canal Remains Open	Piping Alternative (Future with Federal Investment) Pipe the Main Canal
Annual Costs	$0	$852,000
Annual Net Benefits [4]	$0	$847,000
[1] The Piping Alternative's average annual cost is the additional average annual installation costs above the No Action Alternative. [2] Operation, maintenance, and replacement (OM&R) for the Piping Alternative includes an increase in pumping costs from increased depth to groundwater due to reduced recharge and associated increases in carbon and energy, as well as replacement costs from SCADA and the inlet structure. A decrease in O&M costs of the canals for the Piping Alternative was included in the benefits, rather than the costs. [3] Quantified benefits include NUID agricultural damage reduction, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, and avoided damage from failure of the open canal. [4] Annual net benefits shown for the Piping Alternative are the additional net benefits compared with the No Action Alternative.		
Regional Economic Impacts [1]		
Annual Jobs from Recreation	Not applicable	Magnitude/direction of recreation visitation impacts not known, so no benefits quantified.
Local Jobs during Construction (including direct/ indirect/induced)	Not applicable	75 (average over 6 years of construction)
Change in Annual Jobs from Agriculture (including direct/ indirect/induced)	Not applicable	40 (average over 106-year analysis period)
Beneficial Effects Annualized [1,2] (millions, 2021$)		
Region	Not applicable	$1.5
Rest of Nation	Not applicable	Some ripple income/employment effects expected but not estimated.
Adverse Effects Annualized [1,3] (millions, 2021$)		
Region	Not applicable	-$0.2
Rest of Nation	Not applicable	$0.8

Item or Concern Major Features	No Action Alternative (Future without Federal Investment) Main Canal Remains Open	Piping Alternative (Future with Federal Investment) Pipe the Main Canal

[1] 2022 Water Resources Discount Rate of 2.25 percent.
[2] Beneficial effects include only those related to labor income and do not include the net economic benefits quantified in the NEE.
[3] Includes only direct costs (no indirect/induced costs are included). Negative adverse effect annualized indicates benefit.
AID = Arnold Irrigation District; HCP = *Deschutes Basin Habitat Conservation Plan*; NEE = National Economic Efficiency; NUID = North Unit Irrigation District; OM&R = operation, maintenance, and repair; PL = Public Law

6 Environmental Consequences

This section evaluates the environmental consequences of the No Action Alternative and the Piping Alternative. The beneficial and adverse effects of the two alternatives on each resource described in Section 4 were evaluated. The intensity of an adverse effect was classified as negligible, minor, moderate, or major. The duration of an effect was classified as temporary, short-term, or long-term. Appendix E.1 presents the intensity threshold matrix used to categorize and define the range of expected effects.

6.1 Cultural Resources

6.1.1 No Action (Future without Federal Investment)

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

6.1.2 Piping Alternative

AID hired a cultural resource specialist to complete surveys for historic properties in the project area and develop a final report. As a part of this process, the surveys considered alterations to the historic viewshed that would potentially occur due to the proposed project. The final report states: "The Arnold Irrigation Canal is determined to be eligible in accordance with the National Register guidance under Criteria A and B." Furthermore, "The piping will cause an adverse effect to the canal's physical character of the Arnold Irrigation Main Canal by replacing the current inefficient delivery system wrought with a variety of issues including general water loss through trans-evaporation, seepage and system failures. The proposed piping project will have "No Effect" to the contextual integrity and National Register eligibility associated with Criteria A and B" (Stuemke 2021).

NRCS submitted the final report to SHPO on July 20, 2021 for consultation and concurrence. SHPO and the archaeological contractor hired by the District identified the flume as a major contributing factor of NRHP eligibility; thus, potential mitigation focused on the flume. As a result of these consultations and general public concern, an alternate route for piping that omitted the flume from the project was developed.

On June 21, 2022, NRCS submitted an updated description and map of the proposed project, with the flume omitted, to SHPO and requested concurrence of "no Effect". The tracking number assigned to the project was 21-0990. Per the federal regulations outlined in the NHPA, SHPO was given 30 days to review and provide comment. SHPO did not provide a response during the 30-day review period, which ended on July 20, 2022. According to the federal regulations outlined in the NHPA, NRCS has assumed concurrence of "no Effect" for the proposed project (with the flume omitted). NRCS has completed consultation with SHPO and no mitigation is required.

If archaeological resources were inadvertently discovered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop near the discovery; the area would be secured and protected; a professional archaeologist would assess the discovery; consultation with SHPO, THPO, and NRCS cultural resources staff would occur as appropriate; and consulting parties including affiliated tribes and ACHP would be notified and have the opportunity to comment. Construction would continue in accordance with applicable guidance and law.

6.2 Land Use

6.2.1 No Action (Future without Federal Investment)

The No Action Alternative would have no direct effect on land use within the project area. The Main Canal would continue to operate as an open system. Irrigated agriculture producers would continue to face increasing water supply uncertainty. Ecosystem services of water for irrigation would not be affected (see Section 6.8.1).

6.2.2 Piping Alternative

There would be no effect on land use from the Piping Alternative. Property ownership, as well as existing ROW, easements, and property lines, would not change. AID would construct the project pursuant to its existing ROW and easements. There would be no change to existing land use within or adjacent to the project area. More reliable water delivery would support existing agricultural land uses. The Piping Alternative would also have no direct effects on agricultural land served by NUID during or after construction. The water that AID would pass to NUID would support existing agricultural land use. Please see the NEE Analysis in Appendix D.1 for more information on how agricultural production would be affected by the proposed project. Ecosystem services of water for irrigation would be supported through the improvement of delivery infrastructure (see Section 6.8.2).

6.3 Public Safety

6.3.1 No Action (Future without Federal Investment)

Under the No Action Alternative, the Main Canal would remain open, and there would be no effect on public safety; the drowning and flooding risk would remain. In some areas, the risk of drowning, flooding, and other serious accidents would increase as urban and suburban areas grow within the District. Wildfire risk would remain the same.

6.3.2 Piping Alternative

During construction of the Piping Alternative, public safety would be affected by vehicle and heavy equipment traffic entering and leaving the project area. Construction traffic could interact with motor vehicles, pedestrians, and bicyclists traveling through farmlands and urban and suburban zones along U.S. Highway 97, as well as along county and community roads that intersect the project area. Standard safety protocols and BMPs would be followed during construction to minimize any risk to public safety; therefore, a minor short-term effect on public safety is anticipated during construction because effects on public safety would only occur in the project area where construction would occur.

Once fully completed, the Piping Alternative would eliminate the drowning risk from the open Main Canal in the project area because it would be converted to buried pipe. This alternative would also decrease any potential flooding risk from canal breaches and sinkholes within the project area, and the durability of the pipe would increase seismic resiliency. The Piping Alternative would therefore result in beneficial effects on public safety because drowning would no longer be possible in the project area and there would be a decrease in flooding risk within the project area.

Construction would take place during the non-irrigation season when wildfire risk is low. Additionally, any burn bans or other restrictions based on wildfire hazard potential would be followed as appropriate. The fire protection district's primary source of water for fighting fires are hydrants; therefore, access to the primary source of water would not be affected. Ponds, canals, and cisterns are used as secondary water sources. Following completion of the proposed project, the piped Main Canal would no longer be available as a secondary source of water; however, ponds, cisterns, and water traveling through the non-piped sections of the District would remain available as secondary sources of water.

Over time, there has been a buildup of fuels and vegetation has been allowed to become overgrown in the broader landscape surrounding the project area (L. Medina, personal communication, November 12, 2021). The conversion from canal to a buried pipe would result in a narrow vegetated corridor. This vegetated corridor would represent a small area when compared to the broader landscape. Because native grasses and forbs would be used for revegetation, there would not be an increase in the level of fuel available for a wildfire (L. Medina, personal communication, November 12, 2021). Additionally, the fire protection district does not consider the canal a fire beak; therefore, the proposed project would not affect this aspect of wildfire risk (L. Medina, personal communication, October 21, 2021).

During construction, some trees within the AID ROW and easements would have to be removed, which could contribute to defensible space. After construction, based on results of previous piping projects, well-established trees that previously relied on canal water within the project area are expected to survive with active irrigation by the property owner. If trees were to die within the AID ROW or easements and create a safety hazard, AID would remove the hazard trees at its discretion (see Section 6.6.2 for more information). Implementation of the proposed project would not affect a property owner's ability to remove vegetation and trees on their property to maintain defensible space around their house.

Effects of the proposed project as it relates to wildfire are expected to be similar to the other piping projects that have been completed in the area. The fire protection district has indicated that removal of the canal would not create an additional burden on its ability to fight fire and would not increase wildfire risk (L. Medina, personal communication, November 12, 2021). Because this project would have no effect on the ability to fight fires and would not contribute to an increased risk of a wildfire occurring, the proposed project would have no effect on public safety as it relates to wildfire.

6.4 Socioeconomic Resources

To estimate the total economic effects of the No Action Alternative and Piping Alternative in terms of jobs and income supported, this analysis used an IMPLAN (2017) economic impact model of Oregon's Deschutes, Jefferson, and Crook counties.[20]

6.4.1 No Action (Future without Federal Investment)

Under the No Action Alternative, no construction expenditures are anticipated, although some maintenance and repair activities associated with canal breaches may be required (these are not quantified due to uncertain and sporadic nature). No increases in agricultural production are anticipated under the No Action Alternative.

6.4.2 Piping Alternative

Implementation of the Piping Alternative would have a beneficial effect on employment and income in Deschutes County from construction activities, as well as a beneficial effect on agricultural production and related farm household income in Deschutes, Jefferson, and Crook counties. The proposed project would have no effect on any environmental justice communities.

Within the watershed planning area, although property values may be higher when adjacent to an open canal, based on NRCS analysis there was not sufficient market evidence or literature to demonstrate that property values would decrease with the proposed project (see the NEE Analysis in Appendix D.1 and Appendix E.12 for more information).

6.4.2.1 Regional Economic Development

The Piping Alternative construction expenditures of $34.9 million would support construction sector jobs and income, as well as economic ripple effects increasing jobs and income in other economic sectors in Deschutes and neighboring counties. The $34.9 million in construction expenditure would support approximately 75 jobs and $3.4 million in average annual income over the 6-year construction period. Annualized over 106 years, this equates to approximately $0.5 million in annualized average income benefits. Of these impacts, approximately 50 jobs and $2.4 million in annual income are in the construction sector (direct impacts) while the remaining 55 jobs and $1.0 million income are in other sectors.

Water conserved through piping would be passed on to NUID starting in year 6 where it would decrease agricultural damages associated with irrigation water shortages. Water conservation under the Piping Alternative is expected to enhance agricultural productivity in NUID. Annualized average regional economic effects in Jefferson County and neighboring Crook and Deschutes counties are estimated at approximately 40 jobs and $1.0 million in income annually.

The Piping Alternative would also enhance operational flexibility and water reliability in AID, thereby reducing the likelihood of agricultural damages in AID. However, as the increased water

[20] Total construction expenditures were modeled in IMPLAN Construction Sector 57—construction of new commercial structures including farm structures (IMPLAN, 2017).

supply is relatively small and the likelihood of water supply disruptions in the No Action Alternative are not known, this economic development benefit is not quantified.

6.5 Soils

6.5.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be negligible long-term effects on soils because erosion would continue to occur within the open canal. Continued operation of the District's system would have no effects on prime farmlands.

6.5.2 Piping Alternative

Under the Piping Alternative, soils would be disturbed, vegetation would be cleared, and backfilling and grading would occur in the project area. Clearing, compaction, and construction would increase soil erosion and sedimentation potential. During construction, soils adjacent to the canal would be impacted due to equipment access and staging. Excavation for pipe placement would occur primarily in the existing canal.

BMPs would be implemented throughout the project area to minimize erosion and contain runoff onsite. These could include the installation of silt fencing and straw bales, sequestering of any and all concrete placements and concrete truck cleanouts, and limiting equipment access to existing roads except for strategic access points. To the extent practicable, the upper 2 feet of surface materials and rock would be stored beside the construction impact areas and replaced upon the completion of construction. Existing maintenance roads within AID ROW and easements would provide access to the project area. After construction, disturbed soils would be recontoured and reseeded with a mix of native grasses and forbs in consultation with NRCS.

Overall, minor short-term effects on soils are anticipated because BMPs would be in place, effects would be localized to the project area where construction would occur, and effects would only occur during construction. Over the long term, soil erosion would be reduced where buried pipeline would replace open canal.

6.5.2.1 Farmland Classification

No long-term effect would be expected on any federal or state-level farmland designations. Minor temporary effects on limited amounts of agriculturally important soils would be expected during construction in the project area, but adherence to BMPs would minimize these effects. There would be a beneficial effect on farmlands in AID and NUID in the long term due to improved irrigation water delivery reliability.

6.6 Vegetation

6.6.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be no effect on vegetation. Vegetation associated with the open irrigation canal would persist, and adjacent native upland vegetation would remain in its current condition.

6.6.2 Piping Alternative

6.6.2.1 General Vegetation

During construction, existing maintenance roads within the ROW and easements would provide access to the project area. Selection of construction areas adjacent to the canal would consider existing vegetation and avoid mature trees to the extent practicable.

Prior to construction, AID would survey and identify trees greater than 2 feet in diameter within its ROW and easement. These trees would be flagged for avoidance during construction. The width of the construction area would be clearly flagged along both sides of the canal prior to beginning construction to ensure that construction would stay within these boundaries (see Section 5.3.2 for more information regarding this footprint).

During construction, herbaceous, shrub, and woody vegetation within the flagged construction area would be disturbed through activities such as clearing, crushing, and digging. Tree removal would be avoided to the extent practicable with special priority given to retaining trees greater than 2 feet in diameter. Trees would be removed only if they prevented construction activities from occurring, if they posed a safety threat to construction crews, or if their roots would interfere with the pipe.

After construction, the project area would be recontoured and planted with a seed mix of native grasses and forbs (see Figure 6-1 and Figure 6-2). Planting would be conducted in consultation with NRCS. Vegetation within the ROW and easements would transition to entirely upland species similar to the natural vegetation found in the high desert region where the project area is located.

Some trees and vegetation within and adjacent to the project area may depend on water seeping from the canal, and these trees and vegetation may not survive following implementation of the Piping Alternative without active irrigation by property owners. Following the construction of the proposed project, property owners may water trees and vegetation on their properties with water to which they have a legal right (e.g., municipal water, irrigation water). However, prior experience from piping the nearby Bend Feed Canal in Tumalo Irrigation District showed that the majority of well-established trees survived even without active irrigation by property owners (Reclamation, 2010).

If trees were to die within AID's ROW or easements and create a dead snag that is a safety hazard, AID would remove safety hazard trees at its discretion. On the side of the canal without a maintenance road, AID would limit this removal to trees located approximately 10 feet from the edge of the canal. On the side of the canal with a maintenance road, AID would limit this removal to trees located within a few feet of the non-canal side of the maintenance road.

Figure 6-1. A section of nearby Tumalo Irrigation District's Bend Feed Canal after a piping project.

Source: DRC, 2013

Figure 6-2. A section of nearby Tumalo Irrigation District's Bend Feed Canal after piping.

In the long term, native vegetation would be gained because 11.9 miles of open canal would be piped and then covered with topsoil and seeded. Revegetation practices would follow the NRCS *Oregon and Washington Guide for Conservation Seedings and Plantings* (USDA-NRCS, 2000). Trees would not be allowed to establish above the buried pipe because roots may interfere with future O&M activities.

Overall, the implementation of the Piping Alternative would have a minor long-term effect on vegetation including trees. Although some trees in the project area would be removed during construction, and other trees reliant on canal seepage located near the canal may not survive following construction if seepage is eliminated, the number of trees affected would be proportionally small compared to the number of trees in the surrounding landscape and broader geographic area. Please see the NEE Analysis in Appendix D.1 for additional discussion of trees. During construction, effects on vegetation and trees would be localized to the project area. After construction, effects would be localized to the project area and adjacent properties. BMPs would be implemented before and after construction to minimize effects (e.g., revegetation; additional BMPs are identified in Section 8.3).

6.6.2.2 Noxious Weeds

During construction, exposed soils would create areas temporarily susceptible to weed establishment. The movement of construction vehicles could provide opportunities to transport weeds to new locations. The contractor would use BMPs such as avoiding unnecessary ground disturbances and using erosion-control measures that are free of weeds and weed seeds.

After construction, weeds would be managed according to the protocol in the NRCS *Oregon and Washington Guide for Conservation Seedings and Plantings* (USDA-NRCS, 2000). The closed system would no longer present an opportunity for aquatic noxious weeds to grow or be washed to other areas of the District.

Implementation of the Piping Alternative would have a negligible short-term effect on noxious weeds because the spread of noxious weeds during construction would be controlled through BMPs. Over the long term, there would be a beneficial effect because the conversion to a piped system would reduce the spread of noxious weeds through the open canal system.

6.7 Visual Resources

6.7.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be no effect on visual resources.

6.7.2 Piping Alternative

Under the Piping Alternative, construction activities would take place during the non-irrigation season. The Piping Alternative would be constructed in phases; therefore, visual disruptions associated with construction would be limited to the phase or part of the phase that was under construction. Construction activities, such as the use of heavy equipment or pipe laying, would be visible to residents and motorists adjacent to the project area. Visual disruptions from District machinery and trucks occur in the project area when the District is running water during the irrigation season and conducting canal maintenance during the non-irrigation season; they are not an uncommon feature in the landscape.

In residential areas where the open canal is adjacent to the backyards of houses, construction activities would be temporarily pronounced. However, effects would be minimized through BMPs such as limiting construction to daytime hours (see Section 8.3). Construction activities would be less pronounced in the segments of the project area that pass through agricultural land because there are fewer residences with a direct view of the canal in those areas.

During construction, vegetation clearing would be minimized to the extent practicable (see Section 5.3.2 and Section 6.6.2 for more information). Landscaping would not be disturbed outside of AID ROW or easements. Where practicable, construction would not occur across the full width of the ROW (see Section 5.3.2 for more information). Disturbance to existing mature trees would be minimized to the extent possible, and trees would be removed on an individual basis if necessary. See Section 6.6.2 for more information about potential effects on vegetation and trees.

After construction, the pipe would be buried and not visible. The low-lying concrete pipe inlet structure would be visible to residences adjacent to the structure at the western end of the pipe. The two SCADA locations, which would each include a small enclosure and a radio antenna, would be visible from neighboring properties (see Section 5.3.2 for approximate dimensions of the inlet structure and SCADA system). Areas adjacent to the canal would be restored to near-prior contours, and the area over the pipe would be graded to blend with the surrounding landscape. Disturbed areas, including those areas above the newly buried pipes, would be planted with a seed mix of native grasses and forbs in consultation with NRCS.

The view of the project area would change from an open canal (with or without water depending on the season) to a corridor of native upland vegetation in areas where construction took place. Figure 6-1 and Figure 6-2 show examples of revegetated corridors in neighboring districts. In areas where it would be necessary to remove trees, there would be a decrease in the number and density of trees. While property owners adjacent to the project area would lose any individual trees removed during construction, the other trees present in the area and the habitat that they provide would not be lost.

Overall, the Piping Alternative would have a moderate long-term effect on visual resources. The visual change would be localized to properties adjacent to the project area. Following construction and revegetation, the revegetated corridor would blend in with the natural landscape.

6.8 Water Resources

6.8.1 No Action (Future without Federal Investment)

6.8.1.1 Water Rights

Under the No Action Alternative, there would be no effect on water rights; AID would maintain its existing water rights. A portion of the water diverted at the AID diversion would continue to seep from the open canal into the ground before reaching any farms. Concerns regarding water availability for agriculture in NUID would not be addressed. Concerns regarding water availability for agricultural use in AID during dry and very dry years would not be addressed.

6.8.1.2 Surface Water Hydrology

Under the No Action Alternative, conversion of the AID open Main Canal to a modernized, piped system would not be reasonably certain to occur. There would be no effect on water resources in waterbodies associated with District operations (see Table 4-7). Water loss due to seepage and evaporation would continue in the Main Canal, and AID would continue to divert water at rates and in volumes that account for those losses. No additional water would be available to NUID.

6.8.1.3 Surface Water Quality

The No Action Alternative would have no effect on surface water quality in the waterbodies associated with District operations (see Table 4-7).

6.8.1.4 Groundwater

The No Action Alternative would have no effect on groundwater in the planning area or the upper Deschutes Basin. Approximately 11,083 acre-feet of water would continue to seep from the Main Canal annually into the surrounding area.

6.8.1.5 Ecosystem Services

The No Action Alternative would not affect ecosystem services associated with water resources.

Provisioning service, Water available for irrigation (see E1 on Figure 4-1): Under the No Action Alternative, there would be no effect on irrigation water because the amount of irrigation water diverted from the Deschutes River by AID would largely remain the same.

Regulating service, Water quality (see E3 on Figure 4-1): Under the No Action Alternative, the quality of water remaining instream during the irrigation season downstream of the AID diversion would not be affected.

Cultural service, Culturally important areas (see E5 on Figure 4-1): Under the No Action Alternative, the aesthetic and spiritual enjoyment that the open canal brings to some residents would not be affected. Residents would continue to be able to hear and see the water running through the canal during the irrigation season.

Regulating service, Temperature regulation (see E6 on Figure 4-1): Under the No Action Alternative, the canal may continue to have potentially small, localized cooling or warming effects on areas adjacent to the canal depending on the relative temperatures of the canal water and air temperature.

6.8.2 Piping Alternative

6.8.2.1 Water Rights

Under the Piping Alternative, AID patrons' water rights would not change. AID would incrementally reduce its maximum live-flow diversion rate by the amount of live-flow water saved from piping each construction phase (see Section 8.7 for a map of construction phases). The proposed project is estimated to save a total of 11,083 acre-feet annually. However, hydrological modeling used for the HCP predicts that, on average, 2 percent of AID's future water supply will rely on storage water in Crane Prairie Reservoir (AID et al. 2020). To be consistent with the hydrological model predictions, the District would reduce its maximum live-flow water right by 98 percent of the total water savings associated with the proposed project (10,862 acre-feet per year out of a total water savings of 11,083 acre-feet per year). AID would bypass this saved live-flow water in the Deschutes River for diversion downstream by NUID under NUID's existing water rights. The remaining 2 percent of total water savings, an estimated 222 acre-feet per year that would be expected to be sourced from stored water per HCP projections, would be used by AID to ensure water availability for its patrons.

In some seasons, AID has not historically diverted the full rate available under its water rights. For example, while AID is allowed to divert up to 150 cfs during season 3 under its water rights, AID has historically diverted a lower rate (see Table 4-5 in Section 4.8.1 for season dates and Appendix E.4 for AID historical diversion rates). Under the Piping Alternative, AID would identify 118 cfs as a pre-project operational maximum rate as a starting point from which AID would reduce its diversion during these seasons (S. Johnson, personal communication, February 9, 2022).

AID has identified a pre-project operational maximum diversion rate of 106 cfs in season 2 and 118 cfs in season 3 (S. Johnson, personal communication, February 9, 2022). AID would work with OWRD to adjust AID water rights certificates to match these rates after the following actions have been completed: NRCS has authorized the Plan-EA; AID has secured match funding for Phase 1; and construction has been completed on Phase 1.

AID would reduce its diversion rates following the completion of each phase of construction to bypass live flow to NUID. If regulatory calls were issued on AID's live-flow water rights, AID would reduce both its live-flow diversion rate and the rate of live flow bypassed to NUID in equal proportions. For example, if a regulatory call required AID to reduce its live-flow diversion rate by 10 percent, then AID would also reduce the rate of water bypassed to NUID by 10 percent. AID would not bypass any stored water to NUID. Hydrologic modeling suggests that regulatory calls on AID's live-flow water rights may occur more frequently in the future due to the implementation of the HCP (AID et al., 2020).

Once water passes the AID diversion, a portion of the 10,862 acre-feet per year passed to NUID would be lost to seepage in the Deschutes River channel between AID and NUID diversions. Approximately 3.8 percent of this water, or up to 416 acre-feet[21] annually, would be lost to seepage, and approximately 96.2 percent of the water, or up to 10,446 acre-feet annually, would reach the NUID diversion (K. Gorman, personal communication, December 15, 2020). As noted above, regulatory calls may reduce the amount of water bypassed by AID and available to NUID during any given year.

Under this alternative, water bypassed to NUID would assist NUID in fulfilling its patrons' existing water rights throughout the irrigation season (up to 10,446 acre-feet per year). There would be no effect on AID patrons' certificated rate and duty. This alternative would provide additional live flow to NUID's patrons and reduce NUID's dependence on water stored in Wickiup Reservoir to fulfill its water rights. Following the completion of each phase, AID would work with OWRD and its partners to verify and measure all water savings prior to increasing the amount of water bypassed to NUID. AID and NUID would work with other irrigation districts in the Basin and OWRD to ensure water bypassed for NUID is protected for NUID use.

[21] Totals may not sum due to rounding.

When the availability of live flow decreases throughout the irrigation season, AID uses water stored in Crane Prairie to supplement patrons' water supply. Live flow availability may decrease during an irrigation season due to seasonal streamflow declines. Live flow availability may also decrease in the future due to the implementation of the HCP (see above).

When AID diverts both Deschutes River live flow and water released from Crane Prairie Reservoir, the water saved through the proposed action would consist of both Deschutes River live flow and of storage water released from Crane Prairie Reservoir. AID would only bypass Deschutes River live flow to NUID. The portion of the water savings consisting of water released from Crane Prairie Reservoir would be available to AID patrons under their existing water rights (up to 222 acre-feet per year).

Hydrologic modeling projected the frequency and magnitude of which AID would divert water released from Crane Prairie Reservoir following the implementation of the HCP (AID et al., 2020). Modeling suggests that AID would divert stored water released from Crane Prairie Reservoir during very dry years for all years following the implementation of the HCP (years 1 through 30). AID would also divert stored water released from Crane Prairie Reservoir during dry years for years 8 through 30 of the HCP. A corresponding portion of the water saved through the proposed project would consist of saved water and would be available to AID patrons during these years.

AID has historically only diverted and delivered up to the amount of water that its patrons have needed. Correspondingly, the daily diversion rate has varied based on water supply, acreage irrigated, climate conditions, and similar conditions. AID does not expect patrons' water needs to change as a result of the proposed project. AID would continue to divert and deliver only the water that its patrons need, with diversions reduced due to water savings associated with the proposed project. Any live flow that AID does not divert would remain in the Deschutes River and would be available for junior water right holders, including the Deschutes River itself, as it would under the No Action Alternative.

Protecting Water Released by NUID to the Deschutes River

Following the completion of each phase, NUID would legally protect water released from Wickiup Reservoir (up to 10,446 acre-feet]) through an instream lease under Oregon water law (ORS 537.348 [2] and OAR 690-077). If NUID were to release 10,466 acre-feet at a flat rate across the irrigation season, the District would release that water at a rate of 33.8 cfs. The water leased instream would retain the same priority date as NUID's originating water right (Certificate 51229). The instream lease would protect water in the Deschutes River downstream from Wickiup Reservoir during the non-irrigation season (i.e., in the late fall, winter, and early spring). Once an instream lease was approved by OWRD, the leased portion of NUID's water right would be unavailable for use by NUID or its patrons.

The State of Oregon allows for NUID's storage water rights to be leased instream. However, OWRD does not have the authority to permanently transfer storage water rights instream (S. Henderson, personal communication, May 24, 2022). An agreement would be established specifying that these instream leases would be renewed in perpetuity until the State of Oregon has the authority needed to permanently transfer the associated storage water rights instream. At that time, the associated storage water rights would be permanently transferred instream.

Water released by NUID during the non-irrigation season would be in addition to the HCP-required minimum winter flow rate of 100 cfs[22] in the Deschutes River downstream from Wickiup Reservoir. This additional flow would be beneficial to the Deschutes River until year 8 of the HCP (January 2028) when the minimum winter flow rate is increased to 300 cfs. Starting in year 8 of the HCP, the water released by NUID would be a part of, rather than in addition to, the streamflow required under the HCP.

6.8.2.2 Surface Water Hydrology and Water Quality

Effects on individual reaches are identified below.

6.8.2.2.1 *Crane Prairie Reservoir*

Surface Water Hydrology

Implementation of the Piping Alternative would have no effect on Crane Prairie Reservoir.

Surface Water Quality

Implementation of the Piping Alternative would have no effect on water quality in Crane Prairie Reservoir.

6.8.2.2.2 *Wickiup Reservoir*

Surface Water Hydrology

Up to 10,446 acre-feet of NUID's stored water in the reservoir would be dedicated to and released for instream use during the non-irrigation season. This volume represents about 5 percent of the reservoir's capacity.[23] As a result of the Piping Alternative, releases during the non-irrigation season would reduce pool levels in Wickiup Reservoir and result in a slight change in active storage volume at the start of the irrigation season. Because of Wickiup Reservoir's total storage capacity, this change would have negligible effects on Wickiup Reservoir. All effects of the Piping Alternative would be short-term because the minimum winter flow rate downstream from Wickiup Reservoir will increase to 300 cfs in year 8 of the HCP (January 2028).

Surface Water Quality

The Piping Alternative would result in negligible short-term effects on water quality in Wickiup Reservoir as storage volumes are reduced throughout the irrigation season and reservoir water temperatures increase in late summer and early fall. The effects would be negligible because effects

[22] Other water conservation projects are occurring in the Deschutes Basin that will also allocate water instream in addition to the HCP-required minimum flow rate of 100 cfs. These cumulative effects are discussed in Section 6.13.

[23] Wickiup Reservoir has an active storage capacity of 200,000 acre-feet.

on water quality would be below or at the level of detection. These effects could include decreased oxygen levels and increased phosphorus levels, which in turn could increase intensity and duration of algae and cyanobacteria blooms in the reservoir during the summer and into early fall (AID et al., 2020).

6.8.2.2.3 Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5)

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects on this reach of the Deschutes River during the non-irrigation season and no effect on this reach during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by up to 33.8 cfs[24] below Wickiup Reservoir and up to 29.5 cfs[25] at Benham Falls. This additional flow would be beneficial to the Deschutes River until year 8 of the HCP (January 2028) when the minimum winter flow rate is increased to 300 cfs under the HCP. After January 2028, there would be no effect on this reach; the water from the proposed project would be released as part of the 300 cfs maintained instream under the HCP.

The Piping Alternative would have no effect on this reach during the irrigation season as releases from Wickiup Reservoir would continue as they have historically to meet patron demand in both AID and NUID.

Surface Water Quality

The proposed action would increase late fall, winter, and early spring streamflow during the non-irrigation season in the Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5) until year 8 of the HCP (January 2028) when the minimum winter flow rate will be increased to 300 cfs. Water quality in the Deschutes River downstream of Wickiup Reservoir is greatly influenced by water quality in Wickiup Reservoir itself, and higher winter flows are typically associated with improved water quality.

However, as storage volumes in Wickiup Reservoir are reduced throughout the irrigation season and reservoir water temperatures increase, late summer and early fall reservoir releases would result in increased temperatures and reduced water quality in the Deschutes River below Wickiup Reservoir (AID et al., 2020). These effects would be short-term and negligible and would be below or at the level of detection (until year 8 of the HCP [January 2028]). Effects would diminish downstream as a result of tributary inflows and groundwater discharge (AID et al., 2020). Following year 8, additional

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[24] If spread evenly across the non-irrigation season (November 1 to March 31), 10,446 acre-feet of water would allow for 33.8 cfs to be released from Wickiup Reservoir. Due to the geology of the upper Deschutes Basin, OWRD accounts for water losses in certain river reaches. Water losses are described in these sections with loss adjustments incorporated into the flow rates.

[25] Losses were accounted for along the Deschutes River following OWRD's estimations. These losses include a 12.5 percent channel loss from Wickiup Reservoir to Benham Falls and a 7 percent channel loss from Benham Falls to the City of Bend.

water resulting from the proposed action would be used to meet the minimum streamflow rate specified in the HCP, and there would be no effect on surface water quality in this reach.

6.8.2.2.4 *Deschutes River from Arnold Canal Diversion (RM 174.5) to North Canal Dam (RM 164.8)*

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects in this reach of the Deschutes River during the non-irrigation season and long-term beneficial effects during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by up to 27.5 cfs[25] at North Canal Dam. This additional flow would be beneficial to the Deschutes River until year 8 of the HCP (January 2028) when the minimum winter flow rate is increased to 300 cfs. After January 2028, there would be no effect on this reach during the non-irrigation season; the water from this project would be released as part of the 300 cfs maintained instream under the HCP.

During the irrigation season, live flow saved by the proposed project would be allowed to pass AID's diversion; this would increase flows in this reach. In the spring when live flow is available, AID would pass up to 32.5 cfs. This rate would, however, decrease during the irrigation season due to seasonal streamflow declines; therefore, the rate of water passing AID's diversion would also decrease throughout the irrigation season. Live-flow availability may also decrease in the future due to the implementation of the HCP (see Section 6.8.2.1). This water would then be diverted at the NUID diversion (RM 164.8). Increases to streamflow in this reach would be beneficial and long term.

Surface Water Quality

The Piping Alternative would increase late fall, winter, and early spring streamflow in the Deschutes River from the Arnold Canal Diversion (RM 174.5) to North Canal Dam (RM 164.8) until year 8 of the HCP (January 2028) when the minimum winter flow rate will be increased to 300 cfs. Effects on water quality during the non-irrigation season are the same as those described in Section 0.

The Piping Alternative would have long-term benefits to water quality during the irrigation season as the District increases streamflow in this reach by up to 32.5 cfs.

6.8.2.2.5 *Deschutes River from North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0)*

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects on this reach of the Deschutes River during the non-irrigation season and no effect during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by up to 27.5 cfs[25] at North Canal Dam. This additional flow would be beneficial to the Deschutes River until year 8 of the HCP (January 2028) when the minimum winter flow rate is increased to 300 cfs. After January 2028, there would be no effect on this reach during the non-irrigation season; the water from this project would be released as part of the 300 cfs maintained instream under the HCP.

ODFW has a pending instream water right for this reach, which is usually met during the non-irrigation season.

The Piping Alternative would have no effect on this reach of the Deschutes River during the irrigation season as the additional streamflow allowed to pass the AID diversion would be diverted at the NUID diversion at North Canal Dam (RM 164.8).

Surface Water Quality

The Piping Alternative would increase late fall, winter, and early spring streamflow in the Deschutes River from the Arnold Canal Diversion (RM 174.5) to North Canal Dam (RM 164.8) until year 8 of the HCP (January 2028) when the minimum winter flow rate will be increased to 300 cfs. Effects on water quality during the non-irrigation season are the same as those described in Section 0.

The Piping Alternative would have no effect on water quality in this reach during the irrigation season as the additional streamflow allowed to pass the AID diversion would be diverted at the NUID diversion at North Canal Dam (RM 164.8).

6.8.2.2.6 *Drainage Courses*

Although the canal was never intended as a drainage course and the District does not allow its canal and lateral system to be intentionally used for stormwater management,[26] the Piping Alternative would eliminate the opportunity for the canals to be indirectly used for stormwater conveyance or disposal. The conversion of the open canal to a piped system would return the landscape along the canal to its original grade and to the natural surface runoff patterns that existed prior to the presence of the open canal. AID would coordinate with landowners directly down-gradient of the new pipelines to mitigate potential unintended consequences. The elimination of the proposed canal section as a drainage course would result in a minor long-term adverse effect on drainage courses. Effects would be localized to where the project had occurred and could include potential flooding on landowner properties and increased use of stormwater drains.

6.8.2.2.7 Irrigation Water Quality Supplied to Patrons

The Piping Alternative would have long-term beneficial effects on the water quality of irrigation water delivered to AID patrons. Piping the Main Canal would prevent contaminants such as herbicides, pesticides, animal waste, and stormwater runoff from entering the water supply for AID patrons down-gradient.

6.8.2.3 Groundwater

No groundwater resources would be extracted or consumptively used as part of this project; however, piping the Main Canal would affect groundwater hydrology associated with canal seepage.

[26] The District does not allow for its canal and lateral system to be used for stormwater management to avoid risk of contaminating irrigation water with potential stormwater pollutants.

Canal piping would reduce seepage in this area by up to 11,083 acre-feet annually during the irrigation season.

On average, for this part of the Deschutes Basin, this decrease in recharge translates into a decreased groundwater elevation of approximately 0.026 foot annually (see Section 2.3.1 of Appendix D.1 for calculation details). An important caveat is that localized effects on groundwater would differ throughout the area. Over the course of 106 years (the life of the project plus the construction period), this annual drop would result in a cumulative decreased average groundwater elevation of 2.6 feet. These effects would be most prominent at shallow depths closest to canals and attenuate with increasing depth (Gannet & Lite, 2013).

As described in Section 4.8.5, changes in canal seepage account for only a small portion of historical changes in groundwater recharge in the area. Climate remains the primary factor affecting groundwater levels in the region. The U.S. Geological Survey estimated that the combined effects of climate and groundwater pumping accounted for approximately 90 percent of the observed decrease in groundwater levels in the region and that canal piping and lining accounted for 10 percent of that observed decrease (Gannett & Lite, 2013). This 2013 study was used for the analysis of effects on groundwater and in the NEE benefit-cost analysis and is based on data at the Deschutes Basin scale.

A NEE benefit-cost analysis was completed for the Piping Alternative (see Section 8.9 and Appendix D.1). The cost of increased groundwater pumping was included in this analysis (see Appendix D.1.2.3.1). The analysis combined the decreased groundwater elevation for each year in the 106-year analysis period with the estimated volume of groundwater pumping to estimate the total increased costs of groundwater pumping in the basin over time (Sussman et al., 2017).

Overall, effects on groundwater would occur on the basin scale and would be long-term and minor. Reduced canal seepage following piping would lead to measurable groundwater declines. However, the effects from piping would be small relative to the reduced groundwater recharge from climate factors and groundwater pumping. Effects on groundwater wells adjacent to the project and in close proximity to the project area are possible but have a high level of uncertainty. Due to this uncertainty, effects on groundwater wells are not quantified (see Appendix D.1.2.3.1).

6.8.2.4 Ecosystem Services

The Piping Alternative would affect ecosystem services provided by water flowing through the Deschutes River in the following ways.

Provisioning service, Water available for irrigation (see E1 on Figure 4-1): Implementation of the Piping Alternative would have a beneficial effect on irrigation water deliveries. Water conveyance through closed pipe would improve efficiency by eliminating water loss due to seepage and evaporation, which in turn would allow AID to deliver adequate and reliable water to patrons while diverting less water from the Deschutes River. By passing AID-conserved water to NUID during the irrigation season, NUID would have access to more irrigation water to help fulfill its patrons' irrigation needs. Modernizing AID irrigation infrastructure would enable AID to be more resilient to environmental changes and maximize the efficiency of water conveyance.

Regulating service, Water quality (see E3 on Figure 4-1): Following implementation of the Piping Alternative, NUID would release an equivalent volume of water in the non-irrigation season that AID saved through modernization and passed to NUID.

Cultural service, Culturally important areas (see E5 on Figure 4-1): Because implementation of the Piping Alternative would replace the open canal with a covered pipe, residents would no longer see or hear water running through the open canal during the irrigation season. This action may have an adverse effect on the aesthetic and spiritual services that the open canal brings to some residents.

Regulating service, temperature regulation (see E6 on Figure 4-1): Implementation of the Piping Alternative would eliminate the potentially small cooling or warming effect that the canal may have on the local environment. No local data was available to evaluate the effect of piping the canal on temperature regulation; therefore, it is unknown if the elimination of this service would be beneficial or adverse. Based on data about irrigation and temperature regulation in general (see Section 4.8.6), the effect is anticipated to be negligible.

6.9 Fish and Aquatic Resources

6.9.1 No Action (Future without Federal Investment)

6.9.1.1 General Fish and Aquatic Species

Under the No Action Alternative, AID's Main Canal would remain open and there would be no effect on fish and aquatic species in the waterbodies associated with District operations (see Table 4-7). The District would continue to divert water from the Deschutes River for consumptive use at the current rate. This would continue to alter the hydrologic pattern of the Deschutes River streamflow similar to the last 50 years. The Main Canal would continue to leak water. The same amount of water would continue to be stored in Crane Prairie Reservoir and routed along the Deschutes River to the AID diversion. The low streamflow in the Deschutes River downstream of the AID diversion during the irrigation season would continue to reduce the potential fish habitat and compromise water quality for fish and aquatic species.

6.9.1.2 Federally Listed Fish and Aquatic Species

There would be no effect on current habitat supporting Oregon spotted frog under the No Action Alternative. Because bull trout and steelhead populations reside in downstream waterbodies where instream flow changes would have little to no effect on habitat (RM 132.0 to Lake Billy Chinook, Section 4.9.2), the habitat supporting these populations would likely not change from its current state.

6.9.1.3 Ecosystem Services

The No Action Alternative would have no effect on fish and aquatic resources related ecosystem services.

Provisioning service, Fish populations (see E2 on Figure 4-1): Harvest of resident and anadromous fish would not be affected. Anadromous fish would be available when runs are sufficiently large to sustain fishing. Although ODFW and CTWS are working to restore anadromous fisheries in the basin, the pace is likely to be slow and limited to available instream habitat.

Cultural service, Culturally important species (see E4 on Figure 4-1): There would be no effect on habitat supporting populations of culturally important fish species. Habitat limitations for culturally significant anadromous fish would continue to affect fishing, community, health, cultural identity, subsistence, and religious tribal values.

6.9.2 Piping Alternative

6.9.2.1 General Fish Species

During and following project construction, there would be no direct or indirect effects on any fish in the project area. However, common aquatic species such as western toad, Pacific treefrog, and long-toed salamander have been known to use open canals. Implementation of the Piping Alternative would have a direct effect on these species during construction because habitat in the open canal would be lost. However, the habitat is low quality and is not considered critical to the long-term survival of these species (S. Wray, personal communication, November 17, 2017). Open canal habitat used by invasive bullfrog species would also be removed as a result of piping.

During the irrigation season, up to 10,862 acre-feet of water saved by the project would pass the AID diversion and would be diverted 9.7 miles downstream by NUID (RM 164.8) for consumptive use (see Section 6.8.2 for how water saved by the project would be allocated). In the spring, when live flow is available, AID would pass up to 32.5 cfs.[27] However, this rate would decrease throughout the irrigation season as live-flow availability in the Deschutes River decreases. The Piping Alternative would secure any beneficial effects that water in this reach provides to fish and aquatic species during the irrigation season. Following implementation, any beneficial effects on this reach would be long-term (see Section 6.8.2).

In return for passing water to NUID, NUID would release an equal volume of water minus losses in the Deschutes River between the AID diversion and the NUID diversion (up to 10,446 acre-feet) from Wickiup Reservoir into the Deschutes River in the non-irrigation season continuing in perpetuity (see Section 6.8.2). The effect that this activity would have on fish and aquatic species is evaluated in the context of the HCP requirements adopted December 31, 2020.

In years 4 through 7 of the HCP (January 2024 through December 2027), any water released instream in the Deschutes River below Wickiup Reservoir during the non-irrigation season would be in addition to the HCP-required minimum winter flow rate of 100 cfs. If the water were released at a flat rate for the duration of the non-irrigation season, NUID would release up to 33.8 cfs from Wickiup Reservoir. This action would improve the Deschutes River streamflow regime and water quality, which would have an indirect beneficial effect on fish and aquatic species and their habitats.

Of the 33.8 cfs[28] of conserved water released from Wickiup Reservoir into the Deschutes River, 27.5 cfs would pass through North Canal Dam in the Deschutes River (see Section 6.8.2.2) during the non-irrigation season. However, because winter streamflow in this section of the Deschutes

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[27] Conserved water would be released incrementally as the project is completed. See Section 6.8.2.2.

[28] This calculation accounts for water loss along the Deschutes River. According to OWRD, these losses include a 12.5 percent channel loss between Wickiup Reservoir and Benham Falls and a 7 percent channel loss between Benham Falls and the City of Bend.

River ranges between 450 and 1,200 cfs due to the contributions of tributaries and natural springs, the addition of 27.5 cfs would not likely affect fish and their habitats.

Beginning in year 8 of the HCP (January 2028), base instream flow requirements during the non-irrigation season would be increased to 300 cfs. At this point, the release of up to 33.8 cfs (10,446 acre-feet per year) of water into the Deschutes River by NUID as a result of the AID Piping Alternative would support the HCP instream flow requirements. No additional effects on fish and aquatic species are anticipated.

6.9.2.2 Federally Listed Fish and Aquatic Species

Within and adjacent to waterbodies associated with District operations, federally listed Oregon spotted frog occurs in Crane Prairie Reservoir, Wickiup Reservoir, and the Deschutes River (see Section 4.9.2). Water released from Wickiup Reservoir as a result of the Piping Alternative would slightly decrease reservoir storage and increase streamflow during the non-irrigation season (see Section 6.8.2.2). The decrease in reservoir storage and associated effects on water quality (see Section 6.8.2.2) would have a negligible effect on Oregon spotted frog and its habitat in Wickiup Reservoir. Increase in non-irrigation season streamflow in the Deschutes River below Wickiup Reservoir as a result of the Piping Alternative is anticipated to slightly improve overwintering habitat conditions; however, because the increase in streamflow during the non-irrigation season would be insufficient to reach emergent wetlands, Oregon spotted frog would continue to overwinter in unvegetated backwater areas and side channels of the river (AID et al., 2020). Under the proposed action, Oregon spotted frog breeding conditions are anticipated to improve in the Deschutes River below Wickiup Reservoir during the non-irrigation season due to the increased streamflow and reduced fluctuation in flow during the breeding season (AID et al., 2020). All effects are consistent with those described in the HCP.

In years 4 through 7 of the HCP, this action would increase streamflow conditions during the non-irrigation season, which would have a small improvement on Oregon spotted frog critical habitat for overwintering. Breeding conditions would also be expected to have variable improvements from Wickiup Reservoir to Arnold's diversion (RM 174.5) as a result of the Piping Alternative. PCEs of Oregon spotted frog critical habitat would benefit from the Piping Alternative in this reach (see Appendix E.5). Beginning in year 8 of the HCP, the conserved water allocated instream as a result of this Piping Alternative would support the instream flow requirements for restoration and no additional benefits for Oregon spotted frog or its critical habitat would be observed. Informal consultation has been initiated.[29] USFWS concurrence with a "may affect-not likely to adversely affect" determination was signed on July 29, 2022 and received by NRCS on August 1, 2022.

Bull trout critical habitat is located within the waterbodies associated with District operations (see Figure E-1 in Appendix E.5), and bull trout are known to forage in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) during the non-irrigation season. In this reach, however, increased streamflow during the non-irrigation season under the Piping Alternative would have no effect on bull trout; the amount of increased streamflow would not be sufficient to produce a discernable effect on bull trout populations or PCEs identified in the critical habitat designations

[29] Coordination with USFWS and NMFS has been completed as required by the provision of PL 83-566 Section 12.

(70 Federal Register 56211, 2005). Consequently, NRCS determined that there would be no effect on federally designated critical habitat for bull trout and Section 7 consultation under the ESA is not warranted for this species. Technical assistance from USFWS provided no additional information that would warrant reconsideration of this determination (P. Lickwar, personal communication, March 10, 2021).

The Middle Columbia River steelhead population can potentially access the Deschutes River as far upstream as Big Falls (RM 132.0; Figure E-2 in Appendix E.5). Similar to the effects on bull trout, changes to streamflow or water quality as a result of the Piping Alternative would have no effect on the steelhead population. Middle Columbia River steelhead are considered a non-essential experimental population until January 2025. Non-essential experimental populations are treated as "proposed for listing" under Section 10(j) of ESA (Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead Above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon, 2011). Because changes to streamflow or water quality would not affect the population and because implementation of the Piping Alternative is not likely to jeopardize the continued existence of the species (Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead Above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon, 2011; Endangered and Threatened Species: Designation of Experimental Populations Under the Endangered Species Act, 2016; Section 4.9.2; Section 8.5.3), NRCS determined that Section 7 consultation with NMFS under the ESA is not warranted (see Section 8.5.3).

6.9.2.3 Ecosystem Services

The Piping Alternative would affect the ecosystem services provided by fish and aquatic resources in the following ways.

Provisioning service, Fish populations (see E2 on Figure 4-1): Over the long term, increased streamflow under the Piping Alternative would improve habitat for resident fish species during the non-irrigation season. Bolstering fish populations may allow more consistent fishing for harvest and consumption.

Cultural service, Culturally important species (see E4 on Figure 4-1): Following the modernization project, up to 33.8 cfs would be allocated instream during the non-irrigation season (see Section 6.8.2.2). The allocated water would have a beneficial effect on instream habitat for culturally important fish, which would positively affect Central Oregon community member values and contribute to CTWS goals including enhanced fishing, community, health, cultural identity, subsistence, and religious tribal values.

6.10 Wetlands and Riparian Areas

6.10.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be no effect on wetlands and riparian areas. Wetland and riparian vegetation associated with the open irrigation canal would persist. Although the canal within the project area is mechanically managed to clear vegetation, seepage supporting wetland and riparian features adjacent to the canal would remain in its current condition.

6.10.2 Piping Alternative

Wetland and Riparian Areas along the Project Area

The Main Canal within the project area is managed mechanically to clear vegetation. NWI[30] geographic information systems data (USFWS, n.d.) was used as a first-step approach in identifying and evaluating potential wetlands in the project area. Through an analysis of NWI data and examining aerial imagery, no potential wetland sites within the project area were identified.

Generally, project canals and laterals are not considered wetlands or waters of the United States by state or federal agencies (see Section 4.10); however, prior to project implementation, consultation with DSL and USACE would occur to determine exemption applicability to canals in the project area. If wetlands within or adjacent to the project area were identified, they would be avoided to the extent practicable.

Construction would result in the permanent fill of the canal in the project area. Seasonal opportunistic hydrophytic plants that sporadically occur within and directly adjacent to the canal would be removed or buried during excavation, fill, placement of pipe, or other construction activity, and AID would follow appropriate reclamation procedures to revegetate disturbed areas as uplands. In locations where piping would occur, seepage losses would be eliminated and potentially limit the water available to adjacent wetlands if they are dependent upon canal seepage for hydrology. If wetland sites adjacent to the project area are dependent on seepage losses, they would permanently change to upland areas after project construction.

Because eliminating seepage losses could reduce water available to potential wetlands adjacent to the project area and hydrophytic vegetation occurring in places near or adjacent to the project area, this alternative could have minor long-term effects on wetlands and hydrophytic vegetation.

The Piping Alternative would have no effect on excavated water storage ponds adjacent to the project area, and the hydrophytic vegetation along these ponds would not be disturbed.

Wetland and Riparian Areas along Natural Waterbodies Associated with District Operations

The proposed action would result in slight improvements in water quality and habitat function in the 111.8 miles of natural riverine systems along the Deschutes River downstream of Wickiup Reservoir (RM 238.8) as a result of increased streamflow during the non-irrigation season. Restablishing a more natural hydrologic regime in these reaches could allow the river channel to supply water to wetlands and riparian areas via infiltration through channel banks; this would enhance wetland and riparian functions by facilitating processes such as surface and groundwater exchange and physical

[30] The NWI code uses the Cowardin classification system. For further information about Cowardin classifications, refer to *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).

and chemical transformations, and it would support riparian plant communities. However, these benefits would be short-term and only realized prior to the year 8 HCP flow increase to 300 cfs.

6.10.2.1 Permitting and Compliance

Construction and maintenance of the irrigation ditches located outside waters of the United States are generally exempt from regulation under Section 404(f)(1)(C) of the CWA (USACE & EPA, 2020). Under this exemption, it is anticipated that no permit would be required for the disturbance to wetlands within the existing AID canal and lateral system. However, coordination and consultation with DSL and USACE would occur prior to implementation of each site-specific project to ensure that the project either meets exemption criteria or that the proper permitting and construction activities are conducted.

EO 11988 requires federal agencies to avoid to the extent possible the long- and short-term effects associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The proposed action would not occur within the 100-year floodplain, and therefore, it would have no effect on the floodplain elevation.

6.11 Wildlife Resources

6.11.1 No Action (Future without Federal Investment)

Under the No Action Alternative, no effect on wildlife along the Main Canal is anticipated because District activities would remain in their current condition.

6.11.2 Piping Alternative

During construction, terrestrial wildlife could experience noise disturbance due to heavy equipment operation, habitat removal due to tree cutting and other vegetation removal, or injury due to collision with construction equipment or habitat removal. AID regularly uses trucks and other construction equipment for canal operation and maintenance; therefore, most wildlife in the area are accustomed to noise. These disturbances are anticipated to be negligible.

As the canal is piped and the water source is removed, the distribution patterns of wildlife within the project area could change. Although some species may use the canal as a water source, the canal can have an adverse effect on wildlife due to the risk of drowning and the barrier that the canal presents to terrestrial movement (Beier et al., 2008; A. Walch, personal communication, September 17, 2021). As this alternative would be implemented over time, ungulates and other terrestrial wildlife would have time to adjust and find new water sources. Furthermore, this alternative would have no effect on excavated water storage ponds served by the project or on sub-laterals (some of which are open) that intersect the Main Canal. The storage ponds and sub-laterals would still provide summer drinking water and habitat for wildlife. In the winter, icy water storage ponds that are lined would continue to pose a risk to large ungulates.

For wildlife that use the canal as a water source or as a part of their home range, there would be a greater effect on species that have small ranges than on those species with larger ranges. Generally, species with larger ranges, such as mule deer, would be able to more easily find alternate sources of water or habitat; species with smaller ranges would have more limited options. Because other water nearby would not be affected, such as laterals that intersect the Main Canal, ODFW does not anticipate that wildlife would need to travel to the Deschutes River for water (A. Walch, personal communication, February 20, 2022).

Implementation of the Piping Alternative would potentially reduce human the presence throughout the project area, as fewer trips to maintain ditches and headgates would be necessary. This would result in fewer human-wildlife conflicts and improved seclusion for wildlife. In addition, the Piping Alternative could remove barriers to ungulates and other terrestrial wildlife within the project area as the open canal is converted to buried pipeline.

Project implementation would provide increased streamflow in the Deschutes River downstream from Wickiup Dam, and this increased streamflow could enhance riparian habitat. Improved streamflow would provide more consistent access to water for hydrophytic plants, and this would, in turn, enhance riparian wildlife habitat.

During construction, the Piping Alternative would have short-term negligible effects on general wildlife in the project area. Following implementation, the effects on general wildlife species would be negligible and long-term because although local wildlife distribution patterns would be altered, implementation would not have a perceptible effect on the species at the population scale. Unavoidable effects on wildlife would be minimized using BMPs.

6.11.2.1 MBTA/BGEPA

Wintering or migrating birds would be minimally affected by construction disturbance because they have the flexibility to move away from disturbances to other suitable areas. There would be no expected effect on breeding migratory songbirds or waterbirds as construction activities would occur outside the nesting season. Coordination with USFWS regarding birds covered under MBTA is ongoing. Site-specific analysis would occur prior to implementation of each project phase.

AID would follow USFWS guidelines to ensure minimal disturbance to bald or golden eagles nesting near the project area. The critical nesting period for bald and golden eagles is January 1 through August 31. Sections of the project area near Horse Butte Road and Knott Road are approximately 0.6 mile and 1.9 miles, respectively, from golden eagle nesting areas (E. Weidner, personal communication, December 17, 2019). Because of the proximity of the project area to nesting sites, a seasonal restriction for the use of hydraulic hammers is in effect for these segments of the project area. Clearance surveys would be completed prior to implementation, and coordination with USFWS is ongoing (E. Weidner, personal communication, November 25, 2019 and March 2, 2022).

The effects on birds covered under MBTA and BGEPA would be negligible and short-term because effects would primarily occur during the construction phase and be limited to the nesting sites within proximity of the project area. Effects would be mitigated through BMPs and coordination with USFWS.

6.11.2.2 State and Federally Listed Species

The Piping Alternative would have no effect on federally or state-designated terrestrial species within the project area because none are known to exist in the project area (see Sections 4.11.3 and 4.11.4). Effects on federally listed threatened and endangered species and state-listed species are discussed in Sections 6.9.2 and 6.11.2 in this Plan-EA. Effects on federally listed species are also considered in the Biological Assessment developed for the project. USFWS concurred with the NRCS determination that the project may affect but is not likely to adversely affect Oregon spotted frog (signed on July 29, 2022; received by NRCS on August 1, 2022).

6.12 Wild and Scenic Rivers

6.12.1 No Action Alternative (Future without Federal Investment)

The No Action Alternative would have no effect on the values that support the designation of Wild and Scenic Rivers or on State Scenic Waterways in the waterbodies associated with District operations. The No Action Alternative would also have no effect on the ORVs listed in Section 4.12.

6.12.1.1 Ecosystem Services

The No Action Alternative would have no effect on ecosystem services provided by the Wild and Scenic Deschutes River resources.

Cultural service, Culturally important natural areas (see E5 on Figure 4-1): There would be no effect on Deschutes River ORVs or on Central Oregon community member values.

6.12.2 Piping Alternative

Implementation of the Piping Alternative would have no effect on the Wild and Scenic River or State Scenic Waterway designations or on the free-flowing condition of the designated reaches downstream from Wickiup Dam (RM 226.8) to Lake Billy Chinook (RM 120.0).

Increased streamflow would be consistent with Wild and Scenic River management goals (BLM, 1992) and enhance fish, recreation, scenery, wildlife, hydrological, and botanical/ecological values.

6.12.2.1 Ecosystem Services

The Piping Alternative would affect the ecosystem services provided by the Wild and Scenic Deschutes River resources in the following way.

Cultural service, Culturally important natural areas (see E5 on Figure 4-1): Following the modernization project, up to 33.8 cfs would be allocated instream during the non-irrigation season (see Section 6.8.2.2). The allocated water would have a beneficial effect on several Deschutes River ORVs including fisheries and hydrology (see Appendix E.7) and would positively affect Central Oregon community member values.

6.13 Cumulative Effects

6.13.1 Past Actions

Past actions over the last 120 years that have affected resources in the Deschutes River watershed are generally land development activities that include irrigated agriculture (consisting of canal system construction, previous piping projects, and diversions), urban and suburban development, industrial land and water uses, commercial development, water diversions for non-agricultural uses, and transportation infrastructure. Section 4 describes the nature and extent of these past actions and how they have influenced the existing environment for each resource.

The AID delivery system was constructed between 1907 and 1919 to provide water to surrounding farms and ranches for crops and livestock. Seven other irrigation districts were developed within the Deschutes Basin during the early twentieth century, and they collectively altered the hydrology of the Deschutes River and its tributaries. Over time, there has been increasing pressure to reduce the effects of irrigation needs on the natural water cycle in the Deschutes Basin.

Since the early 1990s, there has been increasing interest in improving instream flows and conserving water in the Deschutes River. AID and other Deschutes River–area irrigation districts have completed various water conservation projects. These recent past efforts have included piping existing irrigation canals, on-farm conservation, water management changes, and changes to crop production; these efforts have resulted in increased streamflow in the Deschutes River (see Section 4.8.3) and decreased seepage into the groundwater table (see Section 4.8.5). AID has piped approximately 22 percent of its system to date—all laterals and sub-laterals.

6.13.2 Current and Reasonably Foreseeable Future Actions

Current actions are those projects, developments, and other actions that are presently underway either because they are under construction or are occurring on an ongoing basis. Reasonably foreseeable future actions generally include those actions formally proposed or planned or that are highly likely to occur based on available information. Various sources including local, state, and federal agency websites and city and county staff were consulted to obtain information about current and potential future development in the project area. The following sections describe these current actions and reasonably foreseeable future actions. This list is not comprehensive, and other actions may be taking place or may take place in the future.

6.13.2.1 Land Use and Development

Ongoing agricultural activities including farming and grazing in the project area are not expected to change from current conditions. Land use development in the project area would continue to be managed according to the Deschutes County Comprehensive Plan and Deschutes County zoning regulations. Land development activities are expected to continue into the future.

6.13.2.2 Habitat Conservation Plan

AID, other irrigation districts in the Deschutes Basin, state and federal agencies, local municipalities, and environmental groups have developed a multispecies HCP for the upper Deschutes Basin for listed species and those that may become listed during the 20- to 50-year life of the HCP; these include Oregon spotted frog, bull trout, Chinook salmon, steelhead salmon, and sockeye salmon. The Final HCP was published in the Federal Register on November 6, 2020 (Final Environmental Impact Statement and Final Deschutes Basin Habitat Conservation Plan; Klamath, Deschutes, Jefferson, Crook, Wasco, and Sherman Counties, Oregon, 2020) and a final decision by USFWS was made on December 31, 2020. Covered activities include:

- Storage and release of irrigation water from:
  - Crane Prairie Reservoir
  - Wickiup Reservoir
  - Crescent Lake Reservoir
  - Prineville Reservoir
  - Ochoco Reservoir
- Diversion of irrigation water
- Conveyance and delivery of irrigation water
- Irrigation return flows
- Existing hydropower
- City of Prineville water use activities

The majority of the conservation measures set forth in the HCP are commitments to maintain HCP instream flow requirements (AID et al., 2020). The changes to instream flows will be phased over time to allow the permittees to accomplish the needed conservation projects and water movements. Phasing also provides opportunity for channel restoration activities, supported by the HCP through funds provided by the permittees, to be completed. Channel restoration activities will be focused on restoring channels and floodplains and eventually enable lower summer flows to provide habitats comparable to those that exist today (AID et al., 2020).

6.13.2.3 Deschutes Basin Irrigation District Modernization

Other irrigation districts in the Deschutes Basin are working to pipe their infrastructure using PL 83-566 funding and would implement projects similar to those proposed by AID in this Plan-EA. Five districts—(Tumalo Irrigation District [TID], Swalley Irrigation District [SID], COID, LPID, and Ochoco Irrigation District [OID])—have authorized Plan-EAs. TID plans to pipe approximately 68.8 miles of its canals and laterals over the course of 11 years. SID plans to pipe approximately 16.6 miles of its canals and laterals over the course of 7 years. COID plans to pipe approximately 7.9 miles of its system over the course of 4 years. LPID plans to pipe approximately 10.9 miles of its system over the course of 3 years. OID plans to pipe approximately 16.8 miles of its system over the course of 3 years. The other district most likely to obtain necessary funding and permitting in the next 2 years is NUID. NUID has initiated the Plan-EA process, but the extent of the projects are still being determined. These six modernization projects are contingent on the availability of funding. In the future, the irrigation districts may also pursue other irrigation efficiency projects using funding through other federal, state, and local funding sources.

6.13.3 Cumulative Effects by Resource

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

6.13.3.1 Cultural Resources

Although the canal system has undergone changes in the past (e.g., improvements from 1905 to the present), the basic operations of the District would not be altered due to the proposed improvement efforts.

Cumulative impacts to cultural resources would occur if other past, present, or reasonably foreseeable actions or projects affect the same historic properties and/or cultural resources as the proposed action. Cumulative impacts can result from individually minor but collectively significant actions that occur over a period of time. Where impacts to historic properties including any previously recorded, unevaluated, or not yet documented resources such as archaeological sites, architectural sites, cultural landscapes, or traditional cultural properties would be unavoidable, measures to mitigate the adverse effects would be identified in a Section 106 agreement document (e.g., memorandum of agreement, programmatic agreement). This document would be developed in consultation with SHPO, THPO, and other consulting parties including affiliated tribes.

Any cumulative impacts to the District's conveyance system by future actions such as new piping would be analyzed in light of the conveyance system NRHP eligibility status. Cumulative impacts would not be expected if the conveyance system were determined not eligible for the NRHP; however, if the conveyance system were determined to be eligible and a future action would result in adverse effects under Section 106 of the NHPA, these effects would be addressed in consultation with SHPO, THPO, and other consulting parties, including affiliated tribes, to mitigate adverse impacts. The cumulative impact analysis would consider whether the impact and proposed mitigation are adverse or beneficial for the human environment.

All other projects considered in this cumulative impact analysis, including other PL 83-566 projects occurring in the area, would likely be required to comply with Section 106 of the NHPA, which requires federal agencies to assess and mitigate adverse effects, including cumulative effects, on historic properties or cultural resources. AID has developed a plan to address unanticipated discoveries of cultural resources and human remains during construction of the proposed action. Other federal projects would implement similar plans and measures. These cultural resource studies, agreement documents, and plans ensure proper documentation, protection, and avoidance, minimization, or mitigation of important cultural resources.

6.13.3.2 Land Use

The project area has been substantially altered over the past century by a variety of human activities including agricultural development, livestock grazing, urban and suburban development, and road construction. Implementation of the proposed action would support existing land uses as recent water conservation projects have, and as would implementation of current and reasonably foreseeable future actions and additional irrigation district modernization. Therefore, together with the proposed action, these activities would cumulatively support existing agricultural land uses.

6.13.3.3 Public Safety

Past, current, and future piping projects in the Deschutes Basin all serve to improve public safety by eliminating the risk of drowning in open irrigation canals. Implementation of the proposed project would contribute to these cumulative effects by further reducing cumulative risk to public safety of open irrigation canals.

6.13.3.4 Socioeconomic Resources

Past actions, including agricultural and other land development, and recently completed projects have established the socioeconomic setting of the Deschutes Basin by supporting development and agriculture. Current and reasonably foreseeable future actions would continue to support agriculture through improved infrastructure. Since the proposed action would also support the local economy through construction expenditures and intensified agricultural production, it would contribute to a cumulative benefit to socioeconomic resources in the area.

6.13.3.5 Soils

Past, ongoing, and future actions in the surrounding area that affect soils include agricultural uses, land development, and water management activities. The amount of soil affected by the proposed action is small and localized to the project area compared to the area affected by other past, present, and reasonably foreseeable future actions in the area; the proposed action would, therefore, have a minor contribution to cumulative effects on soils.

6.13.3.6 Vegetation

Agricultural activities, livestock grazing, vegetation control along roads, and urban and suburban development are responsible for most of the past and ongoing effects on vegetation in the project area and the region. The amount of vegetation that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural activities, livestock grazing, vegetation control along roads, and other utility corridors in the area. Current and reasonably foreseeable future actions, such as irrigation infrastructure piping projects in other Districts, would have relatively minor effects on vegetation because effects would be localized to each individual District's ROW or easement and these areas are proportionally a limited area compared to the region. Other actions such, as the HCP, will have beneficial effects on vegetation along the Deschutes River. Ongoing effects of past actions are not expected to change measurably from current conditions, and additional effects from the proposed action would be minor because they are localized to the project area and would result in a minor contribution to cumulative effects on vegetation.

6.13.3.7 Visual Resources

The visual quality of lands in the Deschutes Basin has changed due to past and present development, and these changes are expected to continue. The impact to visual resources from the

Piping Alternative would be a moderate long-term effect localized to the project area. The impact would be similar in character to the natural landscape and development; therefore, combined with other actions, the cumulative effects on visual resources would be minor.

6.13.3.8 Water Resources

Past actions over the last 120 years that have affected water resources include urban and agricultural development, road construction, road maintenance, and other irrigation projects. Since the early 1990s, there has been increasing interest in conserving water and restoring streamflow to the Deschutes River. AID and other Deschutes Basin irrigation districts have implemented various water conservation projects. These recent, past efforts have included piping existing irrigation canals, on-farm conservation, water management changes, and changes to crop production, which have resulted in increased streamflow in the Deschutes River (see Section 4.8) and decreased seepage into the groundwater table (Section 4.8.5).

Ongoing and reasonably foreseeable future actions that could affect waterbodies associated with District operations include additional irrigation piping projects being considered by other Deschutes Basin irrigation districts that divert water from the Deschutes River (see Table 6-1), on-farm water conservation work, and HCP requirements. These actions accompanied by the proposed action would cumulatively increase streamflow in the Deschutes River and its tributaries and result in beneficial cumulative effects on water resources.

Table 6-1. Potential Water Conserved Instream from Projects[1] Approved or Proposed in the Deschutes Basin.

Irrigation District	Total Water Protected Instream (cfs)	Reach Affected [1, 2]
Tumalo Irrigation District	48	Approximately 30 cfs would be allocated to Tumalo Creek during the irrigation season, and 18 cfs would be allocated to Crescent Creek during the non-irrigation season. Both creeks are tributaries of the Deschutes River.
Swalley Irrigation District	15.2	The entire 15.2 cfs would be allocated to the Deschutes River from RM 164.8 to RM 120.0 during the irrigation season.
Central Oregon Irrigation District	30.3	Up to 30.3 cfs would be protected in the Deschutes River below Wickiup Reservoir (RM 226.8) during the non-irrigation season through an instream lease.

Irrigation District	Total Water Protected Instream (cfs)	Reach Affected [1, 2]
	2	The District's current Regional Conservation Partnership Program project includes piping part of the J lateral and the L lateral, which would protect up to 2 cfs in the Deschutes River below Wickiup Reservoir (RM 226.8) during the non-irrigation season through an instream lease.
	COID is initiating an environmental impact statement through PL 83-566, but the extent of the projects is still being determined.	
Lone Pine Irrigation District	5.3	Up to 5.3 cfs would be protected in the Deschutes River below Wickiup Reservoir (RM 226.8) during the non-irrigation season through an instream lease.
Ochoco Irrigation District	16.02	Up to 11.2 cfs of McKay Creek live-flow water rights would be transferred instream and increase flow in McKay Creek and the Crooked River downstream of RM 44.9. Up to 4.82 cfs would be allocated instream in the Crooked River downstream of Prineville Reservoir.
North Unit Irrigation District	NUID has initiated the PL 83-566 planning process, but the extent of the projects is still being determined.	

cfs = cubic feet per second; RM = river mile
Notes:
[1] The water protected instream from projects in TID, SID, COID, LPID, and OID are from authorized Plan-EAs and are reasonably foreseeable to occur. NUID has started the Plan-EA process, but water savings are still being determined.
[2] Flows allocated instream during the irrigation season are shown as maximum flows and may be reduced during the shoulder season depending on the district's water right. Flows allocated instream during the non-irrigation season are shown as a flat rate (cfs). See each district's Plan-EA for more information regarding the timing and location of instream flows.

Reasonably foreseeable irrigation canal and lateral piping projects throughout the Deschutes Basin may contribute to a reduction in groundwater levels. On the eastern side of the Deschutes River, seepage from SID's canals most likely percolates to shallow aquifers where it may be extracted for groundwater consumption or it may ultimately discharge into the Deschutes River (Gannett et al., 2017). Because AID is up-gradient in the groundwater system, its proposed projects could affect groundwater within COID. Ongoing and reasonably foreseeable projects in TID, LPID, and OID are not proximal to AID and therefore would have no effect on groundwater levels in AID. For reference, the TID project is located on the west side of the Deschutes River and LPID and OID are located on the north side of the Crooked River (see Figure 1-1). In the next 100 years, if AID, SID, and COID irrigation piping projects are implemented fully, average groundwater levels in the central basin could decline approximately 7.0 feet.[31] In conjunction with the effects of climate variability, the AID proposed project would have a minor cumulative effect on basin groundwater levels (see Section 4.8.5; Gannett & Lite, 2013). The effects of local groundwater reduction due to piping would be mitigated by increased streamflow during the non-irrigation season, some of which would likely infiltrate into the regional aquifer.

Water quality could be affected due to nonpoint source pollution such as erosion and runoff associated with ongoing and potential construction and land development activities including the proposed irrigation piping projects. The proposed action would be constructed when there is no water in the canal system; construction practices for similar proposed projects are anticipated to be comparable. Proposed cumulative actions would contribute to water quality improvements anticipated from the reduction in erosion from AID canals and increasing streamflow in waterbodies affected by AID operations.

Implementation of the proposed action, HCP requirements, and other reasonably foreseeable future actions would have a moderate cumulative effect on water resources, as implementation of irrigation piping projects could reduce groundwater infiltration, increase streamflow, and improve water quality.

6.13.3.9 Fish and Aquatic Species

Past and ongoing land uses, water diversions, and reservoir operations are responsible for most of the past and ongoing direct and indirect changes in water availability, seasonality, and access to habitat that has cumulatively affected aquatic communities and habitat in the Deschutes Basin.

Past and ongoing land use activities in the project area are not expected to change from current conditions. Future land developments and irrigation district modernization projects may cause short-term and temporary effects on fish, such as sediment inputs or aquatic habitat disturbance, and could potentially affect waters within the same watershed as the proposed action. However, the ongoing and reasonably foreseeable future actions described above, including irrigation modernization activities and the HCP requirements, are all proposed for improving aquatic habitat conditions in the Deschutes Basin. The proposed AID project, along with other current or reasonably foreseeable Deschutes Basin irrigation modernization projects, support the ODFW Conservation Strategy Overall Goal for Water Quality and Quantity. The Water Quality and Quantity goal is defined as maintaining and restoring water quality and quantity to support native fish and wildlife habitats in balance with the economic and social needs of rural and urban communities (ODFW, 2016).

Implementation of the proposed action when combined with other future actions is anticipated to have a beneficial cumulative effect on fish, aquatic species, and available habitat for these species. Implementation of other irrigation piping projects could have an additive effect on the amount of water conserved.

[31] This assumes that SID's and COID's respective projects would reduce local groundwater recharge by 6,172 acre-feet per year and 10,280 acre-feet per year, respectively.

6.13.3.10 Wetlands and Riparian Areas

Past actions that have affected wetlands, riparian areas, and floodplains in the Deschutes Basin include land development, agricultural activities and infrastructure, water diversions, and reservoir operations. These activities are expected to continue. Effects on wetlands from the proposed action and any effects from other current and reasonably foreseeable irrigation modernization projects are anticipated to be localized to the linear areas where proposed projects would occur, which is a proportionally small area compared to the area that wetlands cover in the region. For the five authorized watershed plans in the Deschutes Basin, analysis of the NWI database identified the following:

- About 23 wetland features within or adjacent to the TID project area.
- No natural wetland resources within the SID project area; however, 65.6 acres of seasonal wetland features were identified within or adjacent to the SID project area.
- Two potential sites as Freshwater Emergent Wetlands within or adjacent to the COID project area.
- One site as a Forested/Shrub Wetland in the LPID project area at the site of the proposed river crossing.
- Forty-two potential sites as either Freshwater Emergent Wetlands, Freshwater Forested/Shrub Wetland, or Riparian within or adjacent to the OID project area.

At the time when the Plan-EAs for TID, SID, COID, LPID, and OID were written, verification of NWI-identified sites had not yet been completed. Coordination and consultation with DSL and USACE are in process or will occur prior to implementation of each site-specific project to ensure that the project either meets exemption criteria or that the proper permitting and construction activities are conducted in accordance with the permits' requirements.

Because wetlands occur infrequently within or adjacent to the project areas, implementation of the proposed action is anticipated to have a minor cumulative impact to wetlands in the project areas of the Deschutes Basin.

Wetland and riparian areas along natural waterbodies associated with the districts' operations are anticipated to experience improvements due to the increased instream flow that is expected from implementation of ongoing and future actions (see Table 6-1). Coupled with the proposed AID action, wetland and riparian areas along natural waterbodies would be anticipated to experience a short-term[32] cumulative benefit and improved hydrology for riparian vegetation in the Deschutes Basin. The effects of the project on wetlands and riparian areas along natural waterbodies associated with districts' operations are consistent with the ODFW Conservation Strategy Overall Goal for Water Quality and Quantity to maintain and restore water quality and quantity to support native fish

[32] These benefits would be realized until year 8 of the HCP when minimum flow rates are increased to 300 cfs.

and wildlife habitats in balance with the economic and social needs of rural and urban communities (OCS, 2016).

6.13.3.11 Wildlife

Past and ongoing land use activities including agriculture, urban, and suburban development have affected wildlife and wildlife habitat in the Deschutes Basin starting in the late 1800s. Agricultural activities have substantially altered the habitat in the region by removing native vegetation in some areas and diverting streamflow. Livestock grazing occurs in much of the region around the project area and can result in the introduction and spread of weed species, the degradation of native habitat, and trampling of riparian and wetland areas. Some native habitats have been replaced with disturbance-tolerant or introduced species assemblages that may support different wildlife than previously existed. These ongoing activities would continue to affect wildlife and wildlife habitat in the project area.

Although current and future irrigation modernization projects in addition to the proposed action are taking place across the Deschutes Basin, the cumulative effects on wildlife due to the projects would be localized to the linear area where the projects would be occurring, limited to disturbance during construction, and affect wildlife that use open canals as a water source. Implementation of the proposed action and other irrigation modernization projects would cause wildlife to find other water sources as they did prior to installation of the canals. Since the effects on wildlife have occurred and would occur over a period of time in which the animals would be able to adapt, the cumulative effect on wildlife from the implementation of the proposed action would be minor.

In addition, current vegetation-control activities, including mechanical cutting of vegetation, are ongoing actions that contribute to wildlife habitat changes. The amount of wildlife habitat that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural activities, livestock grazing, vegetation control, and urban and suburban development in the area. In addition, the intensity of these ongoing actions is not anticipated to change measurably in the future; this would result in minor additional cumulative effects.

6.13.3.12 Wild and Scenic Rivers

Sections of the Deschutes River have been designated as Wild and Scenic under the National Wild and Scenic Rivers Act, and a section of the Deschutes River is designated as an Oregon State Scenic Waterway. These designations aim to protect these areas from changes that generally alter the scenic, recreational, and ecological qualities of these areas. The proposed action would have no effect on the Wild and Scenic River or State Scenic Waterways designations or the free-flowing condition of the designated reaches downstream from Wickiup Dam (RM 226.8) to Lake Billy Chinook (RM 120.0). These Wild and Scenic and State Scenic waterways would continue to be managed by federal and state agencies, respectively.

6.13.3.13 Ecosystem Services

All reasonably foreseeable actions regarding the modernization of irrigation infrastructure in the Deschutes Basin would work in concert to conserve water and improve water availability to irrigators. Past and ongoing actions described in the sections above have also contributed to water availability for irrigations and instream flow. Past, ongoing, and reasonably foreseeable actions in the

Deschutes Basin could all impact ecosystem services. However, implementation of the proposed action when combined with other future actions is anticipated to have a beneficial cumulative effect on all ecosystem services assessed.

7 Consultation, Coordination, and Public Participation

AID and its partners planned and conducted numerous agency coordination and public involvement activities throughout the development of this Plan-EA. These activities included a public scoping meeting, presentation, press announcements, and frequent correspondence with federal, state, and local resource agencies, agriculture interests, and other interest groups and individuals. The project development process was designed to work collaboratively with partners, agencies, tribes, and stakeholders to ensure transparency and cooperation toward a solution that fits within the framework of the purpose and need for action.

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

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

Public Announcements

- NRCS public notice (April 3, 2019)
  nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/pnotice/?cid=nrcseprd1450046
- Bend Bulletin—three public notices (April 3, 10, and 17, 2019)
- District website notice (April 3, 2019)
- Postcard to District patrons (April 3, 2019)
- NRCS news release (April 3, 2019)
  nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/releases/?cid=NRCSEPRD1450047

Public Involvement Website

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

- Overview of the NRCS PL 83-566 funding program
- Overview of NEPA and the EA public participation process
- Frequently asked questions about the EA process
- Background on the District, the Draft Plan-EA and appendices, the Preliminary Investigative Report and appendices, and presentations and handouts from public meetings
- Contact information and how to submit public comments

- Email signup option for more information; subscribers receive updates over the course of project development

Public Scoping Meeting

A public scoping meeting was held April 17, 2019, from 6:30 p.m. to 7:30 p.m. at the Elk Meadow Elementary Gymnasium, 60880 Brookswood Boulevard in Bend, Oregon. Participants had an opportunity to learn more about the proposed irrigation improvements and discuss their comments, ideas, and concerns. Public scoping comments were accepted from April 3 through May 15, 2019.

7.1 List of Persons and Agencies Consulted

Table 7-1 describes communications with agency personnel that were consulted during development of this Plan-EA. This includes agencies that provided formal or required consultation or individuals who were conferred with and who provided substantial input. Coordination with state and local agencies has been ongoing since project inception.

Table 7-1. Agency Consultation and Communication Record.

Date	Contact, Agency	Communication
November 14, 2019	Scott McBride, USFS	Discussion of Newberry National Volcanic Monument northern boundary
November 25, 2019	Emily Weidner, USFWS	Discussion about federally listed species, migratory birds, and bald and golden eagles in the area
February 26, 2020	Kyle Gorman, OWRD	Water rights discussion
April 6, 2020	Bridget Moran, USFWS Jennifer O'Reilly, USFWS	Discussion of Oregon spotted frog habitat
May 6, 2020	Bridget Tinsley, Oregon Parks and Recreation Department	Discussion about the State Scenic Waterway Corridor
June 1, 2020	Alicia Underhill, USFS Kevin Larkin, USFS Michelle King, USFS	Discussion about Wild and Scenic Section 7
October 14, 2020	Scott McBride, USFS	Discussion of the proposed project
January, 2021	Joni Cain, USFS Alicia Underhill, USFS	Discussion about land ownership
February 17, 2021	Peter Lickwar, USFWS	Discussion about potential beneficial effects on bull trout

Date	Contact, Agency	Communication
September 17, 2021	Andrew Walch, ODFW	Discussion about the effects that piping or canal lining may have to wildlife and their migration patterns
February 20, 2022	Andrew Walch, ODFW	Discussion about the effects that piping may have to wildlife
March 2, 2022	Anna Soens, USFWS Emily Weidner, USFWS Jennifer O'Reilly, USFWS Peter Lickwar, USFWS	Discussion about Threatened and Endangered species potentially affected by the project including Oregon spotted frog, steelhead, and bull trout Discussion about species covered by MBTA and BGEPA and site clearance surveys
May 26, 2022	Meaghan Walter, NRCS Gary Diridoni, NRCS Damon Brosnan, NRCS Molly Dawson, NRCS Scarlett Vallaire, NRCS Kathy Ferge, NRCS Bobby Brunoe, CTWS Brad Houselt, CTWS	Discussion of the AID Irrigation Modernization Project as well as other PL 83-566 projects occurring in the Deschutes Basin and elsewhere
June 24, 2022	Anna Soens, USFWS Bridget Moran, USFWS USFWS staff	Providing USFWS with a draft of the AID Biological Assessment for review.
July 26, 2022	Bridget Moran, USFWS Emily Weidner, USFWS	Review draft Biological Assessment with USFWS
July 27, 2022	Bridget Moran, USFWS	NRCS initiated informal consultation with USFWS

AID = Arnold Irrigation District; BGEPA = Bald and Golden Eagle Protection Act; CTWS = Confederated Tribes of Warm Springs; MBTA = Migratory Bird Treaty Act; NRCS = Natural Resources Conservation Service; ODFW = Oregon Department of Fish and Wildlife; OWRD = Oregon Water Resources Department; USFS = U.S. Forest Service; USFWS = U.S. Fish and Wildlife Service

7.2 Review of the Draft Plan-EA

NRCS published the proposed Draft Plan-EA on Oregonwatershedplans.org for public review on June 8, 2021, for an initial 30-day comment period. In response to public comments, on July 8, 2021, NRCS extended the public comment period to end on July 23, 2021. During the comment period, NRCS hosted a virtual public outreach meeting on June 23, 2021, using Zoom online meeting software. Specific public outreach activities for the Draft Plan-EA included:

- NRCS public notice (June 8, 2021) nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/pnotice/?cid=nrcseprd1788239

- NRCS news release (June 8, 2021) nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/releases/?cid=NRCSEPRD1788245

- AID postcard to patrons and landowners adjacent to the proposed project (June 8 and July 8, 2021)

- NRCS letters to tribes and agencies (June 16, 2021)

- Bend Bulletin public notice (June 8, 15, and 22, July 8 and 15, 2021)

- FCA emails to stakeholder list (June 8 and 21, July 8 and 23, 2021)

- Virtual public outreach meeting hosted via Zoom webinar (June 23, 2021) at 6:00 p.m. A recording of the meeting is available at oregonwatershedplans.org/arnold-id

NRCS sent a letter on June 16, 2021 to the CTWS providing a link to the Draft Plan-EA and outlining the public comment period. CTWS provided no comments on the Draft Plan-EA. NRCS followed up with a meeting with CTWS on May 26, 2022, to complete tribal consultation.

Comments on the Draft Plan-EA were submitted by email to arnold.id.comments@gmail.com, online at oregonwatershedplans.org, and by mail to Farmers Conservation Alliance, 101 State Street, Hood River, Oregon 97031.

During the review period, 451 comments on the proposed Draft Plan-EA were received. NRCS has reviewed all public comments and has made changes, as appropriate, to this Final Plan-EA based on those comments and internal review. Each comment received consideration in the development of the final rule. According to the NEPA Handbook 6.9.2.1, substantive comments do one or more of the following:

- Question, with reasonable basis, the accuracy of information in the environmental impact statement or EA.

- Question, with reasonable basis, the adequacy of, methodology for, or assumptions used for the environmental analysis.

- Present new information relevant to the analysis.

- Present reasonable alternatives other than those analyzed in the environmental impact statement or EA.

- Cause changes or revisions in one or more of the alternatives.

For a full list of comments and responses, see Appendix A.

8 Preferred Alternative

8.1 Selection and Rationale for the Preferred Alternative

NRCS has selected the Piping Alternative as the Preferred Alternative[33] based on its ability to meet the project purpose and need, meet the Federal Objective and Guiding Principles (USDA-NRCS, 2017a), and provide the most beneficial effects on environmental, social, and economic resources. The Preferred Alternative is the only alternative that meets the purpose and need, funding requirements, and NEE Analysis benefit-cost ratio requirements. The Piping Alternative is the alternative that would maximize net economic benefits.[34] The District and project sponsors have agreed that the Piping Alternative is the Preferred Alternative.

Per requirements of the PR&Gs when selecting a preferred alternative, tradeoffs were considered. Although the Piping Alternative would have minor effects on various resources, those effects would be minimized or mitigated through BMPs and other compliance measures. As a tradeoff to those effects, the Piping Alternative would increase instream flows in the Deschutes River and support ecological resources in and along the Deschutes River system. Additionally, as described in the NEE Analysis, there would be positive economic benefits including NUID agricultural benefits, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, and avoided damage from failure of the open canal. When compared with the No Action Alternative in the face of current conditions and future environmental changes, the Piping Alternative would support the health and resiliency of the ecosystem downstream of Wickiup Reservoir, as well as agricultural land use within the District and within NUID.

8.2 Measures to be Installed

AID would pipe up to 11.9 miles of its Main Canal. Pipes would range in diameter from 48 to 60 inches. In total, 88 turnouts would be upgraded to pressurized delivery systems.[35] A concrete check and pipe inlet structure would be installed at the inlet of the pipe (i.e., the western end of the pipe). AID would install SCADA at the inlet of the pipe and at the terminus of the pipe. More details on construction and O&M of the Preferred Alternative are in Section 5.3.2.

8.3 Minimization, Avoidance, and Compensatory Mitigation Measures

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

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

[34] Net economic benefits are benefits minus costs and are not the same as the "benefit-cost ratio."

[35] Modifications to each turnout would include an appropriately sized tee from the mainline or lateral, a pressure-relief valve, a non-rising stem, a resilient-seat gate valve, a magnetic meter, a combination air and vacuum relief valve, another gate valve for throttling flows, and spool-pipe segments.

8.3.1 Construction Limits and Schedule

All construction would occur within the AID existing ROW and easements. If any temporary staging or construction access areas were required, AID or the contractor would communicate directly with the landowner to ask for permission. In addition, construction limits would be clearly flagged to preserve existing vegetation and private property. Prior to construction, AID would survey and identify trees greater than 2 feet in diameter within its ROW and easement. These trees would be flagged for avoidance during construction and retained to the extent possible. Access to residences, farms, and businesses would be maintained during construction. Construction would occur during the daytime to minimize disturbance to any landowners or other individuals in the vicinity.

8.3.2 Staging, Storage, and Stockpile

Mechanized equipment and vehicles would be selected, operated, and maintained in a manner that minimizes adverse effects on the environment. Appropriate emission-control devices would be required for all construction equipment. Construction staging areas would be selected and used to minimize effects on vegetation and avoid tree removal. Construction equipment and vehicles would be parked a minimum of 150 feet away from streams, wetlands, and other waterbodies at the end of each workday. Fueling and maintenance operations would be performed on a flat surface away from moving equipment and at least 150 feet away from any water source.

8.3.3 Roads and Traffic Control

Standard construction safety procedures and traffic-control measures would be employed to reduce the risk of collisions between construction vehicles and other vehicles, pedestrians, or bicyclists while construction is ongoing. Lane closures on roadways would be avoided during peak travel periods where possible to reduce potential traffic delays from construction vehicles. When needed, water or other dust suppressants would be used on unpaved roads and areas of ground disturbance to minimize dust and any effects on air quality.

8.3.4 Erosion Control

Silt fencing, straw wattles, geotextile filters, straw bales, or other erosion-control measures would be used to minimize soil erosion and prevent eroded soil from entering waterbodies during construction. Erosion-control measures would be free of weeds and weed seeds.

8.3.5 Noise Control and Spill Prevention, Control, and Countermeasure

Construction activities would comply with Chapter 8.08, Noise Control, of the Deschutes County Code (Deschutes County, 2022). Prior to beginning construction, properties adjacent to the construction area would be notified regarding the timing and duration of construction. During construction, the contractor would ensure that all equipment has the manufacturers' recommended noise abatement measures such as mufflers, engine enclosures, and engine vibration isolators, all construction equipment is regularly inspected to ensure proper maintenance and presence of noise-control devices (e.g., mufflers and shrouding); and when not in use, equipment is turned off and not idling.

Spill kits would be located at fuel storage areas, and the construction crew would have adequate absorbent materials and containment booms on hand to clean up spills quickly. In times of burn bans or wildfire concerns, each crew would have a fire suppression kit.

8.3.6 Invasive Species Control

The following measures would be followed to avoid introduction of invasive plants and noxious weeds into project areas:

- Limit ground disturbance to areas necessary to safely implement the Preferred Alternative.
- Begin activities in areas un-infested with invasive plants or noxious weeds before operating in infested areas.
- Use un-infested areas for staging, parking, and cleaning equipment. Avoid or minimize all types of travel through infested areas and restrict work to those periods when the spread of seed or plant reproductive parts is least likely.
- When it is necessary to conduct soil work in infested roadsides or ditches, schedule activity when seeds or propagules are least likely to be viable or spread.
- Inspect material sources at their site of origin to ensure that they are free of invasive plant material before use. If possible, treat contaminated material before any use.

8.3.7 Revegetation

Areas disturbed during access or construction would be regraded to their original contours. When necessary, compacted areas such as access roads, staging, and stockpile areas would be loosened to facilitate revegetation and improve infiltration. Disturbed areas would be planted with a native seed mix appropriate to the habitat and the seed mix would be certified as weed-free. Revegetation practices would follow the NRCS *Oregon and Washington Guide for Conservation Seedings and Plantings* (USDA-NRCS, 2000). Pruning would occur entirely within AID ROW and easement and would not exceed what is required for equipment clearance.

8.3.8 Wildlife Mitigation

Construction would occur outside the primary nesting period for migratory birds of concern (April 15 through July 15) and raptors (April through July). If construction were scheduled to occur during the primary nesting period, construction would occur outside the USFWS-approved buffer distance of any known nests. Should an active nest be found, construction would be paused and a consultation with a local USFWS biologist would occur to determine the following steps.

8.3.9 Cultural Resources Mitigation

Since the proposed project avoids all NRHP eligible resources, no mitigation is required. If archaeological resources were inadvertently discovered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop near the discovery, the area would be secured and protected, a professional archaeologist would assess the discovery, and consultation with SHPO, NRCS cultural resources staff, THPO, and other consulting parties including affiliated tribes and ACHP would be notified and have the opportunity to comment. Construction would continue in accordance with applicable guidance and law.

8.3.10 Water Resources Mitigation

Following the completion of each phase, AID would work with OWRD and its partners to verify and measure all water savings. More information on how AID and NUID would protect the saved water is in Section 6.8.2. Additionally, to reduce effects on junior water right holders, AID would voluntarily reduce its maximum diversion rate and identify 118 cfs as the District's season 3 pre-project maximum diversion rate and 106 cfs as the District's season 2 pre-project maximum diversion rate for the purposes of any water right administrative actions (S. Johnson, personal communication, February 9, 2022).

8.4 Land Rights and Easements

AID ROW and easements underly its entire infrastructure in the project area, and AID would not need to acquire any additional easements for installation of the proposed project. The AID ROW was granted under the Carey Act (2020); it extends 50 feet on each side of the canal from the toe of the bank for a total easement width of 100 feet plus the width of the canal (see Appendix C for a map of the Carey Act ROW). In places where AID has other easements separate from the Carey Act, the widths of the easements vary. All construction would occur within existing AID ROW and easements, and construction would not necessarily use the full width of the ROW or easement (see Section 5.3.2 for additional information). Prior to construction, the contractor would identify if temporary staging or construction access areas outside of AID ROW and easements were required. If any temporary areas were required, AID or the contractor would communicate directly with the landowner to ask for permission. No land would be acquired for construction of the Preferred Alternative.

8.5 Permits and Compliance

8.5.1 Local and County

Deschutes County Planning: Under OAR Chapter 340, Division 18, a Land Use Compatibility Statement would be submitted for County approval prior to construction.

8.5.2 State

Department of Environmental Quality: The National Pollutant Discharge Elimination System program implemented by DEQ would require a permit for construction activities including clearing, grading, excavation, materials or equipment staging, and stockpiling that would disturb 1 or more acres of land and have the potential to discharge into a public waterbody.

Oregon Water Resources Department: To change the place of use, character of use, and/or point of diversion/appropriation of a water right, a water right transfer application must be approved by OWRD.

Department of State Lands: A wetland removal-fill permit from DSL would not be required for work in existing canals. Prior to initiation of construction of the project, surveys would be conducted to confirm the lack of wetlands in the project area as indicated by review of NWI and aerial imagery. If a wetland is identified, a wetland determination and/or delineation would be conducted. Wetlands would be avoided to the extent practicable.

Oregon Fish Passage Law: Laws regarding fish passage are found in ORS 509.580 through ORS 509.910 and in OAR 635, Division 412. Functioning fish screens are present at AID's irrigation diversion, and no fish are present within existing canals and laterals; therefore, no additional consultation or permitting is required.

Oregon State Scenic Waterways: The Oregon Scenic Waterway Act (ORS 390.805 – 390.925) was passed in 1970 to enable federal, state and local agencies, individual property owners and recreational users to work together to protect and wisely use Oregon's special rivers. The act specifies that all fill and removal in a state scenic waterway requires an individual removal-fill permit from the Department of State Lands. No fill or removal would occur within an Oregon scenic waterway, so no permit would be required.

8.5.3 Federal

National Historic Preservation Act Section 106: Pursuant to 36 CFR Part 800 of NHPA (Protection of Historic Properties, 2012) and regulations of the ACHP implementing Section 106 of the NHPA (Effect of undertaking on historic property, 2020), federal agencies must take into account the potential effect of an undertaking on "historic properties," which refers to cultural resources listed in, or eligible for listing in, the NRHP. Consultation with SHPO, NRCS, THPO, and other consulting parties including affiliated tribes to fulfill Section 106 obligations would be completed for the proposed project prior to implementation.

Clean Water Act:

- **Section 404:** Under Section 404(f)(1)(C) of the CWA, discharges of dredged or fill material associated with construction or maintenance of irrigation ditches, or the maintenance (but not construction) of drainage ditches, are not prohibited by or otherwise subject to regulation under Section 404. Discharges of dredged or fill material associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities—as are appurtenant to and functionally related to irrigation ditches—are included in the exemption for irrigation ditches. Under 33 CFR 323.4(a)(1)(iii)(C)(1)(i), "[c]onstruction and maintenance of upland (dryland) facilities such as ditching and tiling, incidental to the planting, cultivating, protecting, or harvesting of crops, involve no discharge of dredged or fill material into waters of the United States, and as such never require a Section 404 permit." The construction and maintenance of irrigation ditches and maintenance of drainage ditches may require the construction and/or maintenance of a farm road. The Subsection 404(f)(1)(E) exemption for discharges of dredged or fill material associated with the construction or maintenance of farm roads applies where such related farm roads are constructed and maintained in accordance with BMPs. However, as stated in 33 CFR 323.4(a)(6) and 40 CFR

232.3(c)(6), there must be assurance that flow and circulation patterns and chemical and biological characteristics of waters of the United States are not impaired, that the reach of the waters of the United States is not reduced, and that any adverse effect on the aquatic environment would be otherwise minimized (Discharges not requiring permits, 2021; Activities not requiring permits, 2021). Prior to construction activities, coordination and consultation with USACE would occur and measures would be taken as required to identify and mitigate impacts to potential jurisdictional wetlands and waters of the United States.

- **Section 401:** Implemented by DEQ, see above.

Farmland Protection Policy Act: The Farmland Protection Policy Act (2020) directs federal agencies to identify and quantify adverse impacts of federal programs to farmlands. The Act's purpose is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses. All work would be done within existing easements and the ROW. The Preferred Alternative would support agricultural productivity and the intention of the Act.

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

- Due to the location of bull trout populations at the very downstream end of the area affected by District operations, bull trout would not be affected by implementation of the Preferred Alternative under consideration. Consequently, Section 7 consultation under the ESA as amended is not warranted for this species. Additionally, it has been determined that the project would not affect the PCEs identified for critical habitat for bull trout (Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Bull Trout, 2005). Therefore, it has been determined by NRCS that no effect would occur to federally designated critical habitat for bull trout.

- Implementation of the Preferred Alternative may affect, but is not likely to adversely affect, the Oregon spotted frog. Informal consultation with USFWS under Section 7 of the ESA has been initiated and was completed on August 1, 2022 when the Letter of Concurrence was received by NRCS (2022-0062518-S7).

- The Middle Columbia River steelhead population present in the Deschutes River is classified as a non-essential experimental population under Section 10(j) of the ESA and is treated as "proposed for listing" because the population is located outside of a National Wildlife Refuge

System or a National Park System. Federal agencies are not required to consult with NMFS because the proposed project's effects are entirely beneficial and would not likely jeopardize the continued existence of the species proposed to be listed. NRCS, therefore, has determined that engagement with NMFS to obtain a conference report is not necessary (Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead Above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon, 2011; Endangered and Threatened Species: Designation of Experimental Populations Under the Endangered Species Act, 2016).

Magnuson Stevens Act: The Magnuson Stevens Act requires that Essential Fish Habitat (EFH) descriptions are included in federal fishery management plans, and it requires that federal agencies consult with NMFS on activities that may adversely affect EFH (PL 104-297). EFH can include all streams, lakes, ponds, wetlands, other viable waterbodies, and most of the habitat historically accessible to salmon necessary for spawning, breeding, feeding or growth to maturity. As the Preferred Alternative would not adversely affect EFH, consultation under the Magnuson Stevens Act is not required.

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

Migratory Bird Treaty Act: The MBTA implements various treaties and conventions between the United States and other countries including Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds (Protection of Migratory Game and Insectivorous Birds, 2020). Under the Act, taking, killing, or possessing migratory birds or taking, destroying, or possessing their eggs or nests is unlawful.

Bald and Golden Eagle Protection Act: The BGEPA prohibits anyone from "taking" bald and golden eagles (including their eggs or nests) without a permit from the secretary of the interior (BGEPA, 2020). Sections of the project area near Horse Butte Road and Knott Road are approximately 0.6 mile and 1.9 miles, respectively, from golden eagle nesting areas. Because of the proximity of the project area to nesting sites, BGEPA requirements would be implemented appropriately. Site clearance surveys would be conducted prior to implementation.

National Wild and Scenic Rivers Act: The National Wild and Scenic Rivers Act (2020) preserves and protects selected free-flowing rivers of the United States that, with their immediate environments, possess outstandingly remarkably scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

8.6 Costs

Total estimated project costs are $34,899,000 for the Preferred Alternative. PL 83-566 funds would support $26,198,000 of the total project cost, which includes $23,310,000 for construction costs, $2,412,000 for technical assistance, and $476,000 for project administration. The $8,701,000 remainder of the total cost would be contributed by the sponsors and other non-federal funds. Table

8-3 itemizes the costs for each project feature and the distribution of how the costs would be shared by the sponsors and NRCS for each cost item.

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

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

- The costs presented are planning-level estimates and do not reflect final costs. Detailed designs and construction cost estimates would be completed prior to initiating the proposed project. Final construction costs would only reflect the time and materials to perform the work.

8.7 Installation and Financing

The following subsections present further details regarding installing and financing the Preferred Alternative.

8.7.1 Framework for Carrying out the Plan

The Preferred Alternative would be implemented in a planned sequence as discussed in Section 8.7.2. NRCS and sponsor responsibilities for the proposed project are outlined in Section 8.7.3. No cost-shared, on-farm measures are involved with the proposed project; therefore, the responsibilities of individual participants do not need to be described. No preconditions are anticipated for installing the proposed project.

8.7.2 Planned Sequence of Installation

AID would obtain all approvals and permits for the proposed project prior to the start of construction. The entire project would be completed over a 6-year period commencing in 2022 and ending by 2028. AID developed a construction phasing schedule that prioritizes sections of the system with high loss; AID also worked within engineering and funding constraints to meet District, patron, and community development needs (see Table 8-1 and Figure 8-1).

Table 8-1. Expected Construction Timeline for the Piping Alternative.

Construction Phase	Expected Construction Years
1	2022–2024
2	2023–2026
3	2025–2027
4	2026–2028

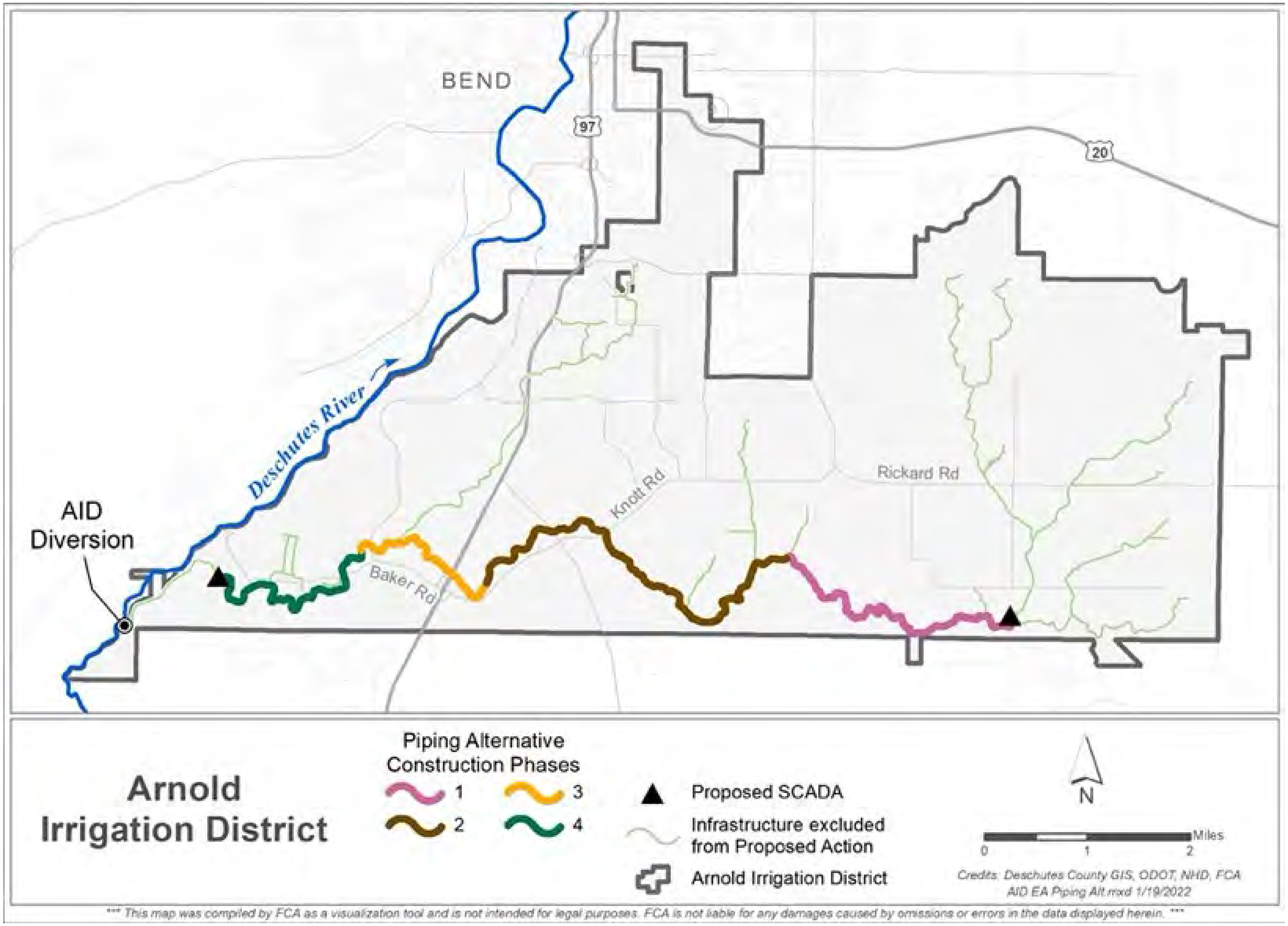

Figure 8-1. Preferred Alternative construction phase map.

8.7.3 Responsibilities

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

8.7.4 Contracting

Piping of the delivery system would be completed using NRCS funding mechanisms. AID would be primarily responsible for overseeing and administering project construction in coordination with NRCS.

8.7.5 Real Property and Relocations

Real property acquisition or relocations would not be required for the Preferred Alternative. All construction would be completed under either AID existing ROW or easements.

8.7.6 Financing

NRCS would provide funding for 75 percent of the total project cost for the Preferred Alternative through PL 83-566. AID is responsible for the remaining 25 percent of the costs including funds that are not eligible under the National Watershed Program. AID would not initiate construction of a project phase until federal and match funding for that phase has been secured. Table 8-2 presents installation costs and the proportion of funding through PL 83-566 and AID.

The required match funding would be expected to be provided through a mix of grants, loans, and patron assessments. To the extent possible, AID would strive to fully fund the match funding from grants through entities such as the Oregon Watershed Enhancement Board and OWRD. If financing were necessary, AID would apply for low interest financing through the DEQ Clean Water State Revolving Fund. Financing costs are not included in the NEE Analysis. AID does not anticipate changing per-acre annual rates or the overall base assessment fee due to any capital improvement project that is fully funded through grants.

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

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

8.7.7 Conditions for Providing Assistance

Conditions for AID to receive program funds for the implementation of the proposed project include completion of a Final Plan-EA, NRCS issuing a Finding of No Significant Impact, and authorization of funding by the chief of NRCS. The chief of NRCS acts on behalf of the secretary of the interior to ensure that the proposed project meets 16 U.S.C. 1005 (Works of improvement, 2020).

8.8 Operation, Maintenance, and Replacement

AID would be responsible for the O&M of the proposed project for the extent of its design life, as well as for any associated replacement costs and activities that could occur. Prior to construction, a separate O&M agreement based on the NRCS *National Operation and Maintenance Manual* (USDA-NRCS, 2003) would be made between NRCS and AID. The agreement would continue through the design life of the proposed project and could be modified with NRCS approval.

Project sponsors and NRCS would conduct annual inspections of project measures to ensure the quality of ongoing O&M. AID would be responsible for scheduling O&M inspections and for any necessary work. AID O&M would consist of a pipe inspection program that would systematically cover inspection of the entire system over a period of several years.

The proposed system would continue its current operation schedule of April through October, in which maintenance work would be performed on an as-needed basis. SCADA system maintenance would occur on a regular schedule and on an as-needed basis throughout the year. Outside of the irrigation season, AID would perform system component maintenance and/or repairs to District meters, valves, and air and vacuum infrastructure, as well as to the inlet structure. AID would expand its current vegetation and weed management to include the areas on top of the newly piped system. All procedures would be followed as specified in the O&M agreement between the project sponsors and NRCS.

8.9 Economic and Structural Tables

The PR&Gs require that an economic analysis be completed. A summary of the economic analysis of the Preferred Alternative (NEE Alternative) and No Action Alternative is provided in Section 5.4. The full NEE Analysis can be found in Appendix D.1. The Piping Alternative represents the future with federal funding through PL 83-566. The No Action Alternative represents the future if AID was not to receive federal funding.

Table 8-2 (NWPM 506.11, Economic Table 1) and Table 8-3 (NWPM 506.12, Economic Table 2) present the proportions of PL 83-566 funding and other funding sources. The average annual NEE costs are shown in Table 8-4 (NWPM 506.18, Economic Table 4). The costs shown are the annual costs for the Piping Alternative above the No Action Alternative, which is discussed further in the NEE Analysis in Appendix D.1.

Table 8-5 (NWPM 506.20, Economic Table 5a) presents the average annual watershed protection damage reduction benefits. The Preferred Alternative damage reduction benefits include NUID agricultural benefits, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, and avoided damage from failure of the open canal.

Using the resulting benefits and costs from Table 8-4 and Table 8-5, Table 8-6 (NWPM 506.21, Economic Table 6) presents a comparison of the NEE Analysis average annual benefits and average annual costs.

Table 8-2. Economic Table 1 – Estimated Installation Cost of the Piping Alternative, Water Resource Project Measures, Deschutes Watershed, Oregon, 2021$.[1,2]

Works of Improvement	Unit	Number			Estimated Cost (dollars)						
					PL 83-566 Funds			Other Funds			Total
		Federal Land	Non-Federal Land	Total	Federal land NRCS	Non-Federal Land NRCS [3]	Total	Federal Land	Non-Federal Land	Total	
Piping Alternative	Feet	0	62,966	62,966	$0	$26,198,000	$26,198,000	$0	$8,701,000	$8,701,000	$34,899,000
Total	**Feet**	**0**	**62,966**	**62,966**	**$0**	**$26,198,000**	**$26,198,000**	**$0**	**$8,701,000**	**$8,701,000**	**$34,899,000**

Notes: Totals may not sum due to rounding. Prepared: June 2022

1/ Price base: 2021 dollars.

2/ Project cost as identified in Crew (2017) and by communications with Black Rock Consulting in 2021, updated to 2021 dollars with additional engineering considerations, project administration, and technical assistance costs based on NRCS-OR guidance.

3/ Federal agency responsible for assisting in installation of works of improvement.

Table 8-3. Economic Table 2 – Estimated Piping Alternative Cost Distribution, Water Resource Project Measures, Deschutes Watershed, Oregon, 2021$.[1,2]

	Installation Costs – PL 83-566 Funds				Installation Cost – Other Funds				
Works of Improvement	**Construction**	**Engineering**	**Project Admin [3]**	**Total PL 83-566**	**Construction**	**Engineering**	**Project Admin [3]**	**Total Other**	**Total**
Piping Alternative	$23,088,000	$222,000	$2,888,000	$26,198,000	$7,695,000	$74,000	$932,000	$8,701,000	$34,899,000
Total	**$23,088,000**	**$222,000**	**$2,888,000**	**$26,198,000**	**$7,695,000**	**$74,000**	**$932,000**	**$8,701,000**	**$34,899,000**

Notes: Totals may not sum due to rounding. Prepared: June 2022

1/ Price base: 2021 dollars.

2/ Project cost as identified in Crew (2017) and by communications with Black Rock Consulting in 2021, updated to 2021 dollars with additional project administration and technical assistance costs. Of total estimated costs, 75 percent has been allocated for construction and 25 percent for engineering.

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

Table 8-4. Economic Table 4 – Estimated Average Annual NEE Costs for Piping Alternative Over the No Action Alternative, Deschutes Watershed, Oregon, 2021$.[1]

Works of Improvement	Project Outlays (Amortization of Installation Cost)	Other Direct Costs [2]	Total
Piping Alternative	$838,000	$14,000	$852,000
Total	**$838,000**	**$14,000**	**$852,000**

Note: Totals may not sum due to rounding. Prepared June 2022

1/ Price base: 2021 dollars amortized over 100 years at a discount rate of 2.25 percent.

2/ Other direct costs include the uncompensated economic losses due to changes in resource use or associated with installation, operation, or replacement of project structures, per PR&G guidance (USDA-NRCS, 2017a). Other direct costs are presented for an increase in pumping costs from increased depth to groundwater due to reduced recharge and associated increases in carbon and energy and replacement costs from SCADA and the inlet structure.

Table 8-5. Economic Table 5a – Estimated Average Annual Watershed Protection Damage Reduction Benefits for Piping Alternative Over the No Action Alternative, Arnold Irrigation District Watershed Plan, Deschutes Watershed, Oregon, 2021$.[1]

	Damage Reduction Benefit, Average Annual	
Item	**Agricultural-Related[1]**	**Non-Agricultural-Related[1]**
Onsite Damage Reduction Benefits		
NUID Reduced Agricultural Damage	$1,407,000	$0
Other – Reduced O&M	$211,000	$0
Other – Avoided Damage from Infrastructure Failure	$3,000	$0
Subtotal	**$1,621,000**	**$0**
Offsite Damage Reduction Benefits		
Other – Social Value of Carbon (Avoided Carbon Emissions)[2]	$0	$0
Instream Flow Value	$0	$41,000
Support to Oregon Spotted Frog	$0	$37,000
Subtotal	$0	$78,000
Total Quantified Benefits	**$1,621,000**	**$78,000**

Note: Totals may not sum due to rounding. Prepared June 2022

1/ Price Base: 2021 dollars amortized over 100 years at a discount rate of 2.25 percent.

2/ These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

Table 8-6. Economic Table 6 – Comparison of Average Annual NEE Costs and Benefits of the Piping Alternative Over the No Action Alternative, Arnold Irrigation District Watershed Plan, Deschutes Watershed, Oregon, 2021$.[1]

Works of Improvement	Agriculture-Related			Non-Agricultural		Average Annual Benefits	Average Annual Cost [2]	Benefit-Cost Ratio
	NUID Agricultural Damage Reduction	Reduced O&M	Avoided Infrastructure Failure Damage	Instream Flow Value	Oregon Spotted Frog			
Piping Alternative	$1,407,000	$211,000	$3,000	$41,000	$37,000	$1,699,000	$852,000	2.0
Total	**$1,407,000**	**$211,000**	**$3,000**	**$41,000**	**$37,000**	**$1,699,000**	**$852,000**	**2.0**

Note: Totals may not sum due to rounding. Prepared June 2022

1/ Price Base: 2021 dollars amortized over 100 years at a discount rate of 2.25 percent.

2/ From Economic Table 4 (see Table 8-4).

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10 List of Preparers

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

Table 10-1. List of Preparers.

Name	Title	Education	Professional Experience	Area Responsible For
FCA Watershed Plan-EA Team				
Kristin Alligood	Program Specialist	Ph.D. Biology B.A. Neuroscience	5 years	Fish and Aquatic Species, Vegetation
Raija Bushnell	Program Specialist	M.P.A. Natural Resource Policy M.S.E.S Natural Resource Management B.A. Political Science	7 years	Land Use, Visual
Brett Golden	Program Manager	M.E.M Environmental Management A.B. Environmental and Evolutionary Biology	15 years	General
Kate Hart	Program Specialist	M.S. Earth Science B.S. Earth Science	5 years	Purpose and Need, Soils, Public Safety, Alternatives, Preferred Alternative, General
David McKay	Program Specialist	M.P.A. Environmental Policy B.A. Political Science	7 years	Cultural Resources, Public Scoping
Amanda Schroeder	Program Specialist	B.S. Natural Resource Management	6 years	Water Resources, Wetlands, Wildlife, Socioeconomics, Wild and Scenic Rivers

Name	Title	Education	Professional Experience	Area Responsible For
NRCS - Oregon				
Gary Diridoni	Natural Resource Specialist	Fisheries Management Graduate Certificate B.S. Wildlife Management B.S. Interdisciplinary Studies, Ecosystem Conservation	18 years	General
Scarlett Vallaire	Watershed Planner	M.S. Ecology B.S. Biology	12 years	General
Louis Landre	Agricultural Economist	M.S. Applied Economics B.S. Biology	23 years	Economic and Socioeconomic Analysis
Lakeitha Ruffin	Agricultural Economist	M.S. Agricultural Economics B.S. Agricultural Economics	9 years	Economic Analysis
Tom Makowski	Assistant State Conservationist-Watershed Resources and Planning	Ph.D. Rural Sociology M.S. Social Psychology B.S. Recreation Resource Management	31 years	General
Employees from Firms Under Contract with FCA				
Barbara Wyse	Principal and Senior Economist, Highland Economics	M.S. Environmental and Natural Resource Economics B.A. Environmental Sciences and Policy	14 years	Economic Analysis

Name	Title	Education	Professional Experience	Area Responsible For
Winston Oakley	Research Economist, Highland Economics	M.S. Applied Economics B.S. Environmental Sciences, Policy, and Management	5 years	Economic Analysis
Jason Keller	GSA Analysis	B.S. Environmental Geoscience M.S. Soil, Water, Environmental Science	19 years	Groundwater
Becky Mellinger	Technical Editor, Parametrix	M.S. Geosciences B.A. Geology	20 years	Final Technical Edit
Jill McLain	Publications Specialist, Parametrix		34 years	Final Technical Edit

11 Distribution List

A Notice of Availability for this Final Plan-EA will be distributed to federal, state, and local agencies, community representatives, and area non-governmental organizations. The agencies, representatives and organizations on the mailing list include the following:

- Bend Parks and Recreation
- Business Oregon
- Central Oregon Land Watch
- City of Bend
- Coalition for the Deschutes
- Deschutes County
- Deschutes River Conservancy
- Deschutes Soil and Water Conservation District
- National Marine Fisheries Service
- Oregon Department of Agriculture
- Oregon Department of Energy
- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- Oregon Department of State Lands
- Oregon Department of Transportation
- Oregon Governor's Office
- Oregon Water Resources Department
- Oregon Watershed Enhancement Board
- State Historic Preservation Office
- Trout Unlimited
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Department of Agriculture, U.S. Forest Service, Deschutes National Forest
- U.S. Fish and Wildlife Service
- Upper Deschutes Watershed Council
- WaterWatch of Oregon

In accordance with EO 13175, Consultation and Coordination with Indian Tribal Governments, NRCS will contact CTWS regarding the availability of the Final Plan-EA.

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

12 Acronyms, Abbreviations, and Short-Forms

ACHP	Advisory Council on Historic Preservation
AID	Arnold Irrigation District
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
cfs	cubic feet per second
CFR	Code of Federal Regulations
COID	Central Oregon Irrigation District
CTWS	Confederated Tribes of Warm Springs
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DRW	Deschutes River Woods
DSL	Oregon Department of State Lands
EA	Environmental Assessment
EE	Environmental Evaluation
EFH	Essential Fish Habitat
EO	Executive Order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FCA	Farmers Conservation Alliance
HCP	Deschutes Basin Habitat Conservation Plan
IPaC	Information for Planning and Consultation
LPID	Lone Pine Irrigation District
MBTA	Migratory Bird Treaty Act
N/A	not applicable
NEPA	National Environmental Policy Act
NEE	National Economic Efficiency
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NUID	North Unit Irrigation District

NWI	National Wetland Inventory
NWPM	National Watershed Program Manual
O&M	operation and maintenance
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
OID	Ochoco Irrigation District
OM&R	operation, maintenance, and replacement
ORS	Oregon Revised Statute
ORV	Outstandingly Remarkable Value
OWRD	Oregon Water Resources Department
PCE	primary constituent element
PGE	Portland General Electric
PL	Public Law
PL 83-566	Watershed Protection and Flood Prevention Program, Public Law 83-566
Plan-EA	Watershed Plan-Environmental Assessment
project	Arnold Irrigation District Infrastructure Modernization Project
PR&G	Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies
Reclamation	United States Bureau of Reclamation
RM	river mile
ROW	right-of-way
SHPO	State Historic Preservation Office
SID	Swalley Irrigation District
THPO	Tribal Historic Preservation Office
TID	Tumalo Irrigation District
UGB	urban growth boundary
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
U.S.	United States

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14 Appendix A-E

Appendices are provided in a separate document.

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

Deschutes Basin Board of Control

February 16, 2023

Steven Johnson
Arnold Irrigation District
19604 Buck Canyon Road
Bend, OR 97702

RE: Support for Arnold Irrigation District Infrastructure Resiliency and Modernization Project

Dear Steven,

The Deschutes Basin Board of Control is writing in support of Arnold Irrigation District's efforts to enclose their network of open porous canals into leak-free piping through the Arnold Irrigation District Infrastructure Resiliency and Modernization Project in coordination with the Natural Resources Conservation Service (USDA).

We believe this project will provide the much-needed improvements to water quality and quantity in the Deschutes Basin through the resulting water conservation of 32.6 cfs, water supply reliability for agriculture, and public safety improvements by enclosing nearly twelve miles (11.9 miles, 62,868 length-feet) of canal.

The project will have an immediate benefit to improving streamflow, water quality, habitat, and habitat availability in the Deschutes River downstream from Wickiup Reservoir by returning 100 percent of the water saved instream; supporting water supply availability and resiliency; and minimizing the potential for public health and safety risks including flooding, injury, and loss of life associated with the open canals.

This project aligns with our interests in restoring stream flow and improving water quality in the basin. This will support native and threatened species including the Oregon spotted frog, steelhead, red band trout, and other listed species. This effort is a part of a basin-wide water management planning effort for long-term resiliency and management of the Deschutes Basin providing reliability to agriculture while also restoring instream water and habitat.

Sincerely,

Craig Horrell, President DBBC

DESCHUTES RIVER
CONSERVANCY

February 13, 2023

Steven Johnson
Arnold Irrigation District
19604 Buck Canyon Road
Bend, OR 97702

RE: Support for Arnold Irrigation District Infrastructure Resiliency and Modernization Project

Dear Mr. Johnson,

The Deschutes River Conservancy (DRC) is writing in support of Arnold Irrigation District's efforts to enclose their network of open porous canals into leak-free piping through the Arnold Irrigation District Infrastructure Resiliency and Modernization Project in coordination with the Natural Resources Conservation Service (USDA).

We believe this project will provide much-needed improvements to water quality and quantity in the Deschutes Basin through water conservation savings of 32.6 cfs, water supply reliability for agriculture, and public safety improvements by enclosing nearly twelve miles (11.9 miles, 62,868 length-feet) of canal.

The project will have an immediate benefit to improving streamflow, water quality, habitat, and habitat availability in the Deschutes River downstream from Wickiup Reservoir by returning 100 percent of the water saved instream; supporting water supply availability and resiliency; and minimizing the potential for public health and safety risks including flooding, injury, and loss of life associated with the open canals.

This work directly supports the DRC's mission to restore streamflow and habitat in the Deschutes River. Protected instream flow will benefit native and threatened species including the Oregon spotted frog and red band trout. This effort is a part of a basin-wide water management planning effort for long-term resiliency and management of the Deschutes Basin providing reliability to agriculture while restoring instream water and habitat.

Sincerely,

Kate Fitzpatrick

Executive Director

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

File Name: Support for Arnold Irrigation District Infrastructure Resiliency and Modernization Project
TS Number: 22-299
Doc Type: Letter

Steven Johnson, District Manager
Arnold Irrigation District
19604 Buck Canyon Road
Bend, Oregon 97702

RE: Support for Arnold Irrigation District Infrastructure Resiliency and Modernization Project

Dear Mr. Johnson:

The U.S. Fish and Wildlife Service (Service) Bend Field Office is writing to you in support of the Arnold Irrigation District Infrastructure Resiliency and Modernization Project (Project). The Service supports the Project because the conservation benefits include permanent protection of flows in the Deschutes River. This protection of instream water provides enhanced ability to increase flows from storage in Wickiup Reservoir into the Deschutes River, which can benefit the Oregon spotted frog, a species Federally-listed as threatened under the Endangered Species Act.

Upon completion of the Project, nearly 12 miles of open irrigation canal will be piped. Piping the main canal will conserve an estimated 32.6 cfs of flow (11,083 acre-feet of reservoir storage) by eliminating seepage and evaporation, increasing flows in the Upper Deschutes River flows below Wickiup Reservoir by an equivalent amount (32.6 cfs).

The Service supports projects when they provide permanent instream water. It is our understanding that the State of Oregon will receive the water rights to the conserved water associated with public funding, which will be applied to permanent instream use. For the reasons stated above, the Service supports the Arnold Irrigation District Infrastructure Resiliency and Modernization Project.

We appreciate your efforts to conserve water and to provide instream benefits to fish and wildlife in the Deschutes River. If you have any questions or I can be of any assistance, please contact me at 541-383-7146.

Sincerely,

Bridget Moran
Field Supervisor

ARNOLD IRRIGATION DISTRICT SYSTEM IMPROVEMENT PLAN

June 2017

Prepared by:
Kevin L. Crew, P.E.
Black Rock Consulting

BLACK ROCK

320 SW Upper Terrace Drive, Suite #102, Bend, Oregon 97702, (541)480-6257

&

Farmers Conservation Alliance

fca

101 3rd Street, Suite #101, Hood River, Oregon 97031, (541)716-6085

Prepared for:

ARNOLD
IRRIGATION DISTRICT

Table of Contents

Executive Summary

Farmers Conservation Alliance commissioned this System Improvement Plan with support from the 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 November of 2016, a meeting was held with District staff to confirm the approach on the SIP. Data requests were fulfilled by the District. The District determined that a value of 7.55 GPM/Acre should be used for hydraulic modeling and pipe sizing purposes (the water right to on-farm). The cost estimating resulting from the SIP should provide District flexibility and should provide grouped project seepage loss and cost of mitigation (through piping) information. Lastly, the model should include future acreage capacity in 6 laterals.

The District's patrons are served by one primary diversion, canal, and lateral system with approximately 46 of the irrigated acres being served directly from Deschutes River withdrawals. The current estimated acreage diverted into the primary canal serves approximately 3,963 acres. The primary canal and laterals were evaluated for seepage loss using state-of-the-art measurement equipment and it was found that approximately 56 CFS were being lost at the time of measurements. After adjustment for an approximate 10 CFS repair, the loss rate was adjusted to 45.8 CFS. Of the 45.8 CFS, it was determined that approximately 32 CFS might be conserved if the system were completely piped (assuming certificated peak flows of 7.55 GPM/Acre delivered).

The District chose to consider pressurization to patron deliveries as it rolls-out its System Improvement Plan. Fully piping the District system will accomplish moderate pressurization of the District resulting in the estimated reduction of 1.02 GWh in patron pumping costs each season. No pressure reducing valves 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 grouped cost elements. An At-A-Glance Map and summary tables are provided below indicating the summary results of this System Improvement Plan.

Section 1

At-A-Glance System Modernization Summary

Figure 1.1 At-A-Glance Arnold Irrigation District System Improvement Plan

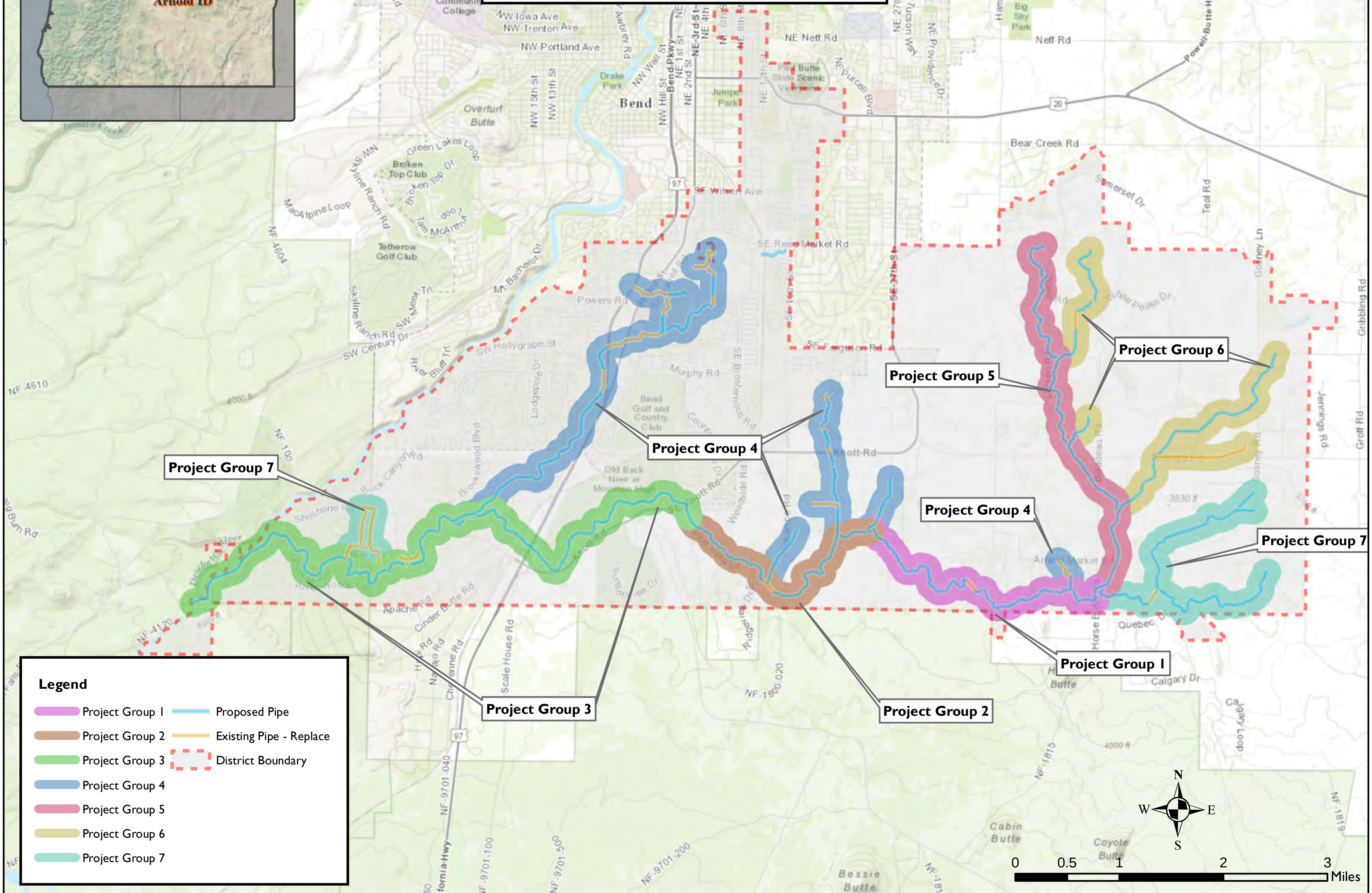


Table 1.1 At-A-Glance Main Canal and Lateral Piping Summary

AT-A-GLANCE - MAIN CANAL AND LATERAL PIPING					
PROJECT GROUP	CANAL/LATERAL	EST. WATER CONSERVATION (CFS)	EST. ENERGY CONSERVATION (KWH/YR)	LENGTH PIPED (FT)	RECON-ESTIMATED COST
1	Main Canal - Tail End	8.4	52,886	16,976	$6,011,611
2	Main Canal - Mid Section	6.9	48,519	13,963	$6,126,811
3	Main Canal - Upper	6.8	27,385	33,550	$20,292,533
3	Main Canal - Flume Replacement	0.0		5,394	$5,120,659
4	Arthur	5.8	144,923	49,415	$1,573,349
4	North				
4	Goat Farm				
4	Ladera				
4	M&M				
4	Estes				
5	Brandon	2.0	395,941	22,634	$3,355,261
6	Rastovich	1.0	256,588	31,093	$2,427,825
6	Penhollow and Billedeau Ropp				
6	McCardle				
6	Rickard				
7	Sundance	1.1	89,176	30,320	$1,919,103
7	Gosney				
7	DWC-1				
	TOTAL=	**32.0**	**1,015,417**	**203,345**	**$46,827,152**

Section 2

Project Description and Overview

2.0 Authorization

Farmers Conservation Alliance commissioned this System Improvement Plan with support from the Energy Trust of Oregon and authorized March 29, 2016 through a Consultant Services Agreement by and between the Farmers Conservation Alliance (FCA) and Black Rock Consulting (BRC).

2.1 Purpose

The Deschutes Reclamation and Irrigation Company, predecessor to Arnold Irrigation District (AID), was founded in 1899 and obtained its water rights for natural flow diversion from the Deschutes River with a priority date of September 1, 1899. From 1891 to 1923, the irrigation delivery system was constructed to serve what became the Arnold Irrigation District. The District currently serves approximately 4,384 acres (including instream leases) of irrigated lands located in the south area of Bend, Oregon, generally spanning east and west across Highway 97 and southerly of Highway 20. The District boundary is approximately 3 ½ miles (north to south) and 6 ½ miles long (east to west) and serves approximately 663 delivery accounts.

The District operates and maintains over 39-miles of main canal and laterals, including existing piped segments. The volcanic nature of the Central Oregon geology presents fractured basalt, cinder, and varied substrates that results in a propensity for seepage losses in many areas of the AID canal system.

The purpose of this System Improvement Plan (SIP) is 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. Consistent with its existing modernization program, well under way, system piping is to be the primary method proposed for such mitigation.

The plan will become a key element of the District's planning documents and is expected to become the basis for future phased construction of the District's conveyance system. Phases or portions of this plan will be implemented by the District only when, as determined by the Board, funding is available that will minimize impacts on AID patron assessments and not result in reduced on-farm deliveries.

2.2 Scope of Services

Black Rock Consulting (hereinafter “BRC”) was employed to provide the following services and deliverables in conjunction with this plan:

Kickoff Meeting -

> BRC met with District staff and management to confirm approach to the study. BRC developed a list of questions to review with District staff. At these meetings BRC requested documents for major system elements that affected system hydraulic modeling, requested a copy of the District Water Conservation Plan, and requested water diversion and water right information, and associated operational input from the District.
>
> BRC discussed seepage loss information with the District and discussed the concluded loss assessment program implemented by BRC within the District.
>
> BRC inquired about energy dissipation approach preferences of the District (i.e. hydroelectric power generation and pressurized delivery preferences).

Review of Materials -

> BRC reviewed materials obtained from the District following the kick-off meetings to insure that required materials for moving the study forward were obtained or readily supplemented during the study to develop the deliverables indicated below. Data gaps that were found during the meeting process were identified and resolved with District staff.

Coordination -

> BRC coordinated with AID staff at various project milestones to confirm that the System Improvement Plan continued to be developed in accordance with the direction of AID.

Seepage Loss Study -

> BRC coordinated the development of seepage loss study with AID staff. The seepage loss study identified a program of seepage loss measurements for the AID system to support loss assumptions to be used in the SIP and to assist with water conservation estimates and system implementation phasing development.

Review of Provided Flow Data -

> BRC provided a thorough review of diversion data and on-farm delivery rates (per water right certificates) to insure a clear understanding of delivery approach. BRC coordinated with the District to insure rates used in system evaluation and modeling were as directed by the District.

AID SIP Base Map Development -

In conjunction with AID staff, BRC, AID, and FireWhat? developed a SIP primary and secondary canal and lateral system base map. The base map was populated with the AID primary and secondary canal system in its existing state.

AID SIP Improvement Map Development -

BRC (with AID input) developed a proposed primary and secondary system piping overlay on the base map. To the extent possible, existing mapping obtained as described above was used for this purpose. This map included an aerial underlay as available and as practical to manage file size.

AID SIP Hydraulic Model -

BRC confirmed approach regarding system pressurization with AID. Following the agreed approach discussed with AID and following delivery of basic system control and elevation information from FireWhat?, BRC then modeled the primary and secondary system elements (i.e. primary and secondary system canals and laterals) with EPANET hydraulic modeling software. Flow assumptions were based upon the rates agreed with AID staff. From iterations of model runs, BRC developed system elements including piping, pressure reducing elements; i.e. PRV stations, hydroelectric power plant locations, primary system valving points, etc. Pipe materials and diameters were determined during this analysis.

AID SIP Phasing Approach -

In conjunction with the system model and upon review with AID, BRC developed a system improvement cost estimate that was broken down by District lateral elements. This will allow the District flexibility in implementation development and design decisions based upon funding availability and other critical considerations.

AID SIP Conservation Table -

BRC developed a table indicating water conservation estimates based upon historic diversions, desired delivery rates within a fully piped system, and also corroborated by the loss assessment program results.

Final SIP Mapping -

In conjunction with AID staff, BRC developed a final SIP map indicating primary and secondary canal system elements, indications of existing and proposed piping, and other key system elements.

Reconnaissance-Level Cost Estimate -

BRC coordinated with a reputable material vendor and developed reconnaissance-level cost estimating for the proposed piping system and pumping identified for the District.

SIP Reporting -

BRC compiled the results of the SIP study into this System Improvement Plan draft report for review and comment by AID. Comments received were incorporated as appropriate into the Final SIP Report. The report includes mapping, and summarizes all findings for elements identified above.

2.3 Goals and Objectives – District Meeting(s*)*

As indicated in the scope, Black Rock Consulting met with District staff on November 3, 2016. Black Rock Consulting and District staff discussed key project parameters required to establish the approach for the SIP.

The meeting was attended by:

Shawn Gerdes, District Manager
Colin Wills, District Operations
Juanita DeJarnett, District Administrations
Kevin L. Crew, Principal, Black Rock Consulting

Key agenda items addressed were as summarized below:

1) Data Needs: District Water Right Certificates, District's Water Management and Conservation Plan, District's Most Recent Irrigated Acre Accounting (Direct River Points of Delivery and Primary Diversion).

   These materials were either provided to Black Rock Consulting and discussed in some detail, or Black Rock Consulting was directed where to obtain these materials. Clarifications were provided by the District.

2) What are the plans for piping and pressurization of the District?

   The District has some segments of piping already in place, including inverted siphons and some lateral piping. Certain segments of existing pipe may tolerate pressurization whereas others likely will not. Some larger siphons on the main canal may serve as carrier pipes (i.e. sleeves) for proposed piping. With only a few noted exceptions, the entire system should be modeled and new proposed pipe sized. The District will evaluate what pipes it may wish to preserve once it has the model results, including *anticipated pressures, etc. and as it designs and implements its improvements.*

Generally, the District plans to pipe a majority of its system, however, the prioritization and timing of piping will be an ongoing consideration by the District. Phases or portions of the plan will be implemented by the District, only when, as determined by the Board, funding is available that will minimize impacts on AID patron assessments and not result in reduced on-farm deliveries.

It is anticipated that pressures within the piped system will not support significant hydroelectric power generation potential versus the benefit of pressurization to the patrons and reduction in pumping costs.

3) Given that water rights would dictate a delivery of 21.59 GPM/Acre for peak delivery flow rate (including transmission loss) to the District's irrigated properties, what flow rate should be used in the model for peak flow rates?

   The model should use 7.55 GPM/Acre for normal delivery modeling at 5 FT/S velocities or less in system elements per NRCS guidelines. The one exception is the North Lateral that should be modeled at 5.5 GPM/Acre in anticipation of further flow rate reductions in that lateral over time. It must also be confirmed that one additional condition will work within the proposed systems: an uncommon high flow rate of 9 GPM/Acre with allowance for velocities to exceed 5 FT/S should be evaluated. This would insure that the system will operate satisfactorily under future scenarios if additional irrigated lands were attributed to the canal system and to address climate change scenarios.

4) Black Rock Consulting indicated that it planned to break the canal piping cost estimates into lateral by lateral estimates, and the remaining primary canal estimate to provide the District with a high level of flexibility in project financial planning and implementation packaging.

   The District agreed with this approach.

5) Does the District anticipate any shift of acreage or flow rates within the District boundary and service areas?

   Yes. The District sees the North Lateral as an element of the system that has slowly reduced in irrigated acreage and delivery flow rates over time due to urbanization. This lateral has some hydroelectric power production potential, however, the long term flows in that lateral and associated future reductions are a challenge for hydroelectric power plant sizing. Other laterals at the east extremity of the main canal are anticipated to *serve slightly more demand over time and this is an anticipated shift of overall demand in the system within the existing District service area.*

The District estimated irrigated acreage shifts as follows, and should be incorporated into hydraulic modeling to insure future capacity:

- *Sundance Lateral - 80 Acres*
- *Gosney Lateral - 120 Acres*
- *McCardle Lateral - 150 Acres*
- *Brandon Lateral - 50 Acres*
- *Rastovich Lateral - 50 Acres*
- *Rickard Lateral - 20 Acres*

Section 3

Existing System

3.0 Existing System Description

Please refer to Figure 3.0.1 below regarding the existing District Delivery System that indicates the District service territory boundary, measurement points, and the primary canal system.

Under its water rights, the Arnold Irrigation District diverts water directly from the Deschutes River. The source of diverted water is based upon the two water right certificates that govern the District's storage and direct river diversion limitations as indicated in Section 3.1. For storage withdrawals, the District cooperates with Central Oregon Irrigation District, North Unit Irrigation District, and Lone Pine Irrigation District based upon an inter-governmental agreement. The District diverts its water from the Deschutes River at its primary diversion point located south of Bend and next to the Newberry Monument. In addition to this main Arnold Canal diversion, the District's water rights also allow for service to six direct river deliveries. Once water is diverted into the primary Arnold Canal, the water passes the District's radial gate that regulates the intake flow rate, its vertical flat-plate fish screen, into its aerial flume, and on into its delivery network. Flows into the system are currently measured by the Oregon Water Resources Department's gauge; the District is in the process of adding measurement and control just below its fish screen.

As indicated on Figure 3.0.1, the AID main canal conveys water generally north and easterly starting with an approximate 1-Mile long aerial flume and trestle system, and then transitioning to a typical earthen and rock substrate open canal. After the flume, the main canal runs approximately 12 miles from east to west, terminating in the Brandon and Sundance Laterals. Along the way it delivers to patrons and to several laterals as indicated on Figure 3.0.1; as indicated piping and siphon piping has occurred within the District. Retention of any of these pipes will be considered on a case-by-case basis by the District and in design for piping improvements. In all, the District operates and maintains over 39 miles of canal and piping in the system.

Water diverted into the Arnold Irrigation District passes through a generally topographically gradual system. The main canal falls about 60-FT from east to west in the District. The maximum differential in the District from the intake to the extremity of a lateral is approximately 200-FT.

In addition to the primary canal system, the District has several direct deliveries from the Deschutes River as indicated on Figure 3.0.1. These direct deliveries (Points of Delivery "POD"s) account for approximately 46 acres of the District's total certificated rights and are monitored and metered by the District.

Patron turnouts from the District's main canal and laterals are typically gate regulated and weir measured. The District regulates flows to each system lateral and patron turnout via its field staff.

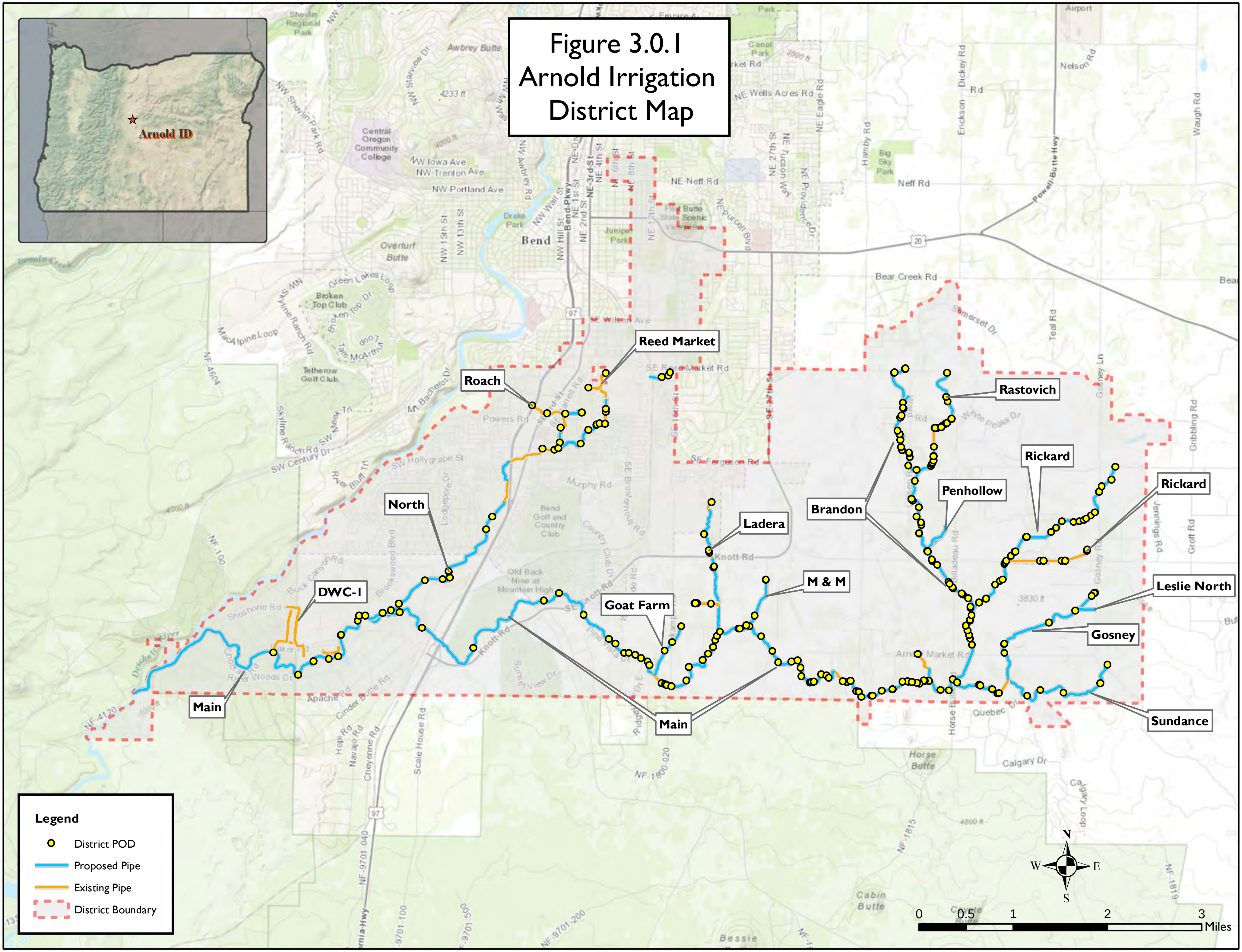


Figure 3.0.1 Arnold Irrigation District Map

3.1 Water Supply and Certificates

The Arnold Irrigation District operates based upon two water right certificates: its direct Deschutes River diversion certificate and its Crane Prairie storage right certificate. Complete water right information is not included in this SIP but may be obtained from the Oregon Water Resources Department and viewed in the District's Water Management and Conservation Plan on file with the Oregon Water Resources Department. It should be noted that the District's water rights change from time to time with conservation activities, hydroelectric power development, transfers, and other water right activities. For the purposes of this SIP, the primary goal is to evaluate the modernization of the District's conveyance system; therefore, information regarding Water Right Certificate #74197 is provided below.

Source: Deschutes River, a tributary of the Columbia River
Priority: February 1, 1905 (25.0 CFS), April 25, 1905 (125.0 CFS)
Use: Primary source for entire District
Irrigation: 3,976.05 Acres
Pond Maintenance: 35.71 Acres/equivalent
Quasi-Municipal Use: 347.59 Acres/equivalent
Industrial: 23.2 Acres
Domestic Use and Stock Water: 1.5 Acres
Maximum Rate: 150.0 CFS
Duty: Main Canal at 15.42 AF maximum per acre at the diversion from the source. (65% transmission loss in the canal system as allowed by the Court. No transmission loss allowed for direct withdrawals at individual points of delivery from the Deschutes River.

<u>QUANTITY FOR CANAL DIVERSIONS FROM SOURCE</u>

Season 1: April 1 – May 1 and Oct. 1 – Nov. 1: 1 CFS to 51.0 Acres
Season 2: May 1- May 15 and Sept. 15-Oct. 1: 1 CFS to 39.0 Acres
Season 3: May 15- Sept. 15: 1 CFS to 20.8 Acres

For the purposes of this SIP, the most critical elements of this certificate are the duty and the rates allowable for "Canal Diversions from the Source." As indicated in the duty criteria above, there is currently an allowance of 65% for transmission losses within the canal system. This loss accounts for evapotranspiration, seepage, and other losses within the large District canal conveyance systems as water is conveyed in excavated canals that cross a variety of rocky and soil substrates. The piping evaluated to improve the canal system in the Arnold Irrigation District will mitigate system losses. The extent of mitigation is further discussed in the System Loss Assessment section of this SIP.

In terms of quantities allowed for diversion into the District canals, the peak allowable is indicated above at 1 CFS per 20.8 Acres. This equates to approximately 21.59 GPM/Acre. After multiplying this flow rate by 35%, the on-farm delivery flow rate is determined at approximately 7.55 GPM/Acre. Therefore, given a "tight" system with little or no losses, the diversion flow rate may clearly be reduced significantly. It should also be noted that at the beginning and the end of the irrigation season the allowable low flow rate for diversion from the Deschutes River is 1 CFS per 51.0 Acres (or 8.80 GPM/Acre) and to each farm is 3.08 GPM/Acre (after reducing by 65%). This is important to the SIP simply to note that system improvements should include provisions to not only accommodate peak system flow rates but to accommodate lower system flow rates that can create sedimentation issues if not properly accounted for.

3.2 On-Farm Water Demand Analysis - Acreage and Duty

As indicated above, the current allowable diversion during peak irrigation season is 15.42 AF/Acre with an assumption after losses of 5.40 AF/Acre on-farm. The rate during peak season is 7.55 GPM/Acre after reducing the diversion rate by the certificated transmission losses.

For the purposes of this SIP, and based upon District input as indicated above, a SIP design delivery flow rate to on-farm was established at the calculated on-farm rate of 7.55 GPM/Acre (with the exception of the North Lateral that was given a design delivery rate of 5.5 GPM/Acre). At these rates, and based upon the Natural Resources Conservation Service criteria, 5 FT/S was used as a maximal velocity criteria for proposed piping of the system. The pipe models were also evaluated to an extreme value of 9 GPM/Acre to insure that the system would still function properly and to insure future flexibility to the District. Under this higher flow rate per acre of irrigated area, velocities were evaluated to insure that the they did not dramatically exceed the 5 FT/S criteria.

3.3 System Loss Assessment

Black Rock Consulting worked with the District to coordinate a seepage loss study performed by Farmers Conservation Alliance staff under Black Rock Consulting/Kevin L. Crew, P.E and David C. Prull, P.E. direction. During the summer of 2016, the Seepage Loss Assessment Program (LAP), supported by Oregon State University and the Oregon Water Resources Department, was implemented in 7 of the 8 Central Oregon irrigation districts to inform the Districts of current system losses and to enhance SIP development for these Districts. The program included the use of newly purchased and calibrated Flowtracker II technology, manual, and office and field training, all in accordance with the United States Geological Survey and United States Bureau of Reclamation "Discharge Measurements at Gauging Stations – Chapter 8 of Book 3, Section A, Techniques and Methods 3-A8." The program was managed by Oregon Registered Professional Engineers, Kevin L. Crew, P.E. and David C. Prull, P.E.

The primary purpose of the LAP was to perform a one-time measurement program in each District thus providing the District SIPs of approximate seepage losses in elements of each system. The measurements were performed at different times of the irrigation season within each District, therefore the percentage of peak flow varied by District as the LAP team entered, measured, and exited each District. The results were used to provide a strong indication of losses. The results were interpolated or extrapolated based upon the maximal expected loss within each District as indicated in the SIP below. The final loss information was used to identify losses associated by project phase or lateral depending upon each specific District SIP. 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.

For Arnold Irrigation District, the LAP was implemented throughout the District's primary canal and system laterals. Tabular results for the LAP study within AID are included in Appendix A to this SIP. A tabulated summary version of the results are provided below in Table 3.3.1.

Table 3.3.1 Water Conservation Estimate by Canal and Lateral

ARNOLD IRRIGATION DISTRICT CONSERVATION ESTIMATE BY CANAL AND LATERAL					
PROJECT GROUP	CANAL/LATERAL	MEASURED (Y/N)	LOSS MEASURED (CFS)*	ADJUSTMENT FACTOR	ADJUSTED CONSERVATION ESTIMATE (CFS)
1	Main Canal - Tail End	YES	11.2	0.75	8.4
2	Main Canal - Mid Section	YES	9.2	0.75	6.9
3	Main Canal - Upper*	YES	12.1	0.56	6.8
3	Main Canal - Flume Replacement	NO	0.0	0.75	0.0
4	Arthur	YES	0.0	0.75	0.0
4	North	YES	6.1	0.75	4.5
4	Goat Farm	YES	0.0	0.75	0.0
4	Ladera	YES	1.1	0.75	0.8
4	M&M	YES	0.6	0.75	0.5
4	Estes	NO	0.0	0.75	0.0
5	Brandon	YES	2.7	0.75	2.0
6	Rastovich	YES	0.4	0.75	0.3
6	Penhollow and Billedeau Ropp	NO	0.0	0.75	0.0
6	McCardle	YES	0.9	0.75	0.7
6	Rickard	YES	0.0	0.75	0.0
7	Sundance	YES	1.0	0.75	0.8
7	Gosney	YES	0.4	0.75	0.3
7	DWC-1	NO	0.0	0.75	0.0
		TOTAL=	**45.8**		**32.0**
*Reduced by 10 CFS for repair after loss assessment was performed					

The adjustment factor provided in the table is the simple ratio of the estimated total piped conservation (fully piped system) at a delivery rate of 7.55 GPM/Acre, 32 CFS (see Table 3.3.2), versus the measured system loss of 45.8 CFS (after a 10 CFS repair-related reduction).

Total piped system conservation estimates were developed. Delivery acreages as assessed for the AID system were used to estimate the fully piped system flow rates at the peak certificate rate (7.55 GPM/Acre). Flow diversion data for the District were evaluated to determine the ordinary-peak diverted flow rate over the last seven years of operation (approximately 108 CFS peak). This ordinary-peak was compared to the peak piped flow rate to estimate potential conservation based upon a completely piped hydraulic delivery system (including all laterals and private laterals down to the individual patron turnouts). The results of this total conservation estimate are tabulated in Table 3.3.2. It should be noted that the 108 CFS ordinary-peak does not represent the highest intermittent flow rate observed by the District, that has been as high as 142 CFS. For the purposes of this SIP, however, the ordinary-peak was used to develop the potential conservation assessment for the District.

Table 3.3.2 Total Piped Water Conservation Estimate

ARNOLD IRRIGATION DISTRICT TOTAL PIPED CONSERVATION ESTIMATE			
Diverted Acreage*	Ordinary-Peak Diversion 2006-2016 (CFS)**	Diversion Flow Rate at 7.55 GPM/Acre (CFS)	Estimated Cons. at 7.55 GPM/Acre (CFS)
3,963	**98**	**66**	**32**
*Acreage is for the current Main Canal diversion and not all inclusive of the District **Reduced by 10 CFS for canal repair: 108 CFS - 10 CFS = 98 CFS			
Note: temporary peak observed by AID in recent years = 142 CFS			

Section 4

System Improvement

4.0 System Improvement Approach

The primary purpose of this SIP was to identify water conservation, hydroelectric power and pumped power conservation possibilities for the District, and to develop a mitigation strategy for system water losses. Although some limited piping has already occurred in the District, there remains a significant canal system calling for mitigation through piping. Consistent with its Scope of Services and the subsequent goals and direction provided by the District, Black Rock Consulting performed a comprehensive hydraulic and piping evaluation of the District.

There are two primary alternatives for the mitigation of seepage losses. The first is canal lining and the second is canal piping. Within each of these alternatives there are a variety of material choices. Canal lining involves the installation of an impervious system to cover the canal bottom and banks. Materials typically employed include geomembranes, rubber liners, shotcrete, or similar materials. Canal lining does not provide pressurization of the irrigation system and it also increases canal velocities, thus increasing hazard risk to people. Black Rock Consulting has performed 50-year life cycle evaluations of lining versus piping alternatives to the District and has not included these in this SIP. In summary, over a 50-year life cycle, it was found that canal lining may be less expensive to implement in its first installation cycle than piping, however canal lining requires significant maintenance and replacement cycles that ultimately cause it to exceed the cost of piping over time. Also, given the elevation differential across the District and the desire of the District to optimize pressurized deliveries to its patrons and reduce pumping electricity effects on the utility grid, piping was chosen as the District's preferred choice for canal water loss mitigation.

Black Rock Consulting commenced the process of hydraulic modeling for the Arnold Irrigation District by receiving base EPANET (.INP) files from FireWhat? in electronic form. The files were generated by FireWhat? by including spatially (i.e. northing, easting, and elevation) correct patron turnout locations including patron delivery flow rates at each turnout. Updated acreages by patron were provided by the District for this purpose. EPANET modeling is discussed further in this SIP below. From the base files, Black Rock Consulting inserted the data in EPANET and then began the process of including existing piped elements of the District. The District was modeled based upon the District's current system approach with an intake at the Deschutes River and incremental gravity pressurization of the system.

The system was evaluated as a completely closed system (i.e. fully piped and pressurized to its extremities). The completed model was calibrated and pipes were sized based upon selected pipe manufacturer information and a peak velocity of 5 FT/S for proposed piping at 7.55 GPM/Acre throughout the system (with the exception of the North Lateral that was modeled at 5.5 GPM/Acre).

Once this process was completed, the system was evaluated for cost as further detailed below. Project "Groups" were developed based upon one approach to incremental system piping as provided in this SIP. This approach is subject to modification based upon funding availability, District operation, and preference over time.

4.1 Pipe and Valve Materials

Pipe materials selections were made by Kevin L. Crew, P.E., based upon 29 years of experience with large diameter piping systems including 20 years of experience in Central Oregon. From the hydraulic model, both static and dynamic pressures were evaluated throughout the system to select appropriate pipe material options. For pipe up to 63-inches in diameter (covering all District piping needs), high density polyethylene solid-wall pipe was selected due to its outstanding abrasion resistance, longevity, and ability to be pulled into canal curve alignments. Costs for materials were obtained from large, reputable vendors that are active in bidding to Central Oregon projects.

While pressure reducing valves were not proposed in this SIP, they were evaluated in the event that any may be required for future use in parallel with hydroelectric power production or other energy dissipation needs that may arise. Valves for pressure reducing stations were technically assessed and narrowed down to plunger valves and Cla-Val valves. Both use internal energy dissipation within the valve to accomplish the needed pressure-sustaining function downstream of the valves. Cla-Val valves use a control tubing and a diaphragm/bonnet arrangement to adjust pressures within the pressure reducing apparatus. No power is necessary for the operation of a Cla-Val. Should pressure reducing valves be required in the future, Cla-Val E-90-01 pressure reducing valves should be considered.

4.2 Hydroelectric Power Potential, Pumping Mitigation, and Pressurization Approach

The hydraulic analysis for the District indicates that there is no appreciable hydroelectric power potential in the District; what pressurization exists may best be used for direct patron pumping offset benefit.

Pressurization of the system will occur as it is piped. The hydraulic model indicates that dynamic (i.e. pressures achieved during full flow operation of the system) will range from approximately 2 PSI to 46 PSI. In reality, system pressures will likely rise well above this pressure range as hydraulic losses (i.e. pressure losses) will be less if the system is moving less water. For example, if the system flows were reduced from 7.55 GPM/Acre to 5.5 GPM/Acre, the highest system pressure located at the end of the McCardle Lateral would rise from 46 PSI to 70 PSI.

Based upon the following assumptions, private patron (on-farm) pumping mitigation was also evaluated:

- 3 AC-FT/Acre of water applied to grow grass or alfalfa/season
- 70% application efficiency
- 4.28 AC-FT/Acre required to flow from the sprinkler heads/season
- 70% pumping efficiency

Where partial pressurization was anticipated by the hydraulic model, a percent of pumping mitigated was assigned to the associated lateral or main canal. The overall District private pumping mitigation and associated patron kWh savings was estimated at 1,015,417 kWh/Year.

Table 4.2.1 Estimated Pumping Power Savings Through Pressurization

ESTIMATED PUMPING POWER SAVINGS THROUGH PRESSURIZATION						
PROJECT GROUP	CANAL/LATERAL	IRRIGATED ACRES ASSOCIATED WITH SEGMENT	ESTIMATED % OF PUMPING MITIGATED	70% EFF. PUMPING PER ACRE AT 60 PSI GRASS HAY (KWH)	SAVINGS/AC (KWH)	TOTAL ESTIMATED PUMPING SAVINGS (KWH/YR)
1	Main Canal - Tail End	522.7	12%	867.3	101.2	52,886
2	Main Canal - Mid Section	479.5	12%	867.3	101.2	48,519
3	Main Canal - Upper	473.6	7%	867.3	57.8	27,385
3	Main Canal - Flume Replacement	0.0		867.3	0.0	0
4	Arthur	Incl. Below				
4	North	140.9	33%	867.3	289.1	40,722
4	Goat Farm	142.0	26%	867.3	225.5	32,019
4	Ladera	148.6	30%	867.3	260.2	38,668
4	M&M	70.1	25%	867.3	216.8	15,191
4	Estes	84.5	25%	867.3	216.8	18,322
5	Brandon	913.0	50%	867.3	433.7	395,941
6	Rastovich	149.8	50%	867.3	433.7	64,943
6	Penhollow and Billedeau Ropp	Incl. Above				
6	McCardle	356.2	58%	867.3	505.9	180,228
6	Rickard	39.5	33%	867.3	289.1	11,417
7	Sundance	232.8	22%	867.3	187.9	43,746
7	Gosney	209.5	25%	867.3	216.8	45,430
7	DWC-1	Incl. Above				
	TOTAL=	**3963**				**1,015,417**

4.3 Elevation Data

Elevation data for use in modeling was obtained through a LiDAR flight performed in March of 2016 by Quantum Spatial of Corvallis, Oregon. The data was post-processed to the requirements of FCA and Black Rock Consulting. Specifications for the data collection are provided in Table 4.3.1.

Table 4.3.1 LiDAR Parameters

Multi-Swath Pulse Density	≥ 8 pulses/m^2
Scan Angle	≤30^o (+/-15^o from Nadir)
Returns Collected Per Laser Pulse	Up to 4
Intensity Range	1-255
Swath Overlap	50% side-lap (100% overlap)
Maximum GPS Baseline	13 nautical miles

With the use of on-ground RTK and OPUS corrections, the data was provided in 1-FT contour interval format and was considered better than 1-FT accuracy vertically.

Units for the elevation information were reported and used in the following systems:

- Horizontal Projection: Oregon State Plane (ORSP) South Zone. International Feet
- Horizontal Datum: NAD83(2011)(Epoch2010.00)
- Vertical Datum: NAVD88 using Geoid12A

4.4 Future Delivery Flexibility

The District has requested system flexibility to insure that, within reason, system changes, added and subtracted irrigated acreage, effects of climate change, effects of changes in cropping patterns, and similar system demands may be addressed in this SIP.

First, with the exception of the North Lateral, the system was modeled with demands at the maximum certificated on-farm water right of 7.55 GPM/Acre. This, in and of itself, is conservative given that it is unlikely that every patron within the District is irrigating at the same moment at full water right demand.

The second system flexibility that was included in the base modeling analysis was the addition of future acreage and associated demand to the following laterals:

- Sundance Lateral - 80 Acres
- Gosney Lateral - 120 Acres
- McCardle Lateral - 150 Acres
- Brandon Lateral - 50 Acres

- Rastovich Lateral - 50 Acres
- Rickard Lateral - 20 Acres

The piping proposed by this SIP and base hydraulic model will accommodate these additional acreages that were assigned to the ends of each of the named laterals.

Modeled system demands were increased to 9 GPM/Acre. At 9 GPM/Acre, there were multiple system locations where negative pressures were predicted. This is because the primary delivery system slope is very gradual and is sensitive to minor hydraulic grade changes. Should the District believe that it will need capacity beyond the future acreages added to the laterals indicated above and with the entire system exceeding 7.55 GPM/Acre, the system should be further evaluated, modeled, and updated to accommodate such capacity prior to commencing system improvements.

4.5 **Hydraulic Modeling**

EPANET –

EPANET was used to model the District's proposed piped network. EPANET is a free-ware product that is maintained by the EPA. The Natural Resources Conservation Service technical offices in Oregon use EPANET exclusively for hydraulic modeling. For these reasons, EPANET was selected as the modeling software of choice for this SIP.

EPANET modeling capabilities go beyond steady-state hydraulic modeling. The software is capable of chemical transport analysis and varying flow modeling. A description of some of its capabilities follows:

EPANET is a computer program that performs extended period simulation of hydraulic and water quality behavior within pressurized pipe networks. A network consists of pipes, nodes (pipe junctions), pumps, valves, and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

EPANET is designed to be a research tool for improving our understanding of the movement and fate of drinking water constituents within distribution systems. It can be used for many different kinds of applications in distribution systems analysis. Sampling program design, hydraulic model calibration, chlorine residual analysis, and consumer exposure assessment are some examples. EPANET can help assess alternative management strategies for improving water quality throughout a system. These can include:

- Altering source utilization within multiple source systems
- Altering pumping and tank filling/emptying schedules
- Use of satellite treatment, such as re-chlorination at storage tanks
- Targeted pipe cleaning and replacement

Running under Windows, EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots.

Hydraulic Modeling Capabilities –

Full-featured and accurate hydraulic modeling is a prerequisite for doing effective water quality modeling. EPANET contains a state-of-the-art hydraulic analysis engine that includes the following capabilities:

- Places no limit on the size of the network that can be analyzed
- Computes friction head loss using the Hazen-Williams, Darcy-Weisbach, or Chezy-Manning formulas
- Includes minor head losses for bends, fittings, etc.
- Models constant or variable speed pumps
- Computes pumping energy and cost
- Models various types of valves including shutoff, check, pressure regulating, and flow control valves
- Allows storage tanks to have any shape (i.e., diameter can vary with height)
- Considers multiple demand categories at nodes, each with its own pattern of time variation
- Models pressure-dependent flow issuing from emitters (sprinkler heads)
- Can base system operation on both simple tank level or timer controls and on complex rule-based controls

Velocity Criteria –

As stated above, the maximal velocity criteria was set at 5 FT/S for on-farm deliveries at 7.55 GPM/Acre (with the exception of the North Lateral that was modeled at 5.5 GPM/Acre). The peak evaluated flow rate was 9 GPM/Acre for future system flexibility and was allowed to increase beyond 5 FT/S in modeling as indicated above.

Elevations –

As indicated above, elevation data was derived from a 2016 LiDAR flight.

Spatially Correct Layout –

Horizontal information for the various system elements and patron turnouts was collected through a field survey performed by District staff in 2016. Turnout locations were "snapped" to the canal centerline (perpendicular to the centerline) as determined through post-processing of the LiDAR data and locating canal and lateral centerlines. The "snapped" locations represented turnout node locations used during hydraulic modeling of the system and were represented in the model by Northing and Easting coordinates of the Oregon State Plane South Zone.

Pressure Reduction (Not Applicable to the Arnold Irrigation District) –

Where applicable, pressure reducing stations and/or hydroelectric power plants were entered into the model as PRVs (pressure reducing valves). These valves are a programmed element in EPANET. The diameter of the valve and the downstream pressure set-point are entered to establish the downstream system pressure to be held by the PRV. PRVs were also used to emulate the pressure reduction through hydroelectric plant(s).

Pipe Diameter Selection –

Pipe diameter selections were derived iteratively in the hydraulic model with the first iteration being a rough estimate. The second iteration utilized actual pipe diameters for high density polyethylene pipe material at the appropriate dimension ratio and pressure rating for each model "link" (pipe). Generally, the third iteration adjusted all pipes in the system to a range of 4 FT/S to 5 FT/S at the peak system flow rates based upon 7.55 GPM/Acre (and 5.5 GPM/Acre for the North Lateral).

Pipe Pressure Rating Selection –

HDPE solid-wall pipes (PE4710 resin) were sized from HDPE pipe sizing tables for the expected static pressure for each pipe segment.

The model for the Arnold Irrigation District is included in Appendix B of this SIP.

4.6 Cost Estimating by Lateral (and Main Canal)

Pipe Estimates –

Pipe material estimates were provided by a reputable vendor that routinely supplies pipe materials to Central Oregon projects. Pipe material budgetary estimates are provided in Appendix C for reference.

Turnouts –

For the purposes of this SIP, patron turnouts were assumed to be converted to pressurized delivery systems. A standard pressurized irrigation delivery turnout was assumed to include an appropriately sized tee from the mainline or lateral, a pressure relief valve, a gear-actuated plug valve (or gate or possibly butterfly valve in smaller turnout situations), a magnetic meter, a combination air and vacuum relief valve and associated hardware, and spool pipe segments. Based upon experience with similar installations at irrigation districts in Central Oregon, the cost of installation of a turnout was set at an estimated average cost of $8,000 per installation.

Construction –

Contractor procurement may come in several forms in Oregon. Design-Bid-Build is a conventional process wherein the survey and design is developed first and then a traditional competitive bid is held to obtain the lowest-cost responsive and responsible bidding contractor. In this process, typically the design-engineering firm will serve as the inspection/construction management firm during the course of construction. Given the magnitude of the project phases and for the purposes of this SIP, a Construction Manager General Contractor (CMGC) model was assumed. In this contractor procurement method, design would precede obtaining the contractor, however, the contractor would include construction management in its delivery of the constructed project. An estimated contractor fee structure of 12% -18% of the project value was assumed for this construction delivery method depending upon the size of the lateral or main canal project being evaluated.

Engineering, Construction Management –

Engineering and Owner’s Representative/Inspection services typically range as high as 10% - 18% of construction value. For the purposes of this SIP, and assuming that project phases are constructed sequentially and annually, it was assumed that total fee of 6% - 18% for survey, engineering design, and inspection/owner’s representative services would be appropriate depending upon the scale of the particular lateral or main canal project. This was based upon the experience of Black Rock Consulting on similar projects deployed in Central Oregon.

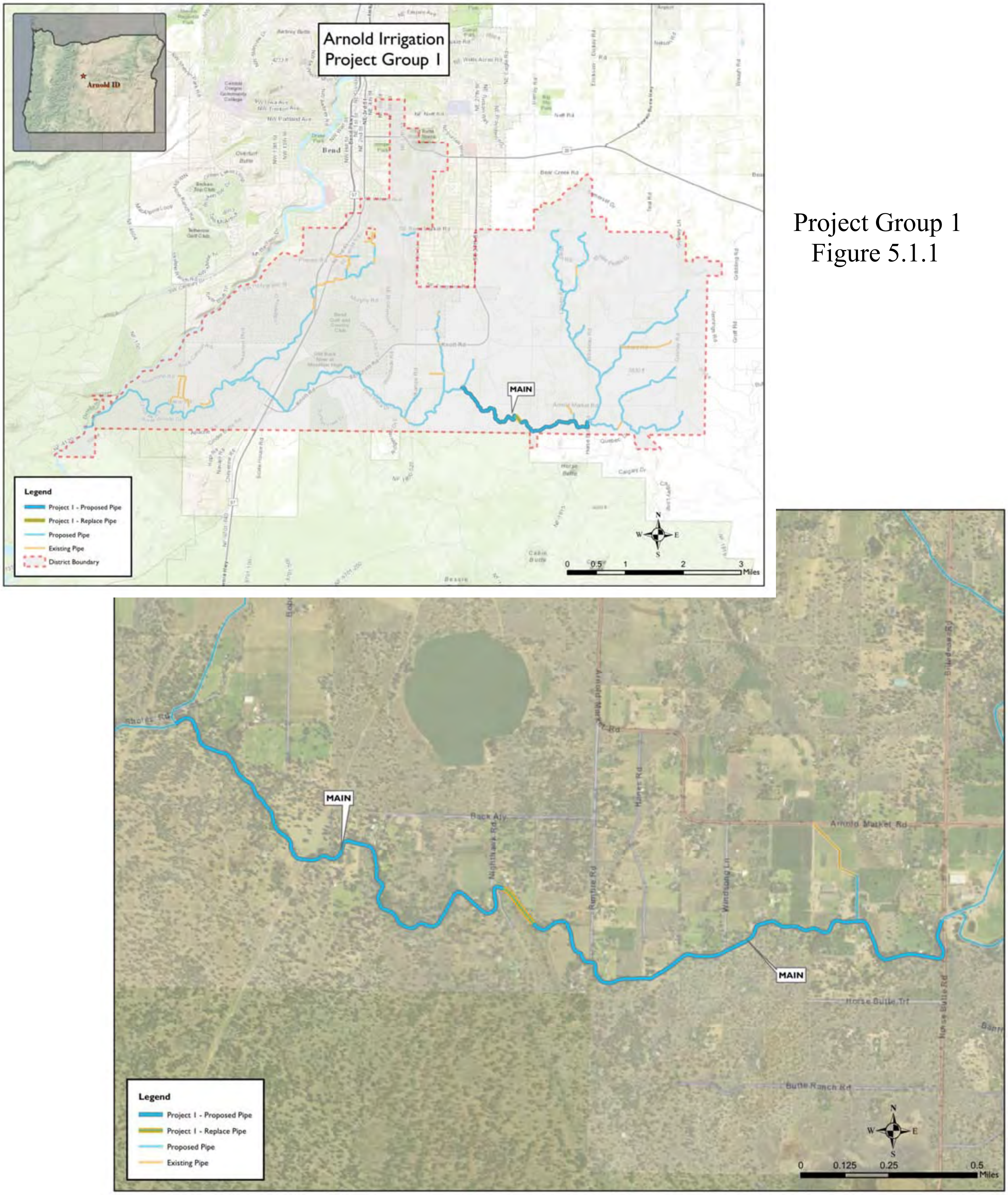
Contingency –

The contingency percentage was carefully considered. The Association for the Advancement of Cost Engineering (AACE) is a nationally recognized organization that has developed an accepted system of contingency ranges based upon project specificity level “Class.” There are 5 project Classes starting from Class 5 with only conceptual project definition to Class 1 where a project has been completely developed and bid. This SIP was considered to fall within the

Class 4 definition. The AACE Class 4 project specificity level (i.e. a project at 1% - 15% definition) carries an anticipated contingency range from -15% to -30% on the low end of the range to +20% to +50% on the high end of the range. We selected a contingency value of +30% that is in the middle of the positive contingency range provided by AACE. It should be noted that the phased cost estimate is based largely upon the cost of pipe materials. Budgetary pricing for high density polyethylene pipe was found to be very competitive at the time of development of this SIP. High density polyethylene solid-wall pipe is manufactured from an oil-based pelletized product. The pellet pricing is tied directly to the cost of oil at the time of pipe manufacture ordering. Given that oil prices have been reduced in the past two years and will likely rebound, it should be anticipated that pipe material pricing will increase significantly with time. The timing of such increases will be dependent upon oil pricing, the economic conditions at the time of order, and the demand for pipe at the time of order. For construction that is completed soon after the development of this SIP, the cost estimates should remain robust. For work lagging several years beyond the development of this SIP, the risk of cost change is greater. For this reason, it is recommended that every 2 years a cost evaluation be performed to update the phased construction cost estimates.

Section 5

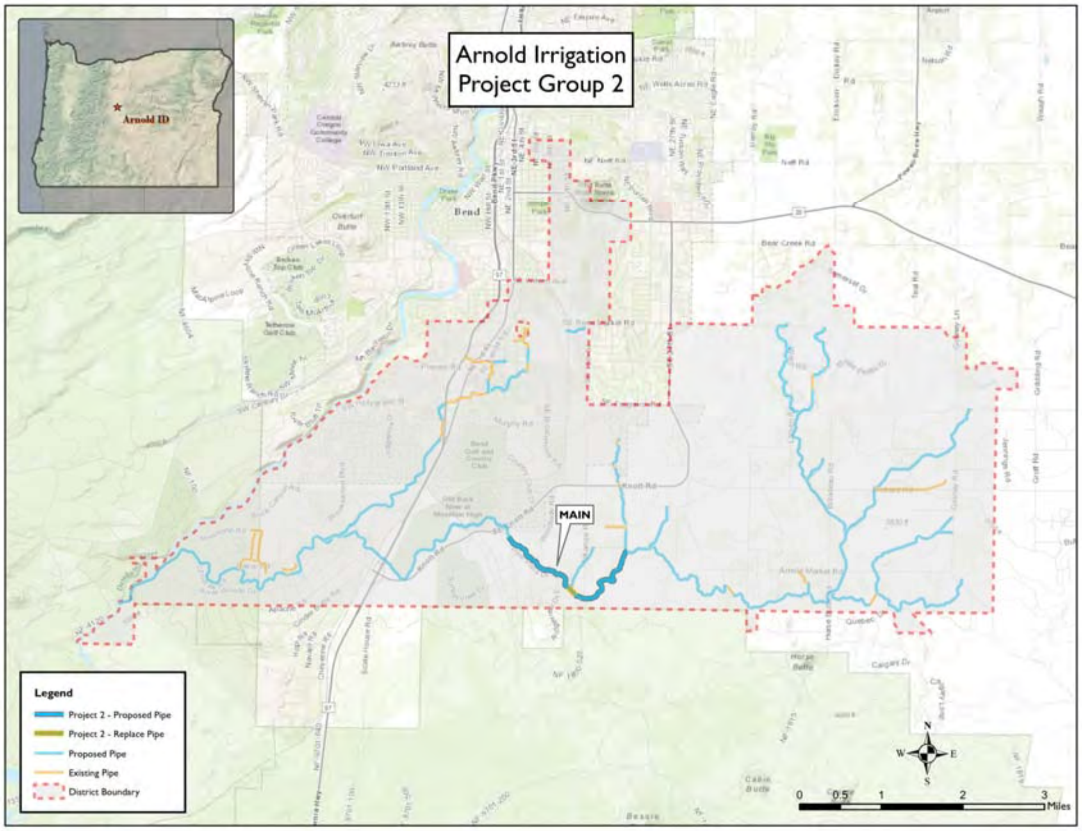
Arnold Irrigation Improvements by Project Group



Project Group 1
Figure 5.1.1

Table 5.1.1 Main Canal - Tail End Cost Estimate

Main Canal - Tail End Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	48	16,976	LF	$212	$3,598,912
TURNOUT			40	EA	$8,000	$320,000
	SUBTOTAL					$3,918,912
	ENGINEERING, CM, SURVEY			6%		$235,135
	CMGC			12%		$470,269
	CONTINGENCY			30%		$1,387,295
	TOTAL					**$6,011,611**



Project Group 2
Figure 5.2.1

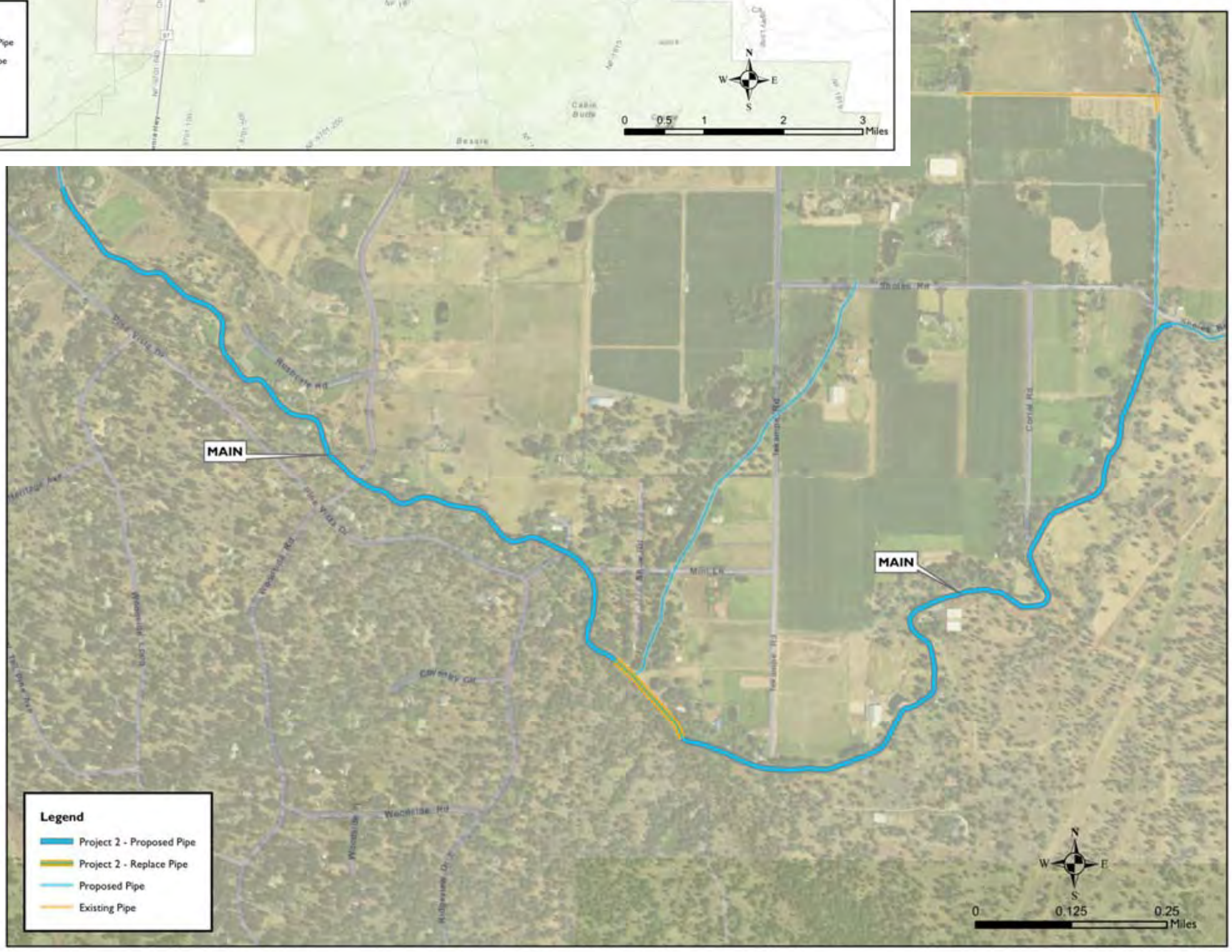
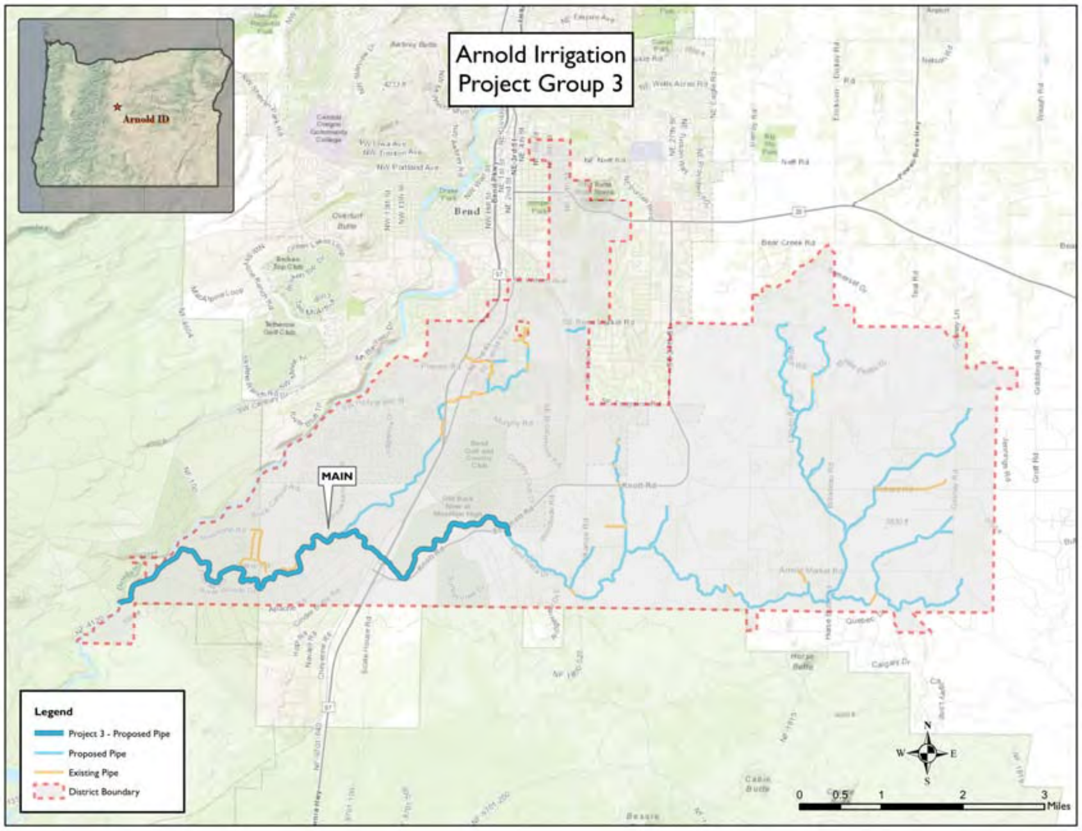


Table 5.2.1 Main Canal - Mid Section Cost Estimate

Main Canal - Mid Section Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	54	13,963	LF	$270	$3,770,010
TURNOUT			28	EA	$8,000	$224,000
	SUBTOTAL					$3,994,010
	ENGINEERING, CM, SURVEY			6%		$239,641
	CMGC			12%		$479,281
	CONTINGENCY			30%		$1,413,880
	TOTAL					**$6,126,811**



Project Group 3
Figure 5.3.1

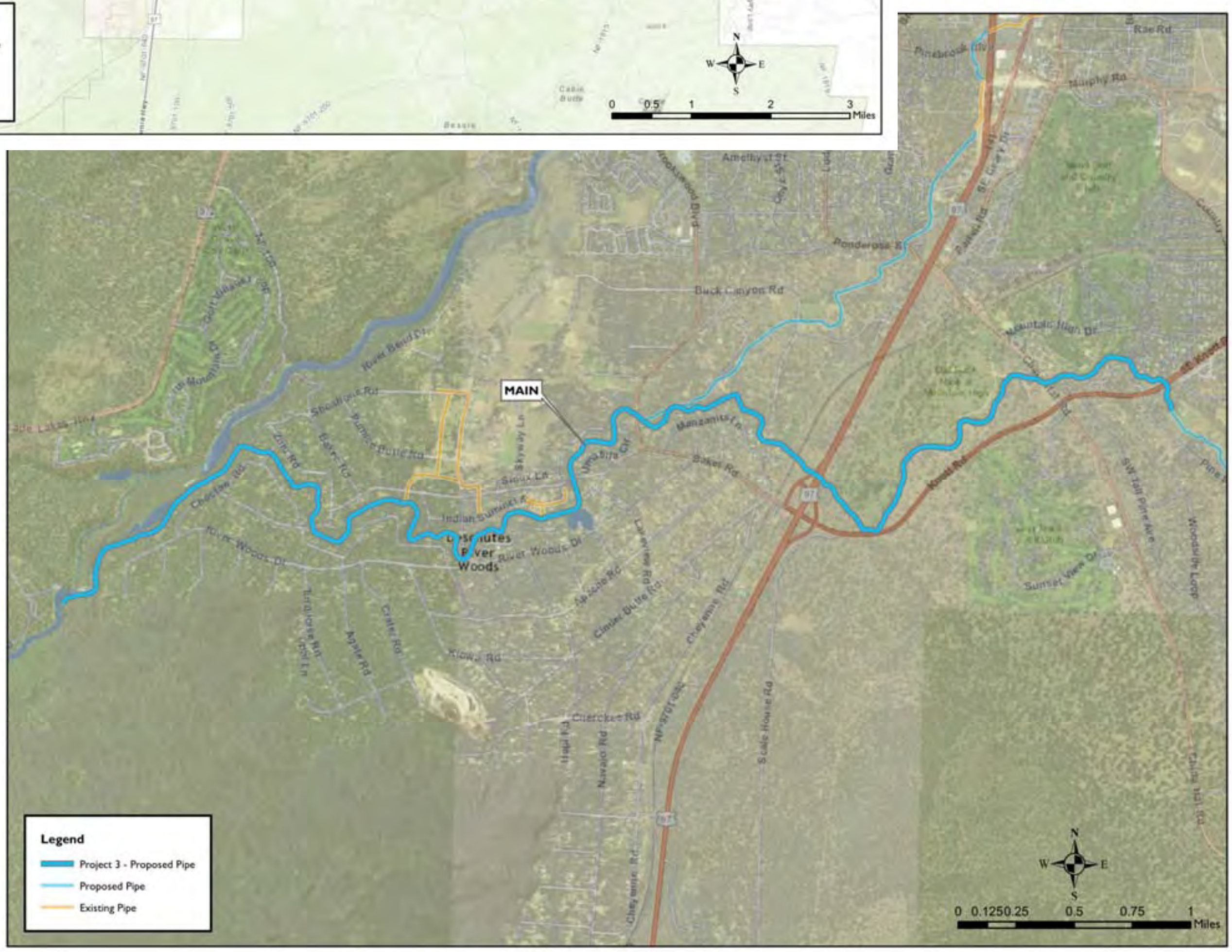
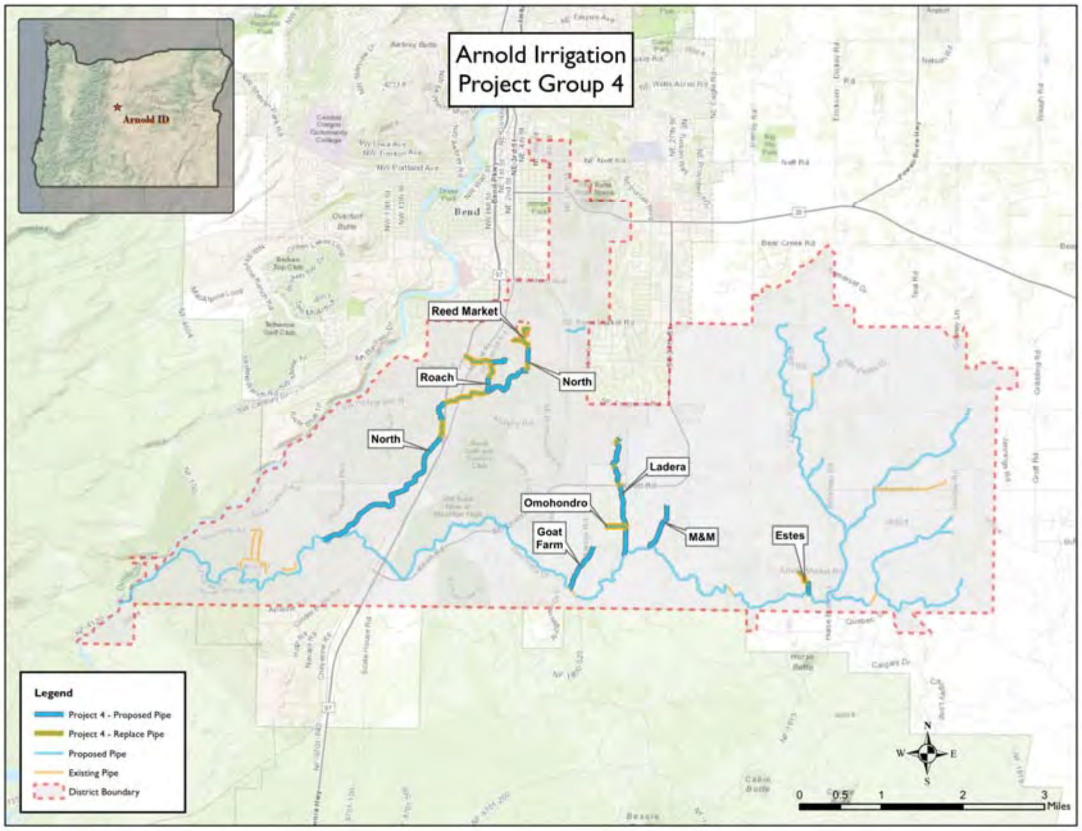


Table 5.3.1 Main Canal - Upper Section Cost Estimate

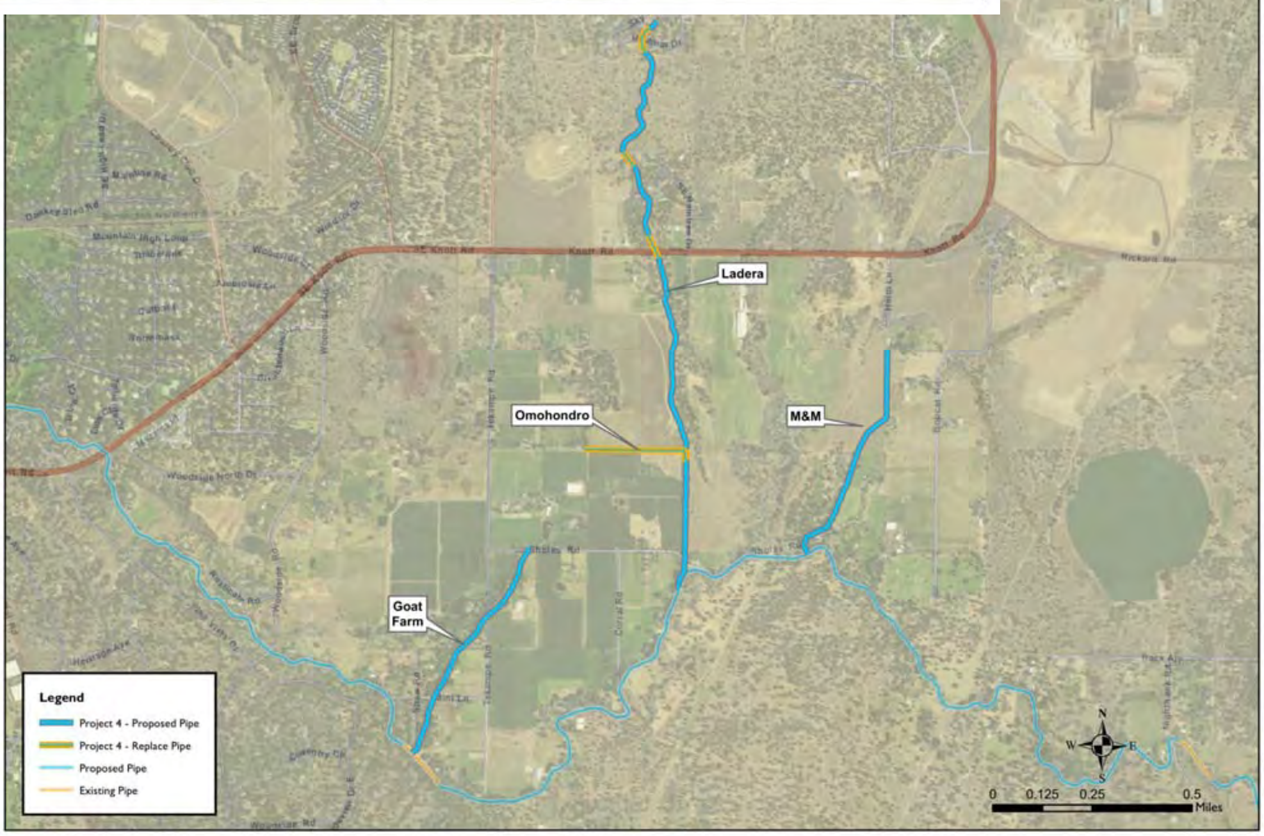
Main Canal - Upper Section Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	63	33,550	LF	$390	$13,084,509
TURNOUT			18	EA	$8,000	$144,000
	SUBTOTAL					$13,228,509
	ENGINEERING, CM, SURVEY			6%		$793,711
	CMGC			12%		$1,587,421
	CONTINGENCY			30%		$4,682,892
	TOTAL					**$20,292,533**

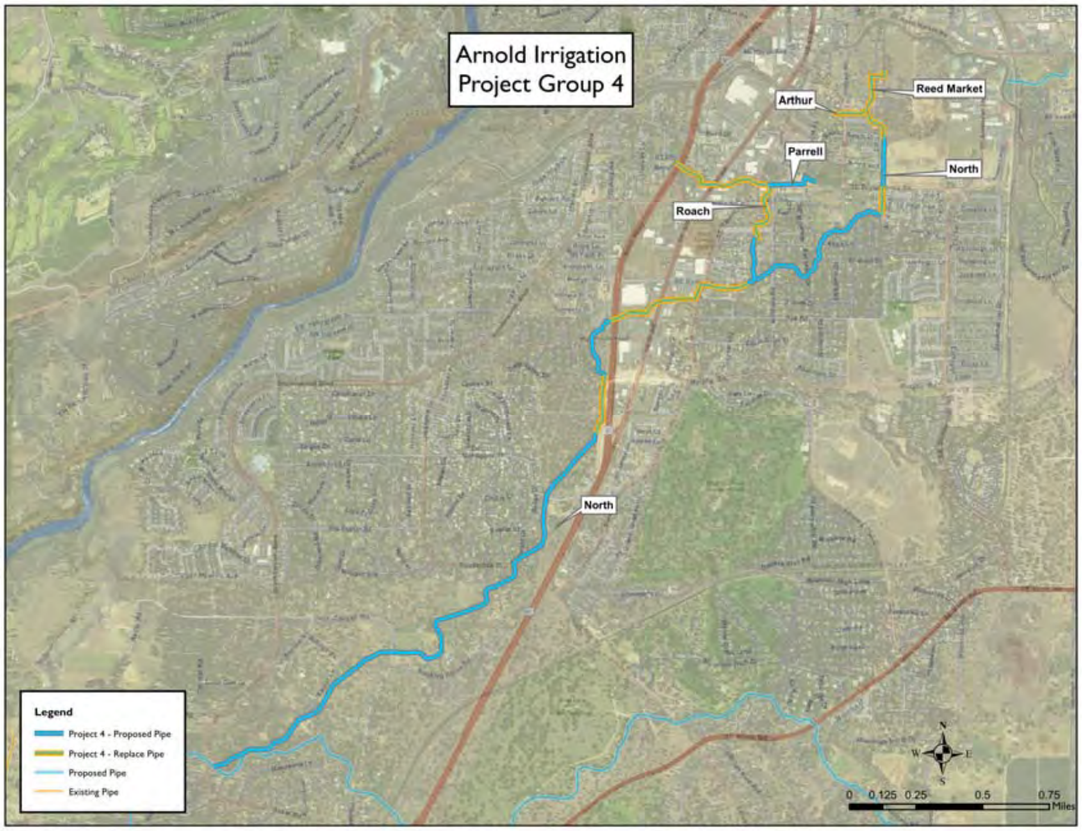
Table 5.3.2 Main Canal - Flume Replacement Cost Estimate

Main Canal - Flume Replacement Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	63	5,394	LF	$450	$2,427,300
DEMO			5,394	LF	$125	$674,250
TURNOUT			0	EA	$8,000	$0
	SUBTOTAL					$3,101,550
	PERMITS,ENGR., CM, SURVEY			15%		$465,233
	CMGC			12%		$372,186
	CONTINGENCY			30%		$1,181,691
	TOTAL					**$5,120,659**



Project Group 4
Figure 5.4.1





Project Group 4
Figure 5.4.1 cont.

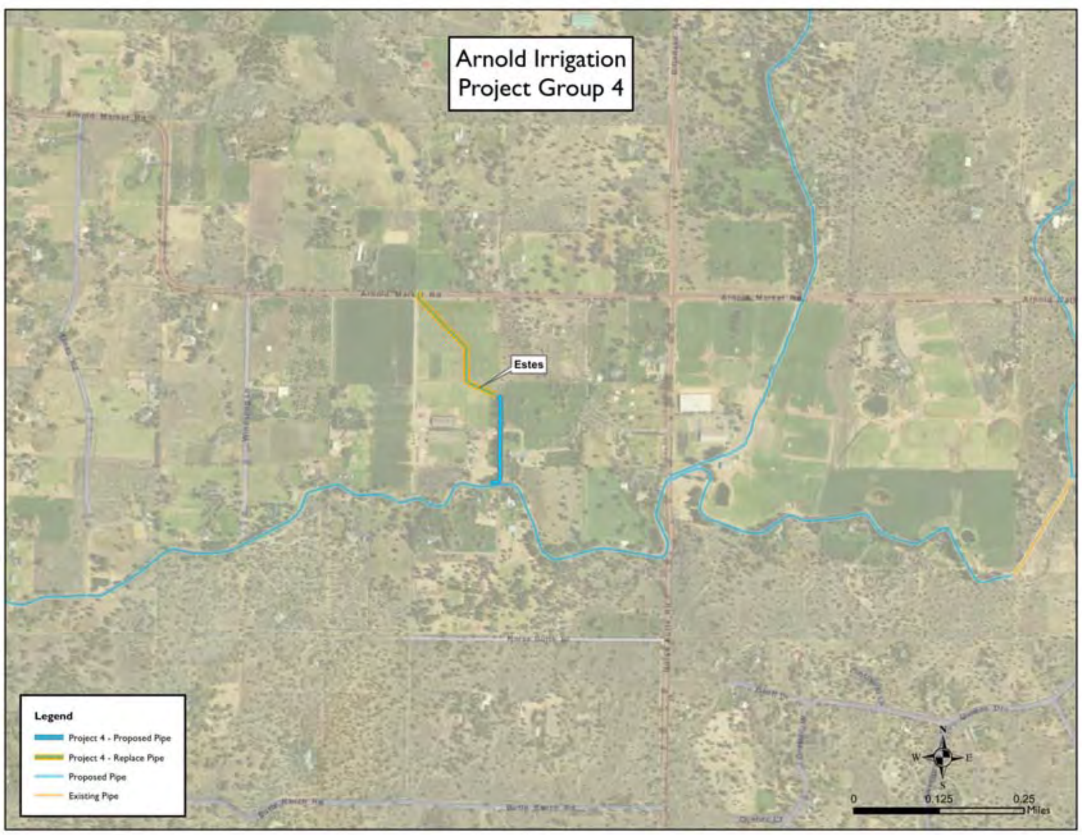


Table 5.4.1 Arthur Lateral Cost Estimate

Arthur Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	21	4	698	LF	$4	$2,792
TURNOUT			1	EA	$8,000	$8,000
	SUBTOTAL					$10,792
	ENGINEERING, CM, SURVEY			18%		$1,943
	CMGC			18%		$1,943
	CONTINGENCY			30%		$4,403
	TOTAL					**$19,080**

Table 5.4.2 North Lateral (and Parrell, Reed Market, and Roach Laterals) Cost Estimate

North Lateral (and Parrell, Reed Market, and Roach Laterals) Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	10	9,646	LF	$12	$115,757
PIPE	32.5	8	6,753	LF	$8	$54,021
PIPE	26	8	926	LF	$10	$9,265
PIPE	26	6	1,532	LF	$6	$9,195
PIPE	26	4	9,295	LF	$4	$37,182
PIPE	21	4	2,772	LF	$4	$11,086
TURNOUT			35	EA	$8,000	$280,000
	SUBTOTAL					$516,505
	ENGINEERING, CM, SURVEY			15%		$77,476
	CMGC			15%		$77,476
	CONTINGENCY			30%		$201,437
	TOTAL					**$872,894**

Table 5.4.3 Goat Farm Lateral Cost Estimate

Goat Farm Lateral						
Arnold Irrigation District						
Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	10	1,525	LF	$12	$18,300
PIPE	32.5	6	1,681	LF	$6	$10,086
TURNOUT			5	EA	$8,000	$40,000
	SUBTOTAL					$68,386
	ENGINEERING, CM, SURVEY			18%		$12,309
	CMGC			18%		$12,309
	CONTINGENCY			30%		$27,901
	TOTAL					**$120,906**

Table 5.4.4 Ladera Lateral (and Omohondro Lateral) Cost Estimate

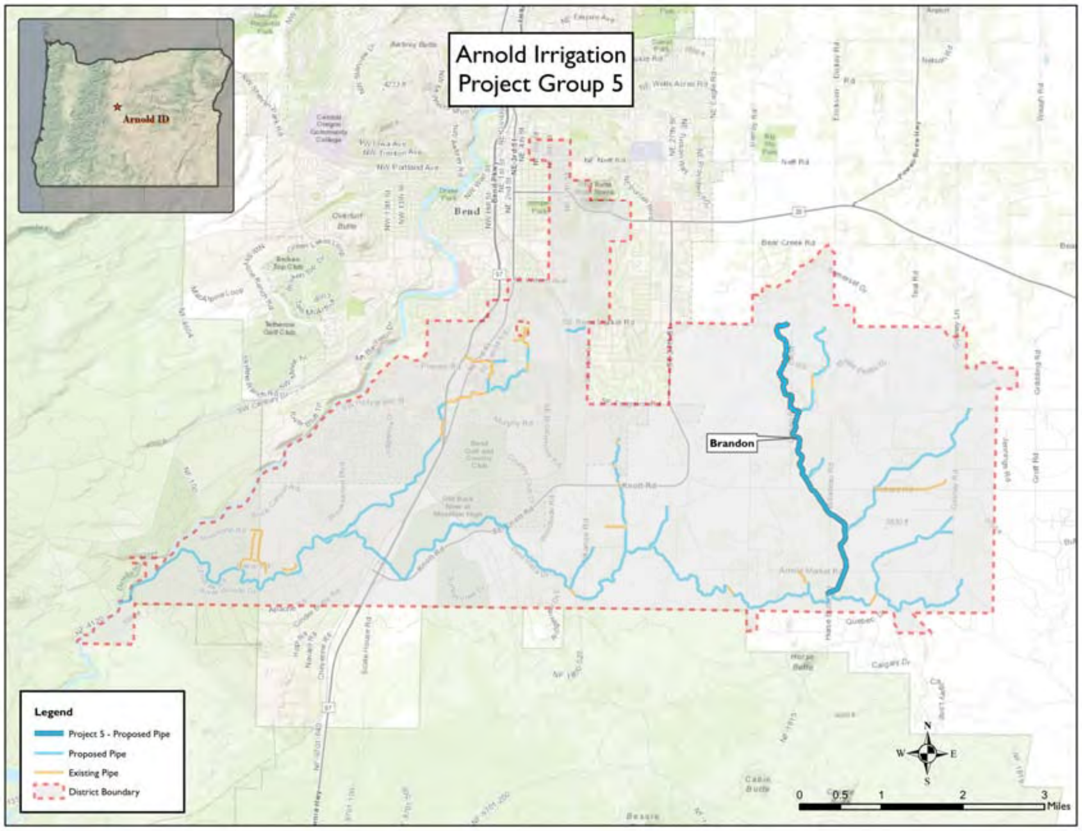
Ladera Lateral (and Omohondro Lateral)						
Arnold Irrigation District						
Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	10	1,741	LF	$12	$20,891
PIPE	32.5	8	1,434	LF	$8	$11,469
PIPE	26	8	2,084	LF	$10	$20,841
PIPE	32.5	6	118	LF	$4	$472
PIPE	26	6	3,700	LF	$6	$22,198
PIPE	26	4	499	LF	$4	$1,994
PPE	32.5	4	33	LF	$3	$99
TURNOUT			16	EA	$8,000	$128,000
	SUBTOTAL					$205,964
	ENGINEERING, CM, SURVEY			18%		$37,074
	CMGC			18%		$37,074
	CONTINGENCY			30%		$84,033
	TOTAL					**$364,145**

Table 5.4.5 M&M Lateral Cost Estimate

M&M Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	8	936	LF	$8	$7,492
PIPE	32.5	6	2,196	LF	$4	$8,783
TURNOUT			5	EA	$8,000	$40,000
	SUBTOTAL					$56,275
	ENGINEERING, CM, SURVEY			18%		$10,130
	CMGC			18%		$10,130
	CONTINGENCY			30%		$22,960
	TOTAL					**$99,494**

Table 5.4.6 Estes Lateral Cost Estimate

Estes Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	8	1,846	LF	$8	$14,768
TURNOUT			5	EA	$8,000	$40,000
	SUBTOTAL					$54,768
	ENGINEERING, CM, SURVEY			18%		$9,858
	CMGC			18%		$9,858
	CONTINGENCY			30%		$22,345
	TOTAL					**$96,830**



Project Group 5
Figure 5.5.1

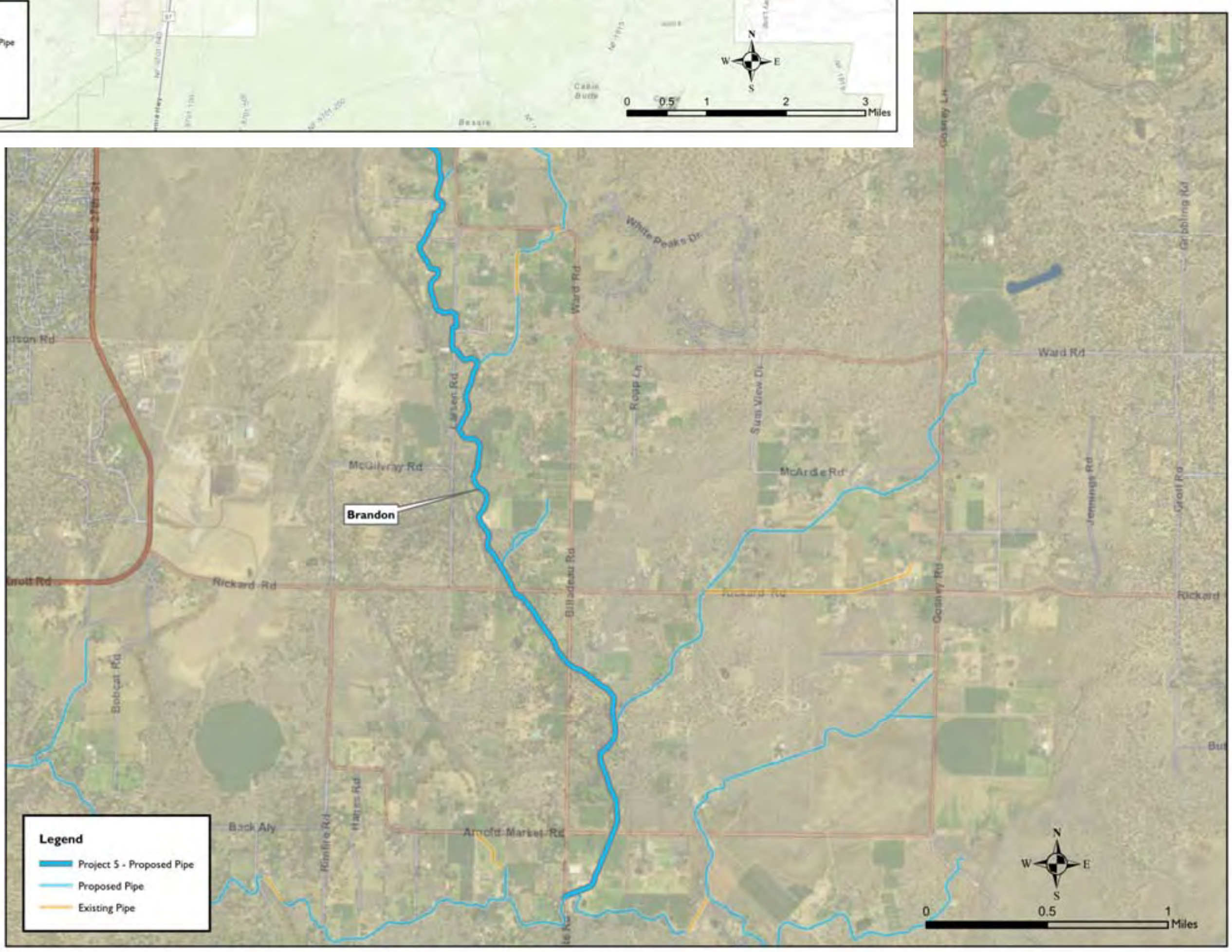
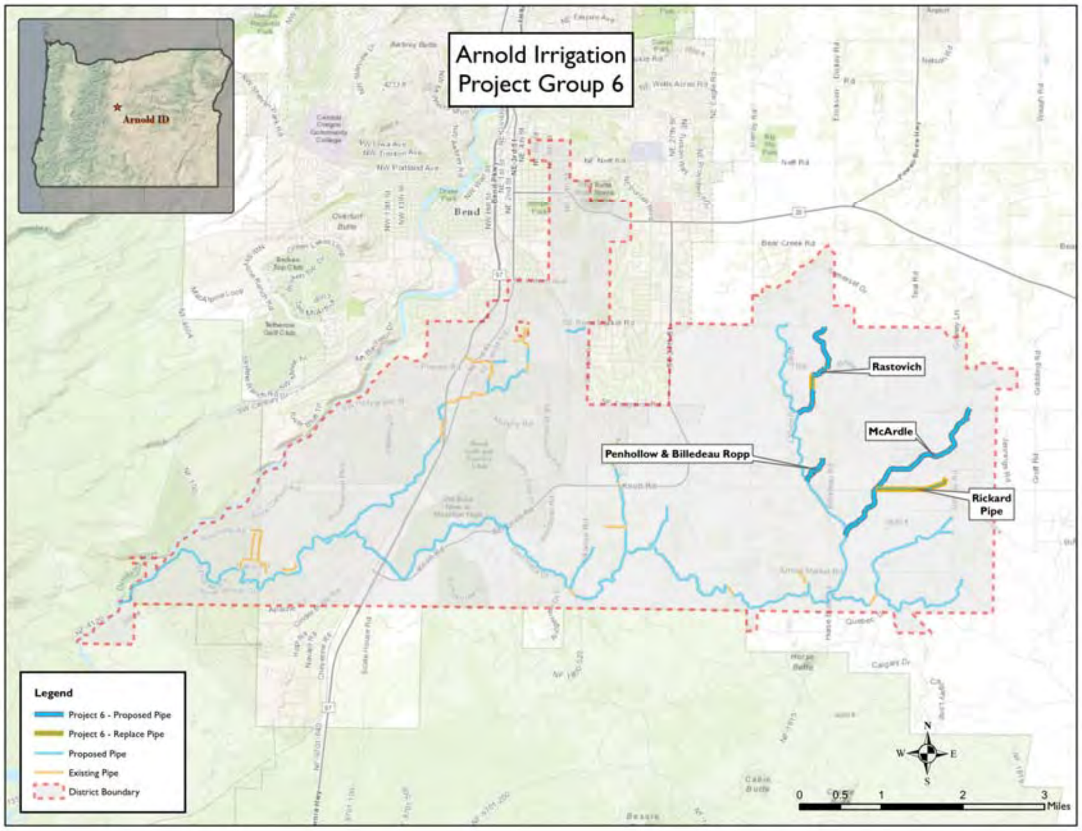


Table 5.5.1 Brandon Lateral (and East Ward Lateral) Cost Estimate

Brandon Lateral (and East Ward Lateral) Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	36	4,483	LF	$126	$564,907
PIPE	32.5	30	1,266	LF	$84	$106,362
PIPE	32.5	28	1,102	LF	$76	$83,731
PIPE	26	28	1,528	LF	$90	$137,486
PIPE	26	26	604	LF	$80	$48,292
PIPE	26	24	5,159	LF	$66	$340,466
PIPE	26	16	3,178	LF	$32	$101,709
PIPE	26	14	224	LF	$26	$5,814
PIPE	21	14	1,826	LF	$28	$51,118
PIPE	21	12	2,734	LF	$24	$65,614
PIPE	21	6	531	LF	$10	$5,310
TURNOUT			80	EA	$8,000	$640,000
	SUBTOTAL					$2,150,808
	ENGINEERING, CM, SURVEY			8%		$172,065
	CMGC			12%		$258,097
	CONTINGENCY			30%		$774,291
	TOTAL					**$3,355,261**



Project Group 6
Figure 5.6.1

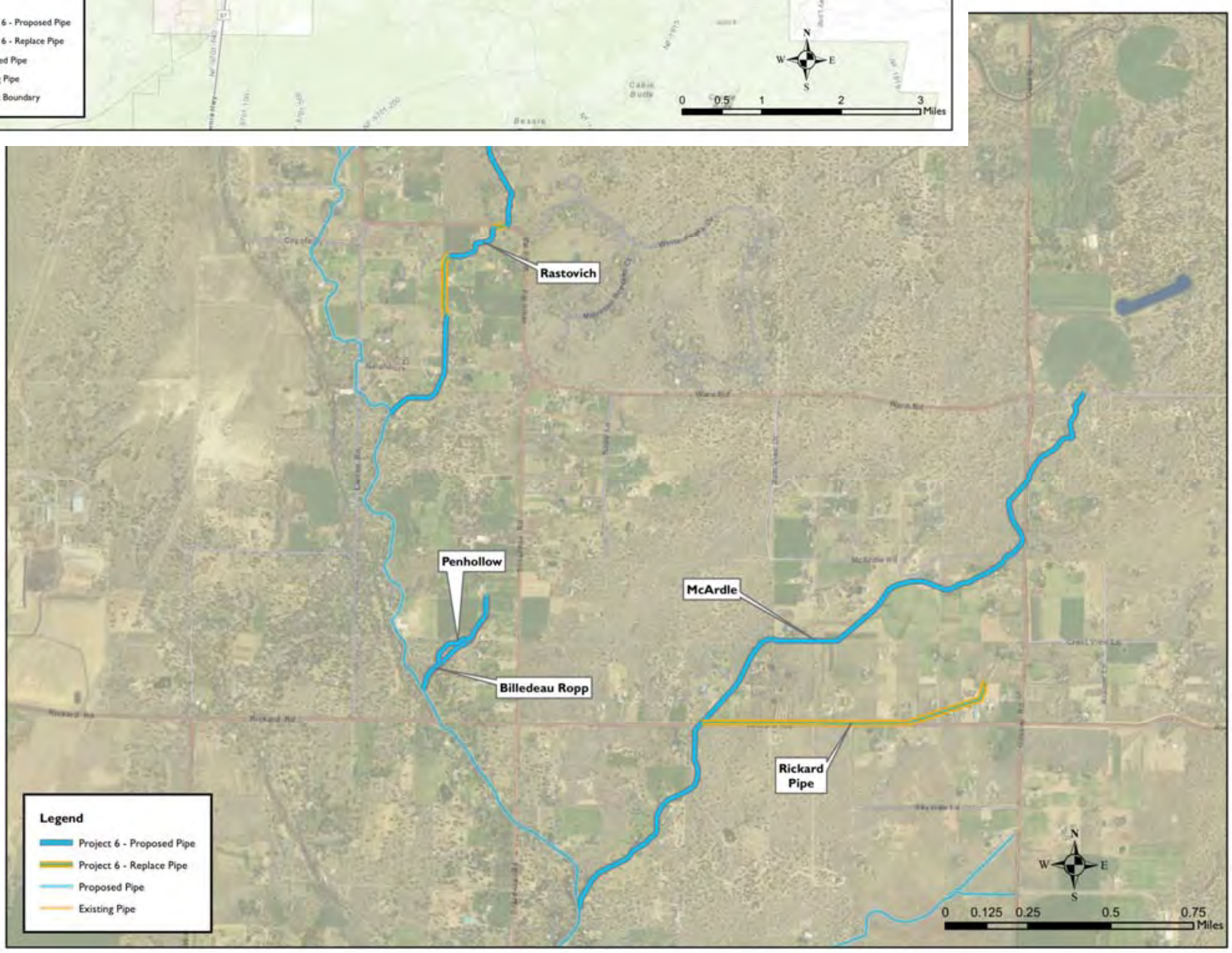


Table 5.6.1 Rastovich Lateral Cost Estimate

Rastovich Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	26	12	882	LF	$20	$17,640
PIPE	21	12	2,678	LF	$24	$64,276
PIPE	21	10	1,826	LF	$20	$36,518
PIPE	21	8	289	LF	$18	$5,206
PIPE	21	6	1,962	LF	$10	$19,619
TURNOUT			22	EA	$8,000	$176,000
	SUBTOTAL					$319,259
	ENGINEERING, CM, SURVEY			18%		$57,467
	CMGC			18%		$57,467
	CONTINGENCY			30%		$130,258
	TOTAL					**$564,450**

Table 5.6.2 Penhollow and Billedeau Ropp Lateral Cost Estimate

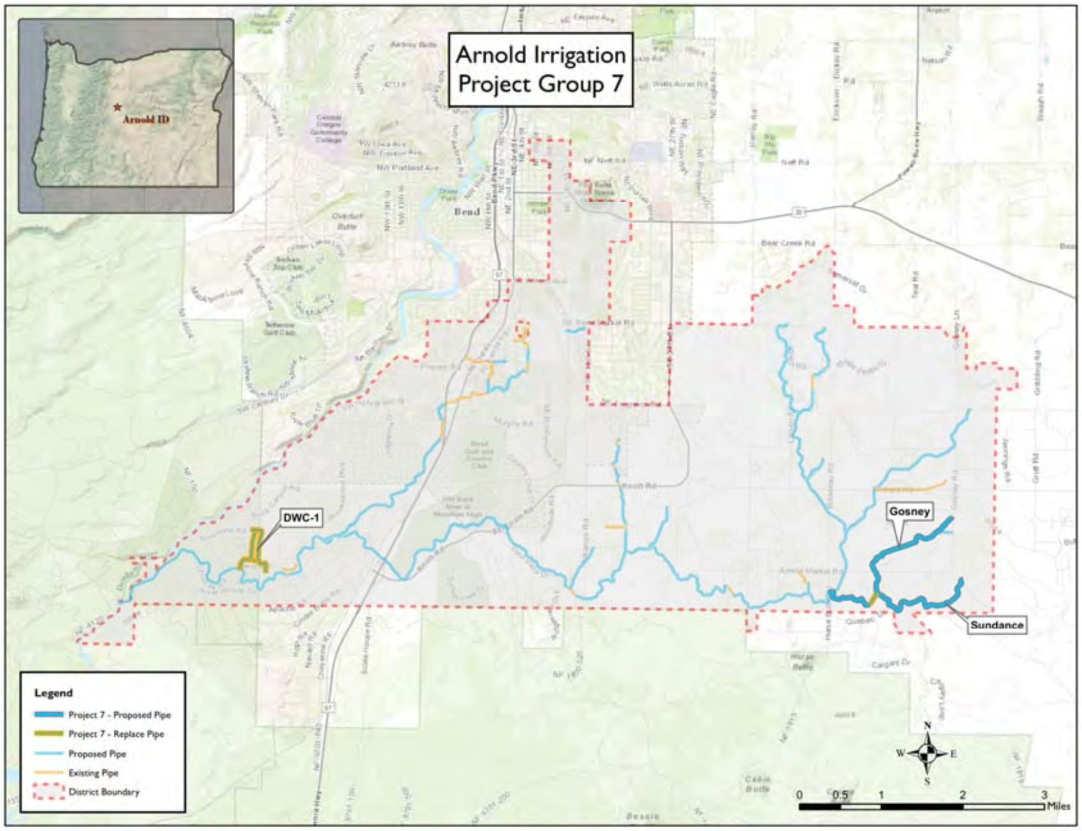
Penhollow and Billedeau Ropp Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	26	8	3,930	LF	$8	$31,443
TURNOUT			1	EA	$8,000	$8,000
	SUBTOTAL					$39,443
	ENGINEERING, CM, SURVEY			18%		$7,100
	CMGC			18%		$7,100
	CONTINGENCY			30%		$16,093
	TOTAL					**$69,736**

Table 5.6.3 McCardle Lateral Cost Estimate

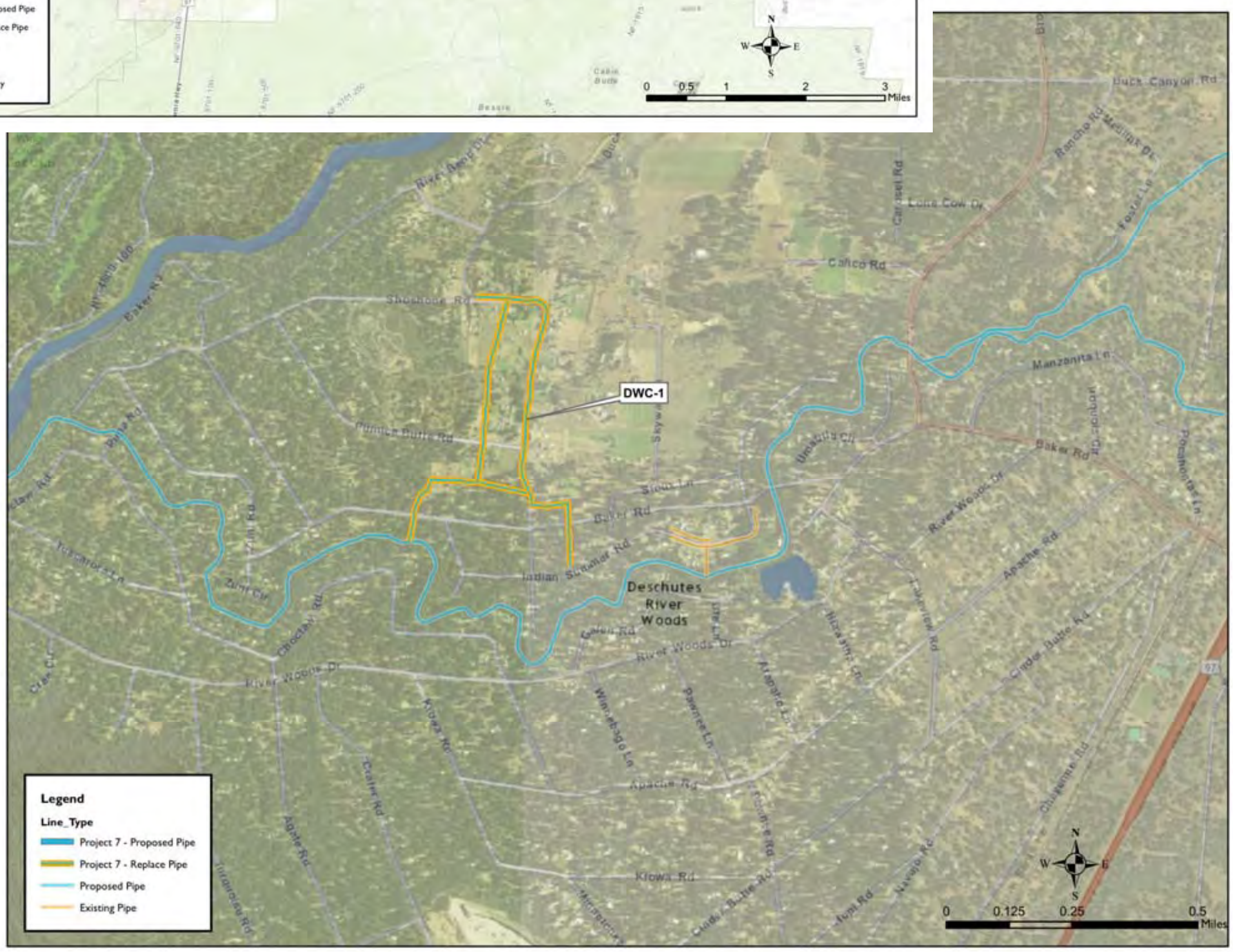
McCardle Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	20	2,754	LF	$40	$110,158
PIPE	26	20	1,553	LF	$50	$77,627
PIPE	26	18	1,791	LF	$48	$85,955
PIPE	21	18	2,374	LF	$58	$137,667
PIPE	21	16	4,471	LF	$46	$205,660
PIPE	19	14	798	LF	$32	$25,538
TURNOUT			35	EA	$8,000	$280,000
	SUBTOTAL					$922,605
	ENGINEERING, CM, SURVEY			15%		$138,391
	CMGC			15%		$138,391
	CONTINGENCY			30%		$359,816
	TOTAL					**$1,559,202**

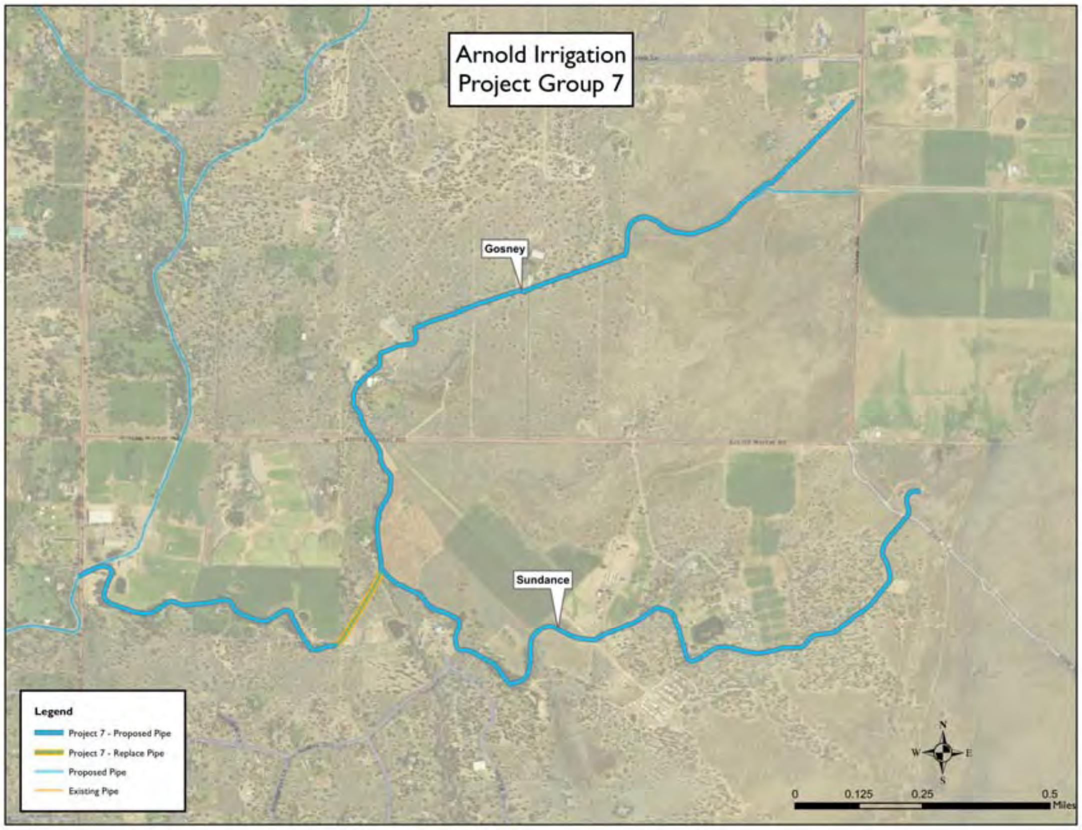
Table 5.6.4 Rickard Lateral Cost Estimate

Rickard Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	26	6	3,083	LF	$6	$18,498
PIPE	21	6	1,215	LF	$10	$12,150
PIPE	21	4	1,488	LF	$4	$5,952
TURNOUT			12	EA	$8,000	$96,000
	SUBTOTAL					$132,600
	ENGINEERING, CM, SURVEY			18%		$23,868
	CMGC			18%		$23,868
	CONTINGENCY			30%		$54,101
	TOTAL					**$234,437**



Project Group 7
Figure 5.7.1





Project Group 7
Figure 5.7.1 cont.

Table 5.7.1 Sundance Lateral Cost Estimate

Sundance Lateral Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	24	4,428	LF	$54	$239,123
PIPE	32.5	16	4,535	LF	$32	$145,122
PIPE	32.5	12	3,760	LF	$16	$60,153
TURNOUT			10	EA	$8,000	$80,000
	SUBTOTAL					$524,398
	ENGINEERING, CM, SURVEY			15%		$78,660
	CMGC			15%		$78,660
	CONTINGENCY			30%		$204,515
	TOTAL					**$886,233**

Table 5.7.2 Gosney Lateral (and Leslie North Lateral) Cost Estimate

Gosney Lateral (and Leslie North Lateral) Arnold Irrigation District Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	16	7,116	LF	$32	$227,704
PIPE	26	16	1,463	LF	$32	$46,820
PIPE	26	12	34	LF	$20	$680
PIPE	26	10	26	LF	$16	$412
PIPE	26	6	1,187	LF	$6	$7,119
TURNOUT			12	EA	$8,000	$96,000
	SUBTOTAL					$378,735
	ENGINEERING, CM, SURVEY			15%		$56,810
	CMGC			15%		$56,810
	CONTINGENCY			30%		$147,707
	TOTAL					**$640,063**

Table 5.7.3 DWC-1 Lateral Cost Estimate

DWC-1						
Arnold Irrigation District						
Reconnaissance-Level Construction Cost Estimate						11/10/2016
Feature	**DR or PR**	**Dia. (In)**	**Length (ft.)**	**Unit**	**$/Unit**	**Total Cost**
PIPE	32.5	6	7,772	LF	$8	$62,176
TURNOUT			40	EA	$4,000	$160,000
	SUBTOTAL					$222,176
	ENGINEERING, CM, SURVEY			18%		$39,992
	CMGC			18%		$39,992
	CONTINGENCY			30%		$90,648
	TOTAL					**$392,807**

APPENDIX A
TABULATED SEEPAGE LOSS DATA

ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

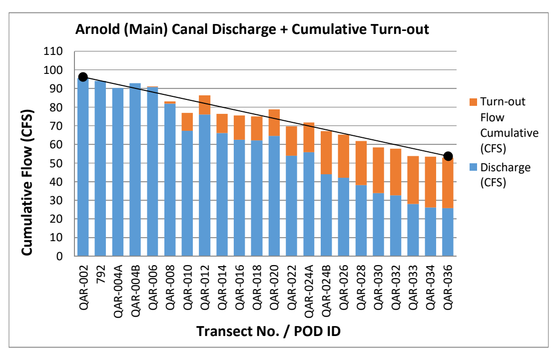
(green)	= Clock House
(yellow)	= Start of Canals / Laterals
(red)	= In-Canal Weirs
(purple)	= Included as turn out flow in-reach, not included as turn-out flow over-all system

Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
Arnold (Main) Canal				
QAR-002	95.57		0.00	Measurement rated as 'Good', 6-23-16
792	94.00		0.00	OWRD/BOR Clock House
QAR-004A	90.32		0.00	50' upstream POD 4834, 6-22-16, rated 'Good'
QAR-004B	92.86		0.00	15' upstream POD 4834, 6-23-16 rated 'Good'
4834		-0.29		Start of DWC1 Lat.
8873		0.00		2 inch rectangular weir, 0.5 inch depth
9930		-0.08		Start of DWC2 Lat.
10435		-0.02		12 inch rectangular weir, 0.625 inch depth
QAR-006	90.71		0.39	Measurement rated as 'Good', 6-22-16
11820		-0.08		12 inch rectangular weir, 1.625 inch depth
11822		0.00		Off
11829		-0.05		6 inch rectangular weir, 1.25 inch depth
13292		-0.57		Start Lundy Lat. (Private), 24" weir, 2.375 in depth
13594		0.00		Flooded Back
14002		-0.06		6 inch rectangular weir, 1.375 inch depth
QAR-008	81.88		1.16	Measurement rated as 'Good', 6-22-16
14306		0.00		Start of North Lat.
QAR-010		-8.41		North Lat flow diversion measured 6-22-16
QAR-012	67.26		9.58	Measurement rated as 'Poor', 6-22-16
18262		-0.06		12 inch rectangular weir, 0.875 inch depth
22366		-0.57		24 inch rectangular weir, 2.375 inch depth
QAR-014	76.13		10.21	Measurement rated as 'Fair', 6-22-16
QAR-016	66.07		10.21	Measurement rated as 'Good', 6-22-16
28040		0.00		Off
28042		-2.16		30 inch rectangular weir, 5.0 inch depth
29015		-0.49		36 inch rectangular weir, 1.625 inch depth
QAR-018	62.57		12.87	Measurement rated as 'Good', 6-22-16
31248		-0.06		6 inch rectangular weir, 1.375 inch depth
QAR-020	62.16		12.93	Measurement rated 'Fair', 6-22-16
33258		-0.03		6 inch rectangular weir, 0.875 inch depth
33734		-0.22		12 inch rectangular weir, 2.0 inch depth
34464		-0.03		6 inch rectangular weir, 0.875 inch depth
34710		-0.18		18 inch rectangular weir, 1.75 inch depth
35106		-0.03		6 inch rectangular weir, 0.875 inch depth
35108		0.00		Flooded Back
35112		-0.60		(2) proportional weirs 12" & 20 1/8"
35478		-0.08		6 inch rectangular weir, 1.625 inch depth
35932		-0.03		6 inch rectangular weir, 0.75 inch depth
QAR-022	64.60		14.14	Measurement rated as 'Poor', 6-22-16
36152		-0.01		6 inch rectangular weir, 0.5 inch depth
36798		-1.16		Start of Goat Farm Lat., 48 in weir, 2.375 in depth
37402		-0.01		6 inch rectangular weir, 0.375 inch depth
37608		-0.14		12 inch rectangular weir, 1.5 inch depth
37610		-0.03		6 inch rectangular weir, 0.875 inch depth
37704		-0.03		6 inch rectangular weir, 0.75 inch depth
37993		0.00		Flooded back
38880		-0.30		18 inch rectangular weir, 1.875 inch depth
QAR-024A	53.89		15.82	15' upstream POD 39788, 6-22-16, rated 'Good
QAR-024B	55.86		15.82	Upstream POD 39788, 6-23-16, rated 'Good'
39788		-0.33		18 inch weir, 2 inch depth, end day 6-22-16
41062		-0.16		24 inch weir, 1 inch depth, start day 6-23-16
41550		-0.06		6 inch rectangular weir, 1.375 inch depth
41994		-0.03		6 inch rectangular weir, 0.875 inch depth
42416		-0.14		12 inch rectangular weir, 1.5 inch depth
42654		0.00		Flooded back
42658		-2.71		Start Ladera Lat., 36 inch weir, 5.125 inch depth
43001		-0.49		24 inch rectangular weir, 2.125 inch depth
44097		-0.38		36 inch rectangular weir, 1.375 inch depth
44190		-1.78		24 inch rectangular weir, 5.125 inch depth
44578		-1.07		Start M&M Lat., 24 inch weir, 3.625 inch depth
QAR-026	44.03		22.98	Measurement rated as 'Good', 6-23-16
44754		0.00		
47503		-0.22		18 inch rectangular weir, 1.5 inch depth
QAR-028	42.13		23.20	Measurement rated as 'Fair', 6-23-16
48296		-0.13		12 inch rectangular weir, 1.375 inch depth
49056		-0.03		6 inch rectangular weir, 0.75 inch depth
49604		0.00		Flooded back
50351		0.00		Flooded back
50422		-0.04		6 inch rectangular weir, 1.0 inch depth
50430		-0.08		6 inch rectangular weir, 1.625 inch depth
50600		0.00		
51278		-0.02		6 inch rectangular weir, 0.625 inch depth
51605		0.00		Flooded back
51766		-0.11		12 inch rectangular weir, 1.25 inch depth
53098		-0.14		12 inch rectangular weir, 1.5 inch depth

Arnold (Main) Canal

Over-all Arnold Discharge Measurements

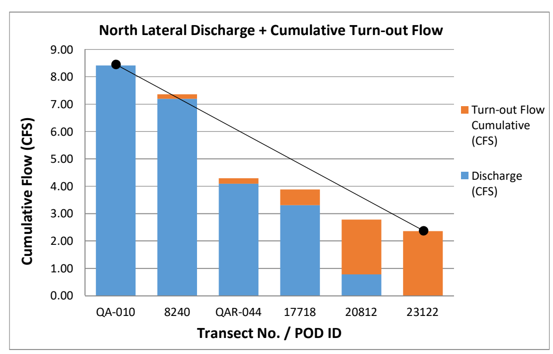
Over-all System Intake to the Study Reach	=	141.85		
Over-all System Turnout + Flow Remaining	=	-86.3		
Over-all System Losses in the Study Reach	=	55.52	=	39.14%



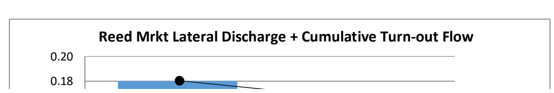
Total Arnold (Main) Canal Intake to the Study Reach	=	95.57		
Total Arnold (Main) Canal Turnout + Flow Remaining	=	-52.99		
Total Arnold (Main) Canal Losses in the Study Reach	=	42.58	=	44.55%

ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

Transect No. POD #ID	**Discharge (CFS)**	**Turn-out Flow Rate (CFS)**	**Turn-out Flow Cumulative (CFS)**	**Comments**
QAR-030	38.10		23.74	Measurement rated as 'Good', 6-23-16
53356		-0.24		36 inch rectangular weir, 1.0 inch depth
53580		-0.04		6 inch rectangular weir, 1.0 inch depth
53592		0.00		Flooded back
54271		0.00		Flooded back
54418		-0.37		24 inch rectangular weir, 1.75 inch depth
54420		-0.03		12 inch rectangular weir, 0.5 inch depth
54430		-0.04		6 inch rectangular weir, 1.0 inch depth
54951		0.00		Flooded back
55302		0.00		Flooded back
55345		-0.03		6 inch rectangular weir, 0.875 inch depth
QAR-032	33.93		24.48	Measurement rated as 'Good', 6-23-16
55954		-0.02		6 inch rectangular weir, 0.625 inch depth
56580		0.00		
56584		-0.03		6 inch rectangular weir, 0.875 inch depth
56586		-0.11		12 inch rectangular weir, 1.25 inch depth
56589		-0.27		12 inch rectangular weir, 1.75 inch depth
56608		-0.05		6 inch rectangular weir, 1.125 inch depth
QAR-033	32.71		24.96	Measurement rated as 'Good', 6-23-16
56612		-0.09		12 inch rectangular weir, 1.125 inch depth
57320		-0.08		12 inch rectangular weir, 1.0 inch depth
57626		-0.29		12 inch rectangular weir, 1.5 inch depth
57679		0.00		Flooded back
57877		0.00		Off
58128		-0.28		12 inch rectangular weir, 2.375 inch depth
58281		0.00		
QAR-034	28.00		25.71	Measurement rated as 'Good', 6-23-16
58630		-0.33		12 inch rectangular weir, 2.625 inch depth
58703		0.00		
58834		-0.97		Start Estes Lat. (90% Piped), 24" weir, 3.375" depth
58836		-0.08		6 inch rectangular weir, 1.625 inch depth
QAR-036	26.27		27.08	Measurement rated as 'Good', 6-23-16
59894		-0.03		6 inch rectangular weir, 0.75 inch depth
60334		-0.11		End Arnold Canal, 12 inch weir 1.25 inch depth
QAR-038	25.77		27.22	End Arnold / start Sundance + Brandon, 'Fair'
Main Canal flow remaining	25.77		27.22	
North Lateral				
QA-010	8.41		0.00	Measurement rated 'Good', 6-22-16
824		-0.05		6 inch rectangular weir, 1.25 inch depth
1332		0.00		Flooded back
1894		0.00		Flooded back
4984		-0.05		6 inch rectangular weir, 1.25 inch depth
4986		0.00		Flooded Back
5457		0.00		Flooded Back
5459		-0.01		4 inch rectangular weir, 1.25 inch depth
5789		-0.03		6 inch rectangular weir, 0.75 inch depth
5828		-0.01		6 inch rectangular weir, 0.5 inch depth
8240	7.19		0.16	Rocking Horse Weir North Lat., 60" weir, 7" depth
9589		0.00		Off
10443		-0.03		6 inch rectangular weir, 0.875 inch depth
QAR-044	4.10		0.19	Measurement rated 'Fair', 6-22-16
16831		-0.02		6 inch rectangular weir, 0.625 inch depth
17485		0.00		6 inch rectangular weir, 0.25 inch depth
17709		-0.02		6 inch rectangular weir, 0.625 inch depth
17713		0.00		Flooded back
17715		-0.02		6 inch rectangular weir, 0.625 inch depth
17716		-0.33		Start Roach Lat., 24" weir, 1.625" depth
17718	3.30		0.58	North Lat Weir, 60" weir, 4.125" depth
19277		-1.41		24 inch rectangular weir, 4.375 inch depth
20300		0.00		
20812	0.78		2.00	North Lat. Weir, 30" weir, 2.5" depth
20912		0.00		Flooded Back
20938		-0.12		6 inch rectangular weir, 2.25 inch depth
21110		0.00		2 inch rectangular weir, 0.375 inch depth
21649		-0.02		6 inch rectangular weir, 0.625 inch depth
22322		-0.03		6 inch rectangular weir, 0.875 inch depth
22410		0.00		Flooded Back
23120		-0.18		Start Reed Mrkt Lat., piped, 12" weir, 1.75" depth
23122	0.00		2.35	North Lat. Weir / End of North Lat.
North Lat flow remaining	0.00		2.35	
Reed Market Lateral				
190	0.18		0.00	12 inch rectangular weir, 1.75 inch depth
670		-0.04		Start Arthur Lat., piped, 6" weir, 1" depth
1567	0.00	-0.13	0.16	End Reed Market Lat., 12" weir, 1.375" depth



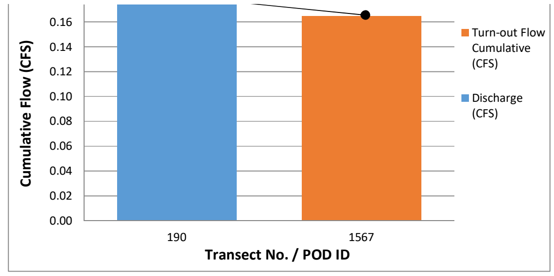
Total North Lateral Intake to the Study Reach	=	8.41		
Total North Lateral Turnout + Flow Remaining	=	-2.35		
Total North Lateral Losses in the Study Reach	=	6.06	=	72.01%



ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
Reed Mrkt Lat flow remaining	0.00		0.16	
Arthur Lateral				
0	0.04		0.00	Piped, 6 inch rectangular weir, 1.0 inch depth
729	0.00	-0.04	0.04	End Arthur Lat., 6" weir, 1" depth
Arthur Lat flow remaining	0.00		0.04	
Goat Farm Lateral				
150	1.16		0.00	Start Goat Farm Lat., 48" weir, 2.375" depth
1492		-0.37		24 inch rectangular weir, 1.75 inch depth
1493		-0.53		Goat Farm Lat. 3-Way Ditch Weir, 24" weir, 2.25" dep
1495		0.00		Off
2150		-0.24		12 inch rectangular weir, 2.125 inch depth
3177		-0.12		18 inch rectangular weir, 1.0 inch depth
3178	0.00	-0.21	1.46	End Goat Farm Lat., 17" weir, 1.5" depth
Goat Farm Lat flow remaining	0.00			
Sundance Lateral				
QAR-040	5.53		0.00	Measurement rated as 'Poor'
612		-0.49		24 inch rectangular weir, 2.125 inch depth
2060		-0.29		24 inch rectangular weir, 1.5 inch depth
2158		0.00		Off
3058		0.00		Off
3441		-0.09		12 inch rectangular weir, 1.125 inch depth
3527		-0.12		18 inch rectangular weir, 1.0 inch depth
QAR-076		-2.19		Start Gosney Lat, measure rated 'Good', 6-27-16
QAR-042	2.35		3.18	Measurement rated as 'Fair'
6028		0.00		
7336		-0.13		12 inch rectangular weir, 1.375 inch depth
QAR-080	2.15		3.30	Measurement rated as 'Excellent'
8995		-0.67		30 inch rectangular weir, 2.25 inch depth
10206		0.00		
11870	0.00	-0.53	4.50	End Sundance Lat., 24" weir, 2.25" depth
Sundance Lat flow remaining	0.00		4.50	
Gosney Lateral				
QAR-076	2.19		0.00	Measurement rated as 'Good'
1681		-0.05		6 inch rectangular weir, 1.25 inch depth
2122		-0.02		6 inch rectangular weir, 0.625 inch depth
2125		-0.05		6 inch rectangular weir, 1.25 inch depth
QAR-078	1.67		0.13	Measurement rated as 'Poor'

Reed Market Lateral



Total Reed Mrkt Lateral Intake to the Study Reach = 0.18
Total Reed Mrkt Lateral Turnout + Flow Remaining = -0.16
Total Reed Mrkt Lateral Losses in the Study Reach = 0.02 = 8.42%

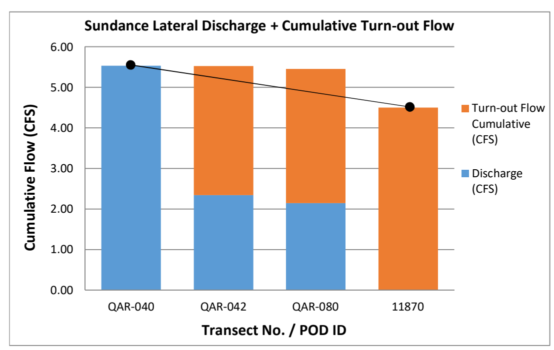
Arthur Lateral

Total Arthur Lateral Intake to the Study Reach = 0.04
Total Arthur Lateral Turnout + Flow Remaining = -0.04
Total Arthur Lateral Losses in the Study Reach = 0.00 = 0.00%

Goat Farm Lateral

Total Goat Farm Lateral Intake to the Study Reach = 1.16
Total Goat Farm Lateral Turnout + Flow Remaining = -1.46
Total Goat Farm Lateral Losses in the Study Reach = -0.30 = -25.96%

Sundance Lateral

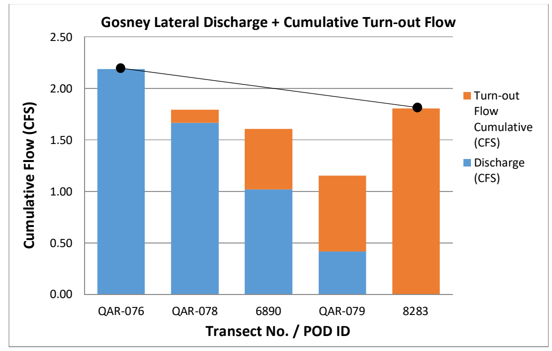


Total Sundance Lateral Intake to the Study Reach = 5.53
Total Sundance Lat Irr. Turnout + Flow Remaining = -4.50
Total Sundance Lateral Losses in the Study Reach = 1.03 = 18.63%

ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

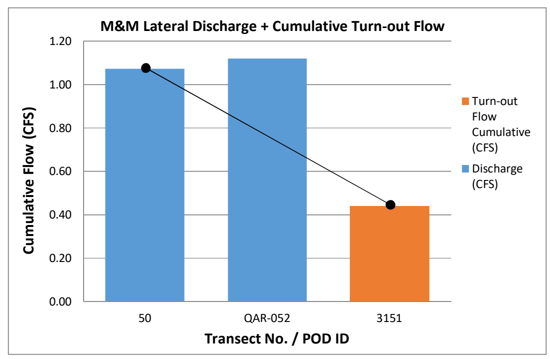
Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
3000		0.00		Off
6791		0.00		Start of Leslie North Lat.
6822		(-0.78)		Top Leslie North Weir (flow at head Leslie North lat, not included as turn-out flow)
NO #		-0.46		End of Leslie North Lat. (flow at turn-out, included as turn-out flow)
6890	1.02		0.59	Gosney Weir, 30 inch weir, 3.0 inch depth
8036		0.00		Flooded Back
8256		-0.03		6 inch rectangular weir, 0.875 inch depth
8258		-0.03		6 inch rectangular weir, 0.75 inch depth
8260		-0.10		6 inch rectangular weir, 1.875 inch depth
QAR-079	0.42		0.74	Measurement rated as 'Poor'
8266		-0.15		Proportional weirs, 7.875" weir, 2" depth
8268		0.00		Proportional weirs, Off
8270		-0.26		Proportional weirs, 13.75" weir, 2" depth
8272		-0.09		Proportional weirs, 4.375" weir, 2" depth
8274		0.00		Proportional weirs, Off
8276		-0.24		Proportional weirs, 12.5" weir, 2" depth
8279		-0.09		Proportional weirs, 4.375" weir, 2" depth
8281		-0.18		Proportional weirs, 9.375" weir, 2" depth
8283	0.00	-0.05	1.80	Prop. weirs / End Gosney Lat., 2.375" weir, 2" depth
Gosney Lat flow remaining	0.00		1.80	
M&M Lateral				
50	1.07		0.00	24 inch rectangular weir, 3.625 inch depth
QAR-052	1.12		0.00	Measurement rated as 'Fair'
176		-0.03		6 inch rectangular weir, 0.75 inch depth
782		-0.02		6 inch rectangular weir, 0.625 inch depth
783		-0.08		12 inch rectangular weir, 1.0 inch depth
3150		-0.05		6 inch rectangular weir, 1.25 inch depth
3151	0.00	-0.26	0.44	End of M&M Lat., 21.5" weir, 1.5 inch depth
M&M Lat flow remaining	0.00		0.44	
Ladera Lateral				
31	2.71		0.00	36 inch rectangular weir, 5.125 inch depth
QAR-048	2.65		0.00	Measurement rated as 'Fair'
1766		-0.87		Start Omohundro, piped, flooded back, 6-27-16
QAR-050	2.65		0.87	Measurement rated as 'Good'
4148		-0.09		12 inch rectangular weir, 1.125 inch depth
4203		-0.04		6 inch rectangular weir, 1.0 inch depth
4995		-0.05		6 inch rectangular weir, 1.25 inch depth
5013		-0.03		6 inch rectangular weir, 0.75 inch depth
5100		-0.09		12 inch rectangular weir, 1.125 inch depth
5144		-0.02		6 inch rectangular weir, 0.625 inch depth
6116		-0.06		12 inch rectangular weir, 0.875 inch depth
8285	0.00	-0.33	1.59	End Ladera Lat., 24 inch weir, 1.625 inch depth
Ladera Lat flow remaining	0.00		1.59	
Omohundro Lateral				
1766	0.87		0.00	Start Omohundro, piped, flooded back, 6-27-16
540		0.00		Off, 6-27-16
1350		-0.22		12 inch rectangular weir, 2.0 inch depth
1450		-0.16		12 inch rectangular weir, 1.625 inch depth

Gosney Lateral



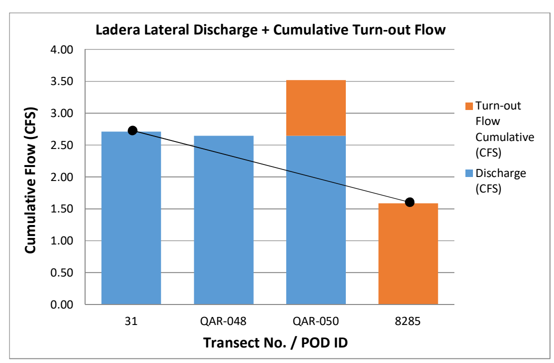
Total Gosney Lateral Intake to the Study Reach = 2.19
Total Gosney Lateral Turnout + Flow Remaining = -1.80
Total Gosney Lateral Losses in the Study Reach = 0.38 = 17.50%

M&M Lateral



Total M&M Lateral Intake to the Study Reach = 1.07
Total M&M Lateral Turnout + Flow Remaining = -0.44
Total M&M Lateral Losses in the Study Reach = 0.63 = 58.94%

Ladera Lateral



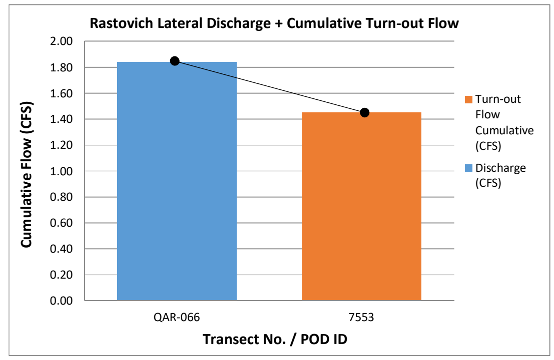
Total Ladera Lateral Intake to the Study Reach = 2.71
Total Ladera Lateral Turnout + Flow Remaining = -1.59
Total Ladera Lateral Losses in the Study Reach = 1.12 = 41.39%

ro Lateral

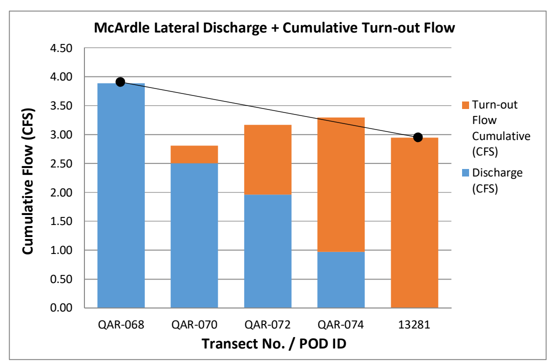
ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments	
1452		-0.11		12 inch rectangular weir, 1.25 inch depth	Omohunc
1475		-0.16		12 inch rectangular weir, 1.625 inch depth	
1500	0.00	-0.22	0.87	End Omohundro Lat., 12" weir, 2" depth	
Omohundro flow remaining	0.00		0.87		
Rastovich Lateral					Rastovich Lateral
QAR-066	1.84		0.00	Measurement rated as 'Fair'	
834		-0.04		6 inch rectangular weir, 1.0 inch depth	
983		-0.02		6 inch rectangular weir, 0.625 inch depth	
1031		-0.04		6 inch rectangular weir, 1.0 inch depth	
1147		-0.05		6 inch rectangular weir, 1.25 inch depth	
1391		-0.01		6 inch rectangular weir, 0.5 inch depth	
1413		0.00		Off	
1415		-0.03		6 inch rectangular weir, 0.875 inch depth	
1417		-0.03		6 inch rectangular weir, 0.875 inch depth	
1898		-0.08		12 inch rectangular weir, 1.0 inch depth	
2996		-0.06		12 inch rectangular weir, 0.875 inch depth	
2997		-0.04		12 inch rectangular weir, 0.625 inch depth	
2998		-0.04		6 inch rectangular weir, 1.0 inch depth	
3127		-0.06		18 inch rectangular weir, 0.625 inch depth	
3333		-0.04		12 inch rectangular weir, 0.625 inch depth	
3459		-0.07		6 inch rectangular weir, 1.5 inch depth	
3745		-0.04		6 inch rectangular weir, 1.0 inch depth	
3751		-0.03		6 inch rectangular weir, 0.875 inch depth	
3882		-0.01		6 inch rectangular weir, 0.5 inch depth	
4215		-0.18		12 inch rectangular weir, 1.75 inch depth	
4227		-0.04		6 inch rectangular weir, 1.0 inch depth	
5343		-0.03		6 inch rectangular weir, 0.875 inch depth	
5590		-0.14		Delivers water to 7533, big loss	
5584		-0.29		24 inch rectangular weir, 1.5 inch depth	
7553	0.00	-0.06	1.45	End Rastovich Lat., 12" weir, 0.875" depth	
Rastovich Lat flow remaining	0.00		1.45		
McArdle Lateral					McArdle Lateral
QAR-068	3.89		0.00	Measurement rated as 'Good', 6-27-16	
797		-0.05		6 inch rectangular weir, 1.125 inch depth	
1298		-0.05		6 inch rectangular weir, 1.125 inch depth	
2319		-0.07		6 inch rectangular weir, 1.5 inch depth	
2505		-0.08		12 inch rectangular weir, 1.0 inch depth	
3259		-0.06		12 inch rectangular weir, 0.875 inch depth	
QAR-070	2.50		0.31	Measurement rated as 'Poor', 6-27-16	
3338		-0.06		12 inch rectangular weir, 0.875 inch depth	
3926		-0.03		6 inch rectangular weir, 0.875 inch depth	
3930		-0.03		6 inch rectangular weir, 0.875 inch depth	
3932		-0.44		Start Rickard Pipe, staff gage	
4284		-0.01		12 inch rectangular weir, 0.25 inch depth	
4599		-0.06		6 inch rectangular weir, 1.375 inch depth	
4637		-0.04		6 inch rectangular weir, 1.0 inch depth	
5694		-0.09		6 inch rectangular weir, 1.75 inch depth	
5700		0.00		Off	
5716		0.00		Off	
5718		-0.05		6 inch rectangular weir, 1.125 inch depth	
5720		-0.04		6 inch rectangular weir, 1.0 inch depth	
5722		0.00			
5724		-0.05		6 inch rectangular weir, 1.125 inch depth	
QAR-072	1.96		1.21	Measurement rated as 'Good', 6-27-16	
7413		-0.27		18 inch rectangular weir, 1.75 inch depth	
7563		-0.22		18 inch rectangular weir, 1.5 inch depth	
8072		-0.22		12 inch rectangular weir, 2.0 inch depth	
8761		-0.04		6 inch rectangular weir, 1.0 inch depth	
9111		-0.14		12 inch rectangular weir, 1.5 inch depth	
9361		-0.08		6 inch rectangular weir, 1.625 inch depth	
9515		-0.01		6 inch rectangular weir, 1.5 inch depth	
9823		-0.03		6 inch rectangular weir, 0.75 inch depth	
10119		-0.11		18 inch rectangular weir, 1.25 inch depth	
QAR-074	0.97		2.32	Measurement rated as 'Good', 6-27-16	
11401		0.00		Flooded back	
11403		-0.03		12 inch rectangular weir, 0.5 inch depth	
11751		0.00		Flooded back	
12453		-0.02		12 inch rectangular weir, 0.375 inch depth	
13281	0.00	-0.57	2.94	End McArdle Lat., ?? Weir, 2.375 inch depth	
McArdle Lat flow remaining	0.00		2.94		
Brandon Lateral					
QAR-056	17.66		0.00	Measurement rated as 'Fair', 6-27-16	
26		-0.35		12 inch rectangular weir, 2.75 inch depth	
QAR-058	18.57		0.35	Measurement rated as 'Good', 6-27-16	

Total Omohundro Lat Intake to the Study Reach	=	0.87			
Total Omohundro Lateral Turnout + Flow Remaining	=	-0.87			
Total Omohundro Losses in the Study Reach	=	0.00	=	0.00%	



Total Rastovich Lateral Intake to the Study Reach	=	1.84		
Total Rastovich Lateral Turnout + Flow Remaining	=	-1.45		
Total Rastovich Lateral Losses in the Study Reach	=	0.39	=	21.06%

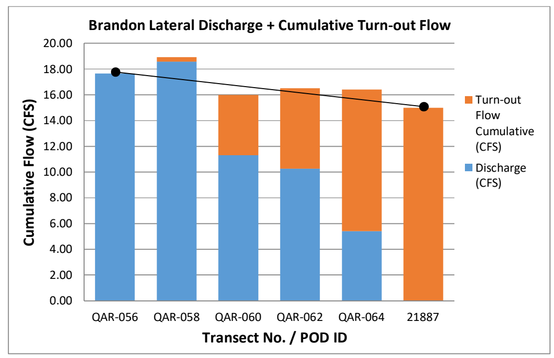


Total McArdle Lateral Intake to the Study Reach	=	3.89		
Total McArdle Lateral Turnout + Flow Remaining	=	-2.94		
Total McArdle Lateral Losses in the Study Reach	=	0.94	=	24.28%

ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
2496		-0.08		12 inch rectangular weir, 1.0 inch depth
2824		-0.08		12 inch rectangular weir, 1.0 inch depth
3064		-0.04		6 inch rectangular weir, 1.0 inch depth
3335		-0.02		6 inch rectangular weir, 0.625 inch depth
3764		-0.09		6 inch rectangular weir, 1.75 inch depth
4017		0.00		Flooded back
4056		-0.06		6 inch rectangular weir, 1.375 inch depth
4325		0.00		Off
QAR-068		-3.89		Transect QAR-068 at start McArdle Lat, 6-27-16
4443	(McArdle Lat flow captured in QAR-068 above)			Ramp Flume Start of McArdle Lat
4750		-0.07		6 inch rectangular weir, 1.5 inch depth
4778		-0.02		6 inch rectangular weir, 0.625 inch depth
QAR-060	11.29		4.69	Measurement rated as 'Good', 6-27-16
5275		-0.04		12 inch rectangular weir, 0.625 inch depth
5723		-0.03		6 inch rectangular weir, 0.875 inch depth
5797		-0.06		12 inch rectangular weir, 0.875 inch depth
5803		-0.07		6 inch rectangular weir, 1.5 inch depth
6317		0.00		Flooded back
6388		-0.22		18 inch rectangular weir, 1.5 inch depth
6392		-0.12		18 inch rectangular weir, 1.0 inch depth
6647		-0.16		24 inch rectangular weir, 1.0 inch depth
6782		-0.13		12 inch rectangular weir, 1.375 inch depth
7978		-0.22		18 inch rectangular weir, 1.5 inch depth
8334		-0.03		6 inch rectangular weir, 0.875 inch depth
8336		0.00		Flooded back
8338		-0.04		6 inch rectangular weir, 1.0 inch depth
8342		-0.18		12 inch rectangular weir, 1.75 inch depth
8344		0.00		Flooded back
8346		-0.03		6 inch rectangular weir, 0.75 inch depth
8348		-0.03		6 inch rectangular weir, 0.875 inch depth
8411		-0.03		6 inch rectangular weir, 0.875 inch depth
8413		-0.11		12 inch rectangular weir, 1.25 inch depth
8415		-0.03		6 inch rectangular weir, 0.875 inch depth
8417		0.00		Flooded back
8419		-0.04		6 inch rectangular weir, 1.0 inch depth
QAR-062	10.24		6.26	Measurement rated 'Good', 6-27-16
8920		-0.02		6 inch rectangular weir, 0.625 inch depth
8963		-0.97		Private Lat. Bill / Rop, 24" weir, 3.375" depth
8965		-0.67		Private Lat. Penhollow, 24" weir, 2.625" depth
10098		-0.13		12 inch rectangular weir, 1.375 inch depth
10100		-0.13		12 inch rectangular weir, 1.375 inch depth
10110		-0.19		24 inch rectangular weir, 1.125 inch depth
10645		-0.14		12 inch rectangular weir, 1.5 inch depth
10787		-0.08		12 inch rectangular weir, 1.0 inch depth
11210		-0.01		6 inch rectangular weir, 0.375 inch depth
11793		-0.16		12 inch rectangular weir, 1.625 inch depth
12405		0.00		Flooded back
12503		-0.29		24 inch rectangular weir, 1.5 inch depth
12534		-0.04		12 inch rectangular weir, 0.625 inch depth
13673		-0.10		18 inch rectangular weir, 0.875 inch depth
QAR-066		-1.84		Transect QAR-066 at Start of Rastovich Lat.
14157	(Rastovich Lat flow captured in QAR-066 above)			Ramp Flume, start of Rastovich Lat
QAR-064	5.40		11.01	Measurement rated as 'Good'
14363		-0.03		6 inch rectangular weir, 0.75 inch depth
14890		0.00		Flooded back
14908		0.00		6 inch rectangular weir, 0.25 inch depth
15451		0.00		Flooded back
15679		-0.08		6 inch rectangular weir, 1.625 inch depth
15715		-0.16		12 inch rectangular weir, 1.625 inch depth
16156		0.04		6 inch rectangular weir, 1.0 inch depth
16366		-0.05		12 inch rectangular weir, 0.75 inch depth
16730		0.00		Flooded back
17234		-0.11		12 inch rectangular weir, 1.25 inch depth
17247		-0.18		12 inch rectangular weir, 1.75 inch depth
17467		-0.01		6 inch rectangular weir, 0.5 inch depth
18171		-0.03		6 inch rectangular weir, 0.75 inch depth
18231		-0.06		12 inch rectangular weir, 0.875 inch depth
18842		0.00		Flooded back
18874		0.00		Flooded back
18879		0.00		Flooded back
18900		0.00		Flooded back / Proportional
19200		-0.29		24 inch rectangular weir, 1.5 inch depth
19203		-1.59		24 inch rectangular weir, 4.75 inch depth
21128		-0.16		12 inch rectangular weir, 1.625 inch depth
21146		-0.01		6 inch rectangular weir, 0.5 inch depth
21868		0.00		Flooded back
21882		-0.09		12 inch rectangular weir, 1.125 inch depth
21883/21885		-1.15		End Brandon Lat, 36" weir, 2.875" depth
21887	0.00	0.00	14.99	Off

Brandon Lateral



Total Brandon Lateral Intake to the Study Reach	=	17.66		
Total Brandon Lateral Turnout + Flow Remaining	=	-14.99		
Total Brandon Lateral Losses in the Study Reach	=	2.67	=	15.11%

ARNOLD IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

Transect No. POD #ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
Brandon Lat flow remaining	0.00		14.99	
Rickard Pipe				
3932	0.44		0.00	Staff Gauge, 6-27-16
1874		-0.11		Piped, 12 inch weir, 1.125 inch depth, 6-27-16
2092		-0.07		6 inch rectangular weir, 1.5 inch depth
2105		-0.05		6 inch rectangular weir, 1.25 inch depth
2107		-0.03		6 inch rectangular weir, 0.875 inch depth
3090		0.00		Off
3937		-0.01		6 inch rectangular weir, 0.5 inch depth
3987		-0.03		6 inch rectangular weir, 0.875 inch depth
4275		-0.02		6 inch rectangular weir, 0.625 inch depth
4324		-0.03		6 inch rectangular weir, 0.875 inch depth
4964		-0.02		6 inch rectangular weir, 0.625 inch depth
4970	0.00	-0.06	0.44	End Rickard Pipe, 6" weir, 1.375" depth
Rickard Pipe flow remaining	0.00		0.44	
Roach Lateral				
32	0.29		0.00	24 inch rectangular weir, 1.5 inch depth, 6-27-16
394		-0.01		6 inch rectangular weir, 1.5 inch depth
1273		-0.01		6 inch rectangular weir, 0.5 inch depth
2395		-0.06		12 inch rectangular weir, 0.875 inch depth
2397		-0.04		6 inch rectangular weir, 1.0 inch depth
3537		-0.05		Proportional weirs, 6.125" weir, 1.125" depth
3538		-0.05		Proportional weirs, 6.5" weir, 1.125" depth
4479		-0.05		Proportional weirs, 5.75" weir, 1.125" depth
4480	0.00	-0.01	0.28	Proportional weirs, 0.875" weir, 1.125" depth
Roach Lat flow remaining	0.00		0.28	

Rickard Pipe

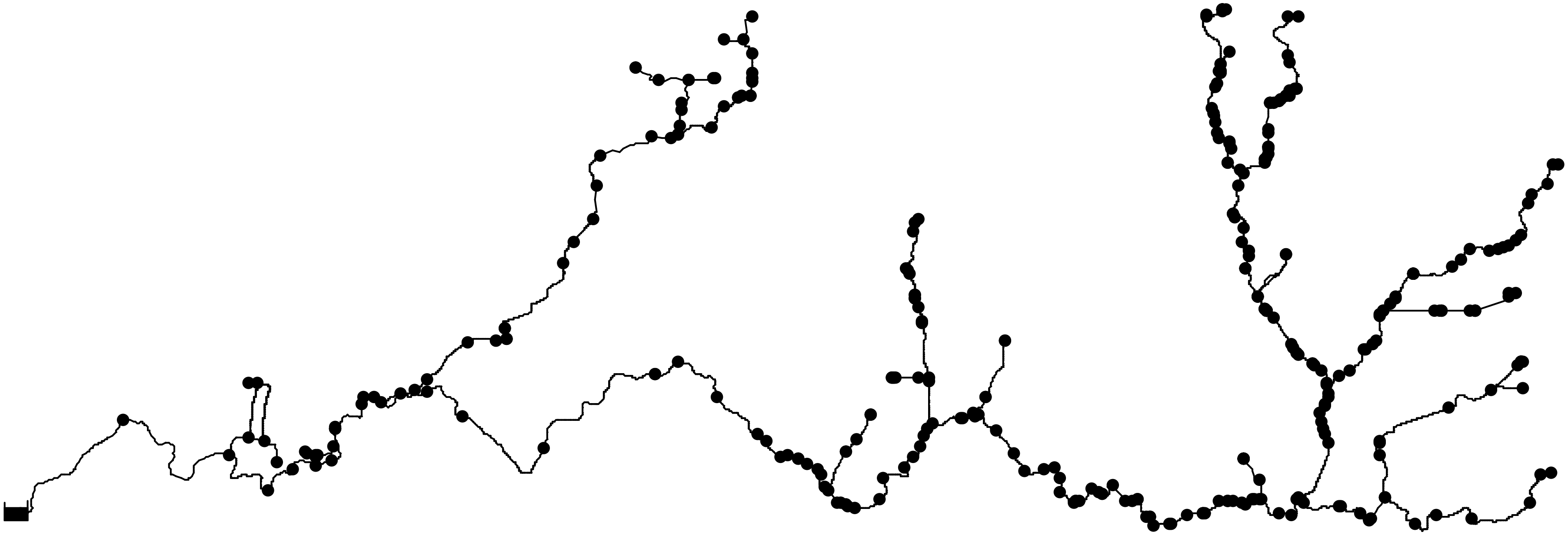
Total Rickard Pipe Intake to the Study Reach	=	0.44		
Total Rickard Pipe Turnout + Flow Remaining	=	-0.44		
Total Rickard Pipe Losses in the Study Reach	=	0.00	=	0.00%

Roach Lateral

Total Roach Lateral Intake to the Study Reach	=	0.29		
Total Roach Lateral Turnout + Flow Remaining	=	-0.28		
Total Roach Lateral Losses in the Study Reach	=	0.01	=	1.99%

APPENDIX B
EPANET HYDRAULIC MODELS

Farmers Conservation Alliance (FCA)



EPANET Node Outputs					
Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 1-04834	3914.57	175.31	175.31	3923.41	3.83
Junc 1-07565	3912.75	2.26	2.26	3921.47	3.78
Junc 1-08873	3912.15	7.55	7.55	3920.56	3.64
Junc 1-09930	3911.82	52.47	52.47	3919.86	3.48
Junc 1-10435	3912.18	77.84	77.84	3919.51	3.18
Junc 1-11818	3910.79	22.65	22.65	3918.58	3.38
Junc 1-11820	3910.84	98.15	98.15	3918.58	3.35
Junc 1-11822	3910.91	45.3	45.3	3918.58	3.32
Junc 1-11829	3910.37	30.12	30.12	3918.55	3.54
Junc 112-01900	3821.18	456.77	456.77	3864.44	18.74
Junc 112-01902	3821.18	30.2	30.2	3864.41	18.73
Junc 112-01904	3821.11	113.25	113.25	3864.4	18.76
Junc 112-01905	3821.11	15.1	15.1	3864.39	18.76
Junc 112-01906	3821.11	22.65	22.65	3864.39	18.76
Junc 1-13292	3910.4	341.93	341.93	3917.54	3.09
Junc 1-13594	3909.97	72.48	72.48	3917.35	3.2
Junc 1-14002	3910.32	36.01	36.01	3917.1	2.94
Junc 1-16227	3905.96	3.77	3.77	3915.67	4.21
Junc 1-18262	3903.19	40.01	40.01	3914.4	4.86
Junc 1-22366	3900.39	1272.38	1272.38	3911.78	4.93
Junc 1-28040	3895.13	888.99	888.99	3908.48	5.78
Junc 1-28042	3895.24	148.13	148.13	3908.48	5.74
Junc 1-29015	3894.56	222.65	222.65	3907.93	5.79
Junc 13-00824	3903.96	27.5	27.5	3914	4.35
Junc 13-01332	3903.88	5.5	5.5	3912.31	3.65
Junc 13-01894	3903.62	11	11	3910.37	2.92
Junc 13-03950	3862.82	23.98	23.98	3903.92	17.81
Junc 13-04984	3852.01	22	22	3900.9	21.18
Junc 13-04986	3852.26	8.25	8.25	3900.9	21.07
Junc 13-05457	3851.6	13.75	13.75	3899.55	20.78
Junc 13-05459	3851.46	8.25	8.25	3899.55	20.84
Junc 13-05789	3851.83	7.15	7.15	3898.68	20.3
Junc 13-05828	3852.03	19.47	19.47	3898.55	20.16
Junc 13-09589	3816.88	18.7	18.7	3889.73	31.57
Junc 13-10443	3811.64	10.45	10.45	3884.33	31.5
Junc 1-31248	3891.52	37.75	37.75	3906.78	6.61
Junc 13-16831	3790.09	7.98	7.98	3846.68	24.52
Junc 13-17485	3785.05	2.2	2.2	3842.09	24.72
Junc 13-17709	3783.55	8.25	8.25	3840.5	24.68
Junc 13-17713	3783.43	5.5	5.5	3840.47	24.72

Junc 13-17715	3783.58	10.01	10.01	3840.45	24.64
Junc 13-19277	3770.32	289.25	289.25	3821.27	22.07
Junc 132-00950	3764.43	27.5	27.5	3809.6	19.57
Junc 132-00951	3764.38	24.75	24.75	3809.6	19.59
Junc 13-20300	3759.88	1.92	1.92	3812.49	22.8
Junc 13-20912	3757.42	7.98	7.98	3807.51	21.7
Junc 13-20938	3756.65	42.73	42.73	3807.31	21.95
Junc 13-21110	3756.45	2.75	2.75	3806.77	21.8
Junc 13-21649	3756.35	8.25	8.25	3805.85	21.45
Junc 13-22322	3753.25	13.75	13.75	3804.32	22.13
Junc 13-22410	3752.57	4.07	4.07	3804.12	22.34
Junc 133-00394	3780.29	5	5	3835.17	23.78
Junc 133-01273	3779.95	5.5	5.5	3823.95	19.07
Junc 133-02397	3778.74	18.1	18.1	3811.45	14.18
Junc 133-03538	3779.49	39.05	39.05	3807.89	12.31
Junc 133-04479	3771.86	28.6	28.6	3807.06	15.25
Junc 133-04480	3771.86	4.79	4.79	3807.04	15.24
Junc 1-33258	3890.59	26.12	26.12	3904.45	6
Junc 1-33734	3890.13	133.25	133.25	3903.94	5.98
Junc 134-00729	3750.64	16.5	16.5	3802.18	22.33
Junc 1-34464	3888.7	15.1	15.1	3903.11	6.24
Junc 1-34710	3888.81	166.47	166.47	3902.82	6.07
Junc 135-01567	3751.65	24.2	24.2	3801.83	21.74
Junc 1-35106	3889.13	46.43	46.43	3902.4	5.75
Junc 1-35108	3889.06	39.94	39.94	3902.4	5.78
Junc 1-35112	3889.29	371.45	371.45	3902.4	5.68
Junc 1-35478	3889.07	45.3	45.3	3901.97	5.59
Junc 1-35932	3888.33	18.87	18.87	3901.51	5.71
Junc 1-36152	3888.71	7.55	7.55	3901.3	5.46
Junc 1-37402	3885.84	15.1	15.1	3899.92	6.1
Junc 1-37608	3885.56	89.09	89.09	3899.71	6.13
Junc 1-37610	3885.56	18.87	18.87	3899.71	6.13
Junc 1-37704	3885.64	15.1	15.1	3899.63	6.06
Junc 1-37993	3885.41	52.85	52.85	3899.37	6.05
Junc 1-38880	3885.22	184.97	184.97	3898.43	5.72
Junc 1-39788	3883.8	196.3	196.3	3897.55	5.96
Junc 1-41062	3879.13	136.65	136.65	3896.31	7.44
Junc 1-41550	3879.87	37.75	37.75	3895.87	6.93
Junc 1-41994	3875.09	28.69	28.69	3895.42	8.81
Junc 1-42416	3873.11	45.3	45.3	3895.03	9.5
Junc 1-42654	3873.66	45.3	45.3	3894.81	9.17
Junc 1-43001	3872.11	307.66	307.66	3894.54	9.72
Junc 1-44097	3872.17	718.75	718.75	3893.6	9.29

Junc 1-44190	3871.34	856.15	856.15	3893.55	9.62
Junc 1-44754	3871.78	15.1	15.1	3893.03	9.21
Junc 1-45730	3871.18	600.36	600.36	3891.78	8.92
Junc 1-46794	3868.07	77.01	77.01	3890.54	9.74
Junc 1-47503	3868.32	283.12	283.12	3889.68	9.26
Junc 1-48296	3867.28	75.5	75.5	3888.68	9.27
Junc 1-48800	3866.63	18.87	18.87	3888.19	9.34
Junc 1-49056	3866.63	8.3	8.3	3887.64	9.1
Junc 1-49604	3867.21	30.2	30.2	3887.04	8.59
Junc 1-50351	3866.09	30.2	30.2	3886.35	8.78
Junc 1-50422	3866.31	22.65	22.65	3886.25	8.64
Junc 1-50430	3866.36	46.05	46.05	3886.25	8.62
Junc 1-50600	3866.38	20.76	20.76	3886.08	8.54
Junc 1-51278	3866.3	15.1	15.1	3885.34	8.25
Junc 1-51605	3865.42	185.95	185.95	3884.93	8.46
Junc 1-51766	3866.61	89.47	89.47	3884.74	7.86
Junc 1-53098	3865.36	83.8	83.8	3883.24	7.75
Junc 1-53356	3865.54	685.07	685.07	3882.93	7.54
Junc 1-53580	3864.76	37.75	37.75	3882.71	7.78
Junc 1-53592	3865.28	30.2	30.2	3882.72	7.56
Junc 1-54271	3863.75	67.95	67.95	3881.99	7.91
Junc 1-54418	3864.11	212.3	212.3	3881.85	7.69
Junc 1-54420	3864.11	50.06	50.06	3881.85	7.69
Junc 1-54430	3863.99	30.2	30.2	3881.84	7.74
Junc 1-54951	3863.86	30.58	30.58	3881.52	7.65
Junc 1-55302	3864	77.39	77.39	3880.98	7.36
Junc 1-55354	3863.5	34.73	34.73	3880.92	7.55
Junc 1-55954	3862.98	15.1	15.1	3880.33	7.52
Junc 1-56580	3863.36	25.37	25.37	3879.73	7.09
Junc 1-56584	3862.78	22.65	22.65	3879.73	7.34
Junc 1-56586	3863.16	56.77	56.77	3879.72	7.18
Junc 1-56588	3863.29	103.66	103.66	3879.72	7.12
Junc 1-56608	3862.87	12.08	12.08	3879.7	7.29
Junc 1-56612	3862.89	60.4	60.4	3879.7	7.28
Junc 1-57320	3862.03	45.3	45.3	3879.03	7.37
Junc 1-57626	3862.64	145.49	145.49	3878.77	6.99
Junc 1-57679	3862.6	30.2	30.2	3878.72	6.98
Junc 1-57877	3863.22	36.24	36.24	3878.54	6.64
Junc 1-58128	3862.51	151.75	151.75	3878.28	6.83
Junc 1-58281	3862.28	52.85	52.85	3878.12	6.86
Junc 1-58630	3861.61	175.91	175.91	3877.83	7.03
Junc 1-58703	3861.39	17.36	17.36	3877.76	7.09
Junc 1-58836	3862.39	37.75	37.75	3877.58	6.58

Junc 1-59894	3861.68	30.2	30.2	3876.76	6.53
Junc 16-01492	3852.07	385.04	385.04	3890.83	16.79
Junc 16-01495	3852.27	264.24	264.24	3890.8	16.7
Junc 16-02150	3841.89	158.55	158.55	3883.21	17.9
Junc 16-03177	3836.5	135.9	135.9	3877.9	17.94
Junc 16-03178	3836.5	128.35	128.35	3877.9	17.94
Junc 1-60334	3861.33	67.19	67.19	3876.37	6.52
Junc 17-04148	3770.26	90.6	90.6	3872.31	44.22
Junc 17-04203	3770.67	22.65	22.65	3871.38	43.64
Junc 17-04995	3768.93	30.2	30.2	3862.68	40.62
Junc 17-05013	3767.82	15.1	15.1	3862.52	41.03
Junc 17-05100	3767.65	55.11	55.11	3861.69	40.75
Junc 17-05144	3767.91	7.55	7.55	3861.51	40.56
Junc 17-06116	3765.24	52.85	52.85	3855.93	39.3
Junc 17-08285	3762.77	212.91	212.91	3837.75	32.49
Junc 171-00540	3814.69	139.6	139.6	3879.01	27.87
Junc 171-01350	3806.8	135.9	135.9	3875.52	29.78
Junc 171-01450	3807.62	89.92	89.92	3874.68	29.06
Junc 171-01452	3807.91	62.29	62.29	3874.66	28.92
Junc 171-01475	3807.54	90.6	90.6	3874.6	29.06
Junc 171-01500	3807.82	117.02	117.02	3874.36	28.83
Junc 18-00176	3868.33	15.1	15.1	3892.38	10.42
Junc 18-00782	3846.62	29.9	29.9	3888.75	18.26
Junc 18-00783	3846.52	60.4	60.4	3888.72	18.28
Junc 18-03150	3795.41	30.2	30.2	3862.2	28.94
Junc 18-03151	3795.88	393.35	393.35	3862.15	28.71
Junc 2-00026	3860.32	264.62	264.62	3875.63	6.63
Junc 2-02496	3822.7	60.4	60.4	3871.38	21.09
Junc 2-02824	3822.63	52.32	52.32	3870.73	20.84
Junc 2-03064	3821.68	18.87	18.87	3870.4	21.11
Junc 2-03335	3821.97	15.1	15.1	3869.91	20.77
Junc 2-03764	3821.52	50.73	50.73	3869.4	20.75
Junc 2-04017	3815.93	15.1	15.1	3868.77	22.9
Junc 2-04056	3815.37	49.07	49.07	3868.68	23.1
Junc 2-04325	3816.07	15.1	15.1	3868.21	22.59
Junc 2-04750	3814.02	49.07	49.07	3867.45	23.15
Junc 2-04778	3814.16	18.87	18.87	3867.33	23.04
Junc 2-05275	3812.96	54.36	54.36	3866.34	23.13
Junc 2-05723	3811.65	22.65	22.65	3865.67	23.41
Junc 2-05797	3810.72	52.85	52.85	3865.46	23.72
Junc 2-05803	3810.83	45.3	45.3	3865.45	23.67
Junc 2-06317	3807.76	97.39	97.39	3864.06	24.39
Junc 2-06388	3802.65	115.14	115.14	3863.88	26.53

Junc 2-06392	3802.78	126.84	126.84	3863.87	26.47
Junc 2-06647	3806.05	98.75	98.75	3863.31	24.81
Junc 2-06782	3802.68	91.2	91.2	3863.01	26.14
Junc 2-07978	3782.08	168.36	168.36	3860.27	33.88
Junc 2-08334	3781.87	22.65	22.65	3859.43	33.61
Junc 2-08336	3782	98.15	98.15	3859.43	33.55
Junc 2-08338	3781.92	32.92	32.92	3859.42	33.58
Junc 2-08342	3781.96	80.41	80.41	3859.41	33.56
Junc 2-08344	3785.76	68.7	68.7	3859.41	31.91
Junc 2-08346	3786.03	35.86	35.86	3859.41	31.79
Junc 2-08348	3786.28	22.65	22.65	3859.4	31.68
Junc 2-08411	3781.84	29.22	29.22	3859.24	33.54
Junc 2-08413	3781.84	56.62	56.62	3859.23	33.53
Junc 2-08415	3781.71	22.65	22.65	3859.23	33.59
Junc 2-08417	3781.71	26.42	26.42	3859.22	33.59
Junc 2-08419	3782.6	30.2	30.2	3859.22	33.2
Junc 2-08920	3781.44	15.1	15.1	3857.76	33.07
Junc 2-08963	3781.44	641.59	641.59	3857.68	33.04
Junc 2-08965	3781.41	472.24	472.24	3857.67	33.04
Junc 2-10098	3778.43	75.5	75.5	3854.22	32.84
Junc 2-10100	3778.12	67.95	67.95	3854.22	32.97
Junc 2-10110	3778.21	191.77	191.77	3854.2	32.93
Junc 2-10645	3778.18	101.17	101.17	3852.85	32.36
Junc 2-10787	3777.6	86.82	86.82	3852.44	32.43
Junc 2-11210	3776	7.55	7.55	3851.33	32.64
Junc 2-11793	3774.17	101.92	101.92	3849.92	32.82
Junc 2-12405	3776.02	49.07	49.07	3848.39	31.36
Junc 2-12530	3774.47	173.65	173.65	3848.14	31.92
Junc 2-12534	3774.47	30.2	30.2	3848.14	31.92
Junc 2-13673	3761.91	301.99	301.99	3845.71	36.31
Junc 2-14363	3761.68	30.2	30.2	3843.53	35.46
Junc 2-14890	3761.29	52.85	52.85	3839.89	34.06
Junc 2-14908	3760.97	15.1	15.1	3839.87	34.19
Junc 2-15451	3761.21	7.55	7.55	3836.5	32.62
Junc 2-15679	3761.22	30.2	30.2	3835.14	32.03
Junc 2-15715	3763.64	124.57	124.57	3834.77	30.82
Junc 2-16156	3757.1	37.75	37.75	3832.31	32.59
Junc 2-16366	3757.52	61.08	61.08	3831.35	31.99
Junc 2-16730	3753.77	33.97	33.97	3829.17	32.67
Junc 2-17243	3755	60.4	60.4	3826.58	31.01
Junc 2-17247	3754.81	104.41	104.41	3826.55	31.08
Junc 2-17467	3754.41	22.65	22.65	3824.66	30.44
Junc 2-18171	3742.09	22.65	22.65	3816.96	32.44

Junc 2-18231	3740.32	55.26	55.26	3815.71	32.67
Junc 2-18842	3739.93	37.75	37.75	3811.53	31.03
Junc 2-18874	3739.5	22.65	22.65	3811.26	31.09
Junc 2-18879	3739.31	30.2	30.2	3811.21	31.16
Junc 2-18900	3738.76	65.91	65.91	3810.98	31.29
Junc 2-19200	3736.97	173.65	173.65	3808.75	31.1
Junc 2-19203	3736.67	430.87	430.87	3808.7	31.21
Junc 22-00797	3805.18	49.75	49.75	3864.85	25.85
Junc 22-01298	3794.78	47.56	47.56	3863.15	29.62
Junc 22-02315	3790	16.99	16.99	3859.26	30.01
Junc 22-02319	3790	52.85	52.85	3859.22	29.99
Junc 22-02505	3790.43	58.59	58.59	3857.97	29.27
Junc 22-03258	3790.22	37.75	37.75	3857.35	29.09
Junc 22-03338	3788.22	57.98	57.98	3853.57	28.32
Junc 22-03433	3788.52	154.39	154.39	3853.2	28.03
Junc 22-03926	3788.49	13.21	13.21	3852.79	27.86
Junc 22-03930	3788.49	16.38	16.38	3852.78	27.86
Junc 22-04284	3788.23	52.7	52.7	3849.85	26.7
Junc 22-04599	3786.12	51.49	51.49	3848.54	27.04
Junc 22-04637	3785.35	22.65	22.65	3848.32	27.29
Junc 22-05694	3761.03	49.07	49.07	3843.81	35.87
Junc 22-05700	3761.03	60.4	60.4	3843.79	35.86
Junc 22-05716	3761.07	22.65	22.65	3843.78	35.84
Junc 22-05718	3761.51	15.1	15.1	3843.77	35.64
Junc 22-05720	3761.79	30.2	30.2	3843.75	35.52
Junc 22-05722	3761.77	30.2	30.2	3843.74	35.52
Junc 22-05724	3761.48	40.17	40.17	3843.73	35.64
Junc 22-07413	3744.65	163.08	163.08	3837.67	40.31
Junc 22-07563	3740.43	176.67	176.67	3836.28	41.53
Junc 22-08072	3738.8	126.16	126.16	3834.65	41.53
Junc 22-08761	3737.38	27.93	27.93	3831.09	40.61
Junc 22-09111	3736.3	113.25	113.25	3829.34	40.31
Junc 22-09361	3736.36	47.19	47.19	3828.14	39.77
Junc 22-09515	3733.93	7.55	7.55	3827.37	40.49
Junc 22-09823	3734.92	15.1	15.1	3825.94	39.44
Junc 22-10119	3733.72	162.32	162.32	3824.62	39.39
Junc 221-01874	3765.87	67.95	67.95	3824.06	25.21
Junc 221-02092	3764.03	45.3	45.3	3821.89	25.07
Junc 221-02105	3764.11	37.75	37.75	3821.85	25.02
Junc 221-02107	3764.11	22.65	22.65	3814.86	21.99
Junc 221-03090	3746.01	22.65	22.65	3808.21	26.95
Junc 221-03937	3748.21	11.32	11.32	3807.09	25.51
Junc 221-03987	3748.46	22.65	22.65	3807.12	25.42

Junc 221-04275	3748.55	15.1	15.1	3807.1	25.37
Junc 221-04324	3748.21	7.55	7.55	3807.09	25.51
Junc 221-04964	3735.42	15.02	15.02	3775.05	17.17
Junc 221-04970	3735.67	30.2	30.2	3773.19	16.26
Junc 2-21128	3721.81	98.15	98.15	3795.84	32.08
Junc 22-11401	3719.54	15.1	15.1	3819.24	43.2
Junc 22-11403	3718.66	41.52	41.52	3819.22	43.57
Junc 2-21146	3721.72	9.44	9.44	3795.7	32.06
Junc 22-11751	3717.58	41.52	41.52	3818.01	43.52
Junc 22-12453	3716.57	52.85	52.85	3815.55	42.89
Junc 22-13281	3705.3	819.16	819.16	3810.09	45.41
Junc 2-21868	3720.03	52.85	52.85	3791.69	31.05
Junc 2-21882	3720.29	56.93	56.93	3791.57	30.89
Junc 2-21883	3720.38	479.87	479.87	3791.54	30.83
Junc 2-21884	3720.38	45.3	45.3	3791.53	30.83
Junc 2-21885	3720.38	301.77	301.77	3791.52	30.82
Junc 2-21887	3720.38	104.19	104.19	3791.52	30.83
Junc 25-00834	3755.58	22.65	22.65	3839.71	36.46
Junc 25-00983	3754.39	22.65	22.65	3838.96	36.64
Junc 25-01031	3753.72	21.14	21.14	3838.51	36.74
Junc 25-01147	3752.97	26.42	26.42	3837.78	36.75
Junc 25-01391	3745.6	28.39	28.39	3836.43	39.36
Junc 25-01413	3746.25	41.52	41.52	3836.33	39.03
Junc 25-01415	3745.67	30.2	30.2	3836.34	39.29
Junc 25-01417	3745.43	33.97	33.97	3836.37	39.4
Junc 25-01898	3735.26	54.36	54.36	3833.84	42.72
Junc 25-02996	3734.11	37.75	37.75	3829.08	41.15
Junc 25-02997	3733.18	28.69	28.69	3829.06	41.54
Junc 25-02998	3736.67	42.28	42.28	3829.07	40.04
Junc 25-03127	3733.04	64.4	64.4	3828.59	41.4
Junc 25-03333	3732.48	68.1	68.1	3827.85	41.32
Junc 25-03459	3732.56	41.52	41.52	3827.56	41.16
Junc 25-03745	3731.48	29.44	29.44	3825.98	40.95
Junc 25-03751	3731.48	24.91	24.91	3825.98	40.95
Junc 25-03882	3731.24	9.81	9.81	3825.44	40.82
Junc 25-04215	3725.92	132.12	132.12	3823.27	42.18
Junc 25-04227	3725.12	30.2	30.2	3823.24	42.52
Junc 25-05343	3723.49	32.09	32.09	3819.35	41.54
Junc 25-05584	3725.03	270.28	270.28	3816.5	39.63
Junc 25-07553	3720.6	37.75	37.75	3788.97	29.62
Junc 3-00612	3861.1	343.52	343.52	3874.57	5.84
Junc 3-02060	3859.76	173.65	173.65	3871.78	5.21
Junc 3-02158	3860.4	80.48	80.48	3871.92	4.99

Junc 3-03058	3859.82	83.8	83.8	3870.38	4.58
Junc 3-03441	3859.76	63.12	63.12	3869.68	4.3
Junc 3-03527	3858.8	68.33	68.33	3869.54	4.66
Junc 3-06028	3856.75	10.57	10.57	3865.24	3.68
Junc 3-07336	3833.54	43.03	43.03	3862.94	12.74
Junc 3-08995	3829.61	408.6	408.6	3860.15	13.23
Junc 31-01681	3852.33	30.95	30.95	3861.08	3.79
Junc 3-10206	3822.07	72.48	72.48	3853.13	13.46
Junc 31-02122	3851.85	31.26	31.26	3858.72	2.98
Junc 31-02125	3852.26	30.2	30.2	3858.63	2.76
Junc 31-03000	3814.71	3.77	3.77	3846.58	13.81
Junc 31-06791	3798.91	499.05	499.05	3838.62	17.21
Junc 31-08036	3776.99	49.07	49.07	3834.99	25.13
Junc 31-08256	3775.86	39.64	39.64	3834.47	25.4
Junc 31-08258	3775.93	39.64	39.64	3834.47	25.36
Junc 31-08260	3776.34	55.34	55.34	3834.46	25.18
Junc 31-08266	3776.59	95.13	95.13	3834.39	25.04
Junc 31-08268	3776.71	15.1	15.1	3834.37	24.98
Junc 31-08270	3775.73	166.1	166.1	3834.35	25.4
Junc 31-08272	3776.56	52.85	52.85	3834.33	25.03
Junc 31-08274	3775.95	128.35	128.35	3834.3	25.28
Junc 31-08276	3775.98	151	151	3834.29	25.27
Junc 31-08279	3776.11	52.85	52.85	3834.28	25.21
Junc 31-08281	3775.76	113.25	113.25	3834.27	25.35
Junc 31-08283	3775.43	28.31	28.31	3834.25	25.49
Junc 3-11870	3808.23	409.96	409.96	3849.89	18.05
Junc HG-1	3763.02	0	0	3844.74	35.41
Junc HG-10	3868.41	0	0	3900.56	13.93
Junc HG-11	3778.85	0	0	3811.49	14.14
Junc HG-14	0	0	0	3868.16	1676.08
Junc HG-15	0	0	0	3851.52	1668.86
Junc HG-2	3815.63	0	0	3868.02	22.7
Junc HG-3	3862.05	0	0	3875.77	5.94
Junc HG-4	3857.56	0	0	3869.48	5.17
Junc HG-5	3857.73	0	0	3868.12	4.5
Junc HG-6	3861.95	0	0	3877.62	6.79
Junc HG-7	3870.66	0	0	3893.24	9.78
Junc HG-8	3874.02	0	0	3894.8	9.01
Junc HG-9	3822.04	0	0	3882.72	26.29
Junc N-1	3752.59	0	0	3803.24	21.95
Junc N-10	3774.99	0	0	3834.15	25.63
Junc N-11	3832.21	0	0	3872.26	17.35
Junc N-12	3866.26	0	0	3883.98	7.68

Junc N-13	3815.35	0	0	3882.15	28.94
Junc N-14	3769.8	0	0	3866.07	41.71
Junc N-15	3768.45	0	0	3862.76	40.86
Junc N-16	3764.98	0	0	3856.79	39.78
Junc N-17	3763.14	0	0	3855.67	40.09
Junc N-18	3762.89	0	0	3849.87	37.69
Junc N-19	3761.53	0	0	3840.99	34.43
Junc N-2	3755.99	0	0	3802.35	20.09
Junc N-20	3888.11	0	0	3900.02	5.16
Junc N-21	3886.38	0	0	3900.72	6.21
Junc N-22	3908.2	0	0	3916.91	3.77
Junc N-23	3804.02	0	0	3877.12	31.67
Junc N-24	3798.99	0	0	3869.4	30.51
Junc N-25	3791.14	0	0	3860.57	30.08
Junc N-26	3780.17	0	0	3827.97	20.71
Junc N-27	3910.33	0	0	3919.86	4.13
Junc N-28	3909.59	0	0	3919.86	4.45
Junc N-29	3908.1	0	0	3919.86	5.1
Junc N-3	3754.07	0	0	3805.89	22.45
Junc N-30	3908.02	0	0	3919.86	5.13
Junc N-31	3905.19	0	0	3919.86	6.36
Junc N-32	3908.75	0	0	3919.86	4.81
Junc N-33	3906.32	0	0	3923.41	7.4
Junc N-34	3903.5	0	0	3923.41	8.63
Junc N-35	3900.59	0	0	3923.41	9.89
Junc N-36	3905.71	0	0	3923.41	7.67
Junc N-37	3907.11	0	0	3923.41	7.06
Junc N-38	3776.8	0	0	3857.67	35.04
Junc N-39	3776.78	0	0	3857.68	35.06
Junc N-4	3754.2	0	0	3804.63	21.85
Junc N-40	3733.28	0	0	3808.7	32.68
Junc N-5	3731.98	0	0	3824.48	40.08
Junc N-6	3727.24	0	0	3823.42	41.68
Junc N-7	3736.6	0	0	3833.36	41.93
Junc N-8	3857.66	0	0	3868.18	4.56
Junc N-9	3778.53	0	0	3838.62	26.04
Junc 1	3922.17	0	0	3927.39	2.26
Junc 2	3924	0	0	3931	3.03
Junc 4	3808.23	604	604	3849.88	18.05
Junc 5	3774.99	906	906	3834.14	25.63
Junc 6	3735.67	151	151	3773.17	16.25
Junc 7	3705.3	1132.5	1132.5	3810.08	45.4
Junc 8	3720.6	377.5	377.5	3777.21	24.53

Junc 9	3720.38		377.5	377.5	3791.5	30.82
Resvr 3	3931	#N/A		-33175.05	3931	0

EPANET LINK OUTPUTS				
Pipe ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 1	1373.8374	58.89	32997.48	3.89
Pipe 2	566.1116	50.477	27954.17	4.48
Pipe 3	2931.42	58.89	32999.73	3.89
Pipe 4	529.8409	58.89	32937.44	3.88
Pipe 5	1056.7154	58.89	32989.93	3.89
Pipe 6	1415.3747	58.89	32859.6	3.87
Pipe 7	5899.8233	58.89	30122.17	3.55
Pipe 8	469.4841	50.477	28798.53	4.62
Pipe 9	391.0458	50.477	28483.71	4.57
Pipe 10	266.1289	50.477	28650.18	4.59
Pipe 11	768.347	50.477	28665.28	4.6
Pipe 12	207.546	50.477	27961.72	4.48
Pipe 13	436.7454	50.477	27980.59	4.49
Pipe 14	415.2274	50.477	28025.89	4.49
Pipe 15	2.4276	50.477	28443.77	4.56
Pipe 16	3.5831	50.477	28397.34	4.55
Pipe 17	1561.5388	58.89	32663.38	3.85
Pipe 18	398.9184	58.89	32248.97	3.8
Pipe 19	287.0973	58.89	32321.46	3.81
Pipe 20	43.973	58.89	32693.5	3.85
Pipe 21	1.825	58.89	32738.8	3.86
Pipe 22	2.4923	58.89	32836.95	3.87
Pipe 23	2050.755	58.89	31438.33	3.7
Pipe 24	300.265	58.89	32212.96	3.79
Pipe 25	4343.487	58.89	31394.55	3.7
Pipe 26	2134.8611	50.477	28824.65	4.62
Pipe 27	2105.9597	58.89	31434.56	3.7
Pipe 28	2226.3909	58.89	28862.4	3.4
Pipe 29	1050.6597	58.89	29085.05	3.43
Pipe 30	2.2202	58.89	29233.18	3.44
Pipe 31	110.8755	50.477	26882.09	4.31
Pipe 32	993.43	50.477	26691.08	4.28
Pipe 33	273.7657	50.477	26743.93	4.29
Pipe 34	85.2561	50.477	26759.03	4.29
Pipe 35	1.8784	50.477	26777.9	4.29
Pipe 36	212.2915	50.477	26866.99	4.31
Pipe 37	1344.3799	50.477	26309.81	4.22
Pipe 38	948.1799	50.477	26506.11	4.25
Pipe 39	616.833	44.87	21373.85	4.34
Pipe 40	539.5762	44.87	21404.05	4.34

Pipe 41	707.0268	44.87	20963.67	4.25
Pipe 42	177.5937	44.87	21053.14	4.27
Pipe 43	369.8113	44.87	21239.09	4.31
Pipe 44	671.9347	44.87	21254.19	4.31
Pipe 45	148.7574	44.87	21274.95	4.32
Pipe 46	7.835	44.87	21321	4.33
Pipe 47	88.418	44.87	21343.65	4.33
Pipe 48	496.2038	50.48	26135.41	4.19
Pipe 49	477.2141	50.477	26173.16	4.2
Pipe 50	242.9069	50.48	26061.42	4.18
Pipe 51	425.8924	50.48	26106.72	4.19
Pipe 52	890.336	44.87	21506.72	4.36
Pipe 53	745.1045	44.87	21789.84	4.42
Pipe 54	487.4922	44.87	21412.35	4.34
Pipe 55	441.0243	44.87	21431.22	4.35
Pipe 56	320.2711	50.48	24893.82	3.99
Pipe 57	1148.1537	50.48	24586.16	3.94
Pipe 58	9.8024	50.48	26016.12	4.17
Pipe 59	160.7327	44.09	22482.31	4.72
Pipe 60	940.0928	44.09	22467.21	4.72
Pipe 61	426.6396	50.48	23011.26	3.69
Pipe 62	73.788	50.48	23867.41	3.83
Pipe 63	1065.3319	44.87	21866.85	4.44
Pipe 64	290.4191	44.87	20879.87	4.24
Pipe 65	142.3549	44.87	20058.9	4.07
Pipe 66	624.3807	44.87	19623.64	3.98
Pipe 67	60.5282	44.87	19658.37	3.99
Pipe 68	568.9458	44.87	19735.76	4
Pipe 69	332.3159	44.87	19766.34	4.01
Pipe 70	8.8826	44.87	19796.54	4.02
Pipe 71	2.522	44.87	19846.6	4.03
Pipe 72	628.1039	44.87	19608.54	3.98
Pipe 73	4.0596	44.87	19583.17	3.97
Pipe 74	2.6164	44.87	19560.52	3.97
Pipe 75	2.5664	44.87	19503.75	3.96
Pipe 76	22.9642	44.87	19400.09	3.94
Pipe 77	2.408	44.87	19388.01	3.93
Pipe 78	717.5218	44.87	19327.61	3.92
Pipe 79	473.4918	44.87	17966.59	3.65
Pipe 80	755.4124	44.87	17899.4	3.63
Pipe 81	6.6667	44.87	20164.6	4.09
Pipe 82	213.3557	44.87	20194.8	4.1
Pipe 83	719.3094	44.87	20126.85	4.08

Pipe 84	291.6865	44.87	19282.31	3.91
Pipe 85	50.5919	44.87	18034.54	3.66
Pipe 86	291.8825	44.87	19070.38	3.87
Pipe 87	50.127	44.87	19136.82	3.88
Pipe 88	196.9148	44.87	19106.62	3.88
Pipe 89	184.2774	44.87	18918.63	3.84
Pipe 90	328.1654	44.87	18865.78	3.83
Pipe 91	71.4136	44.87	18689.87	3.79
Pipe 92	161.148	44.87	18672.51	3.79
Pipe 93	1021.8601	44.87	17996.79	3.65
Pipe 94	574.3783	22.44	4849.4	3.93
Pipe 95	40.8998	22.44	4036.5	3.27
Pipe 96	86.859	22.44	4104.83	3.33
Pipe 97	447.8777	22.44	4167.95	3.38
Pipe 98	852.1588	22.44	4251.75	3.45
Pipe 99	82.0087	22.44	4425.4	3.59
Pipe 100	1455.0061	22.44	4505.88	3.66
Pipe 101	1609.86	14.96	1548.64	2.83
Pipe 102	1282.3564	14.96	1538.07	2.81
Pipe 103	1642.8603	14.96	1495.04	2.73
Pipe 104	2464.6165	11.92	1086.44	3.12
Pipe 105	1294.9224	11.92	1013.96	2.92
Pipe 106	11.0187	22.44	4036.5	3.27
Pipe 107	1611.0249	14.96	2487.86	4.54
Pipe 108	2959.7426	14.96	2395.45	4.37
Pipe 109	21.8403	14.96	2425.65	4.43
Pipe 110	552.4165	14.96	2456.91	4.48
Pipe 111	1959.6998	14.96	2391.68	4.37
Pipe 112	1267.9634	14.7	1892.63	3.58
Pipe 113	188.6587	14.7	1843.56	3.49
Pipe 114	3.3432	14.7	1803.92	3.41
Pipe 115	3.1703	14.7	1764.28	3.34
Pipe 116	9.9608	11.71	1708.94	5.09
Pipe 117	21.3754	9.87	906	3.8
Pipe 118	3.3594	9.87	934.31	3.92
Pipe 119	2.8826	11.71	1047.56	3.12
Pipe 120	3.3583	11.71	1100.41	3.28
Pipe 121	2.9848	11.71	1251.41	3.73
Pipe 122	5.9733	11.71	1379.76	4.11
Pipe 123	2.7547	11.71	1432.61	4.27
Pipe 124	3.0273	11.71	1598.71	4.76
Pipe 125	3.0582	11.71	1613.81	4.81
Pipe 126	1186.5587	6.08	0	0

Pipe 127	78.8989	33.65	13050	4.71
Pipe 128	2432.1514	33.65	12785.38	4.61
Pipe 129	195.4345	33.65	12672.66	4.57
Pipe 130	373.1003	33.65	12724.98	4.59
Pipe 131	116.5548	33.65	12508.69	4.51
Pipe 132	276.141	33.65	12523.79	4.52
Pipe 133	57.919	33.65	12572.86	4.54
Pipe 134	370.736	33.65	12587.96	4.54
Pipe 135	297.8114	33.65	12638.69	4.56
Pipe 136	284.6433	33.65	12653.79	4.56
Pipe 137	301.0952	28.04	8237.57	4.28
Pipe 138	557.595	26.17	7994.47	4.77
Pipe 139	5.9036	26.17	8039.77	4.8
Pipe 140	81.8616	26.17	8092.62	4.83
Pipe 141	367.6278	28.04	8115.27	4.22
Pipe 142	534.0334	28.04	8169.63	4.24
Pipe 143	63.4576	28.04	8188.5	4.25
Pipe 144	135.7234	26.17	7556.35	4.51
Pipe 145	368.1402	25.72	7296.79	4.51
Pipe 146	1146.7479	25.72	7465.15	4.61
Pipe 147	242.6792	26.17	7655.1	4.57
Pipe 148	2.8199	26.17	7781.94	4.64
Pipe 149	75.1371	26.17	7897.08	4.71
Pipe 150	28.0136	23.88	6755.24	4.84
Pipe 151	1144.4507	22.04	5641.4	4.74
Pipe 152	5.2439	23.88	6113.65	4.38
Pipe 153	508.4592	23.88	6770.34	4.85
Pipe 154	2.0479	23.88	6800.54	4.87
Pipe 155	1.3227	23.88	6826.96	4.89
Pipe 156	1.264	23.88	6849.61	4.91
Pipe 157	1.5654	23.88	6906.23	4.95
Pipe 158	55.7377	23.88	6935.45	4.97
Pipe 159	1.525	25.72	6958.1	4.3
Pipe 160	1.7672	25.72	6993.96	4.32
Pipe 161	1.8036	25.72	7062.66	4.36
Pipe 162	3.4995	25.72	7143.07	4.41
Pipe 163	2.0782	25.72	7175.99	4.43
Pipe 164	2.0602	25.72	7274.14	4.49
Pipe 165	560.5421	22.04	5110.64	4.3
Pipe 166	441.3697	22.04	5118.19	4.3
Pipe 167	160.8112	22.04	5205.01	4.38
Pipe 168	498.9683	22.04	5306.18	4.46
Pipe 169	6.9937	22.04	5497.95	4.62

Pipe 170	2.2581	22.04	5565.9	4.68
Pipe 171	1103.8744	22.04	4755.8	4
Pipe 172	1.8892	22.04	4786	4.02
Pipe 173	106.3362	22.04	4959.65	4.17
Pipe 174	631.9081	22.04	5008.72	4.21
Pipe 175	186.5388	14.7	2945.67	5.57
Pipe 176	551.2415	14.7	2847.52	5.38
Pipe 177	3.4124	14.7	2862.62	5.41
Pipe 178	569.733	14.7	2915.47	5.51
Pipe 179	499.1696	22.04	4453.81	3.75
Pipe 180	519.147	14.7	2552.4	4.83
Pipe 181	427.9423	14.7	2586.37	4.89
Pipe 182	178.8825	14.7	2647.45	5
Pipe 183	449.1808	14.7	2685.2	5.08
Pipe 184	61.8299	14.7	2809.77	5.31
Pipe 185	224.8954	14.7	2839.97	5.37
Pipe 186	482.3803	12.59	2287.03	5.89
Pipe 187	138.3293	12.59	2342.29	6.04
Pipe 188	835.5622	12.59	2364.94	6.09
Pipe 189	223.5973	12.86	2387.59	5.9
Pipe 190	5.6065	14.7	2492	4.71
Pipe 191	293.7872	12.59	2130.52	5.49
Pipe 192	1986.9942	11.46	1526	4.75
Pipe 193	8.7156	12.59	1956.87	5.04
Pipe 194	28.5362	12.59	2196.43	5.66
Pipe 195	5.419	12.59	2226.63	5.74
Pipe 196	32.912	12.59	2249.28	5.8
Pipe 197	0.0616	5.96	783.46	9.01
Pipe 198	709.8973	11.46	1418.41	4.41
Pipe 199	24.8213	11.46	1427.85	4.44
Pipe 200	0.8412	7.75	679.27	4.62
Pipe 201	3.4121	9.66	828.76	3.63
Pipe 202	2.6492	9.66	1308.63	5.73
Pipe 203	9.545	9.66	1365.56	5.98
Pipe 204	991.318	11.46	1226.84	3.82
Pipe 205	2.6472	11.46	1189.09	3.7
Pipe 206	196.2042	9.66	879.94	3.85
Pipe 207	790.3438	18.7	4271.12	4.99
Pipe 208	433.5778	18.7	4221.37	4.93
Pipe 209	1013.0568	18.7	4173.81	4.88
Pipe 210	334.8277	18.7	4103.97	4.79
Pipe 211	10.2484	18.7	4156.82	4.86
Pipe 212	973.9906	18.37	4007.63	4.85

Pipe 213	171.9005	18.7	4045.38	4.73
Pipe 214	117.7945	18.37	3795.26	4.59
Pipe 215	96.2334	18.37	3949.65	4.78
Pipe 216	1060.6345	16.53	3189.69	4.77
Pipe 217	49.0572	16.53	3212.34	4.8
Pipe 218	296.2516	16.53	3263.83	4.88
Pipe 219	364.5279	16.53	3316.53	4.96
Pipe 220	2.7838	18.37	3782.05	4.58
Pipe 221	1490.3178	16.18	2941.9	4.59
Pipe 222	3.2885	16.53	2982.07	4.46
Pipe 223	3.1617	16.53	3012.27	4.5
Pipe 224	3.0089	16.53	3042.47	4.55
Pipe 225	2.8049	16.53	3057.57	4.57
Pipe 226	4.0009	16.53	3080.22	4.6
Pipe 227	378.9491	16.18	2778.82	4.34
Pipe 228	254.2107	14.38	2334.81	4.61
Pipe 229	341.6278	14.38	2448.06	4.84
Pipe 230	678.0092	14.38	2475.99	4.89
Pipe 231	504.297	16.18	2602.15	4.06
Pipe 232	316.6893	14.38	2280.07	4.5
Pipe 233	295.3073	14.38	2264.97	4.47
Pipe 234	170.5942	14.38	2287.62	4.52
Pipe 235	328.7811	14.38	2046.03	4.04
Pipe 236	4.8096	14.38	2087.55	4.12
Pipe 237	1387.9657	14.38	2102.65	4.15
Pipe 238	692.8657	14.38	2004.51	3.96
Pipe 239	798.0558	12.44	1951.66	5.15
Pipe 240	878.1717	22.44	4036.5	3.27
Pipe 241	1920.5127	7.92	0	0
Pipe 242	2010.4086	7.92	0	0
Pipe 243	153.3355	50.477	27954.17	4.48
Pipe 244	557.178	50.477	26882.09	4.31
Pipe 245	690.9478	44.87	20963.67	4.25
Pipe 246	751.1866	8.06	637.97	4.01
Pipe 247	1094.6003	8.06	637.97	4.01
Pipe 248	0.4587	4.21	37.75	0.87
Pipe 249	1.586	4.21	151	3.48
Pipe 250	1.4119	4.21	181.2	4.18
Pipe 251	170.3821	8.06	528.95	3.33
Pipe 252	7.9867	8.06	483.95	3.04
Pipe 253	2190.992	6.19	423.55	4.52
Pipe 254	758.073	8.06	513.85	3.23
Pipe 255	4.8759	6.19	393.35	4.19

Pipe 256	1525.5318	10.05	1072.08	4.34
Pipe 257	1051.5314	6.19	264.25	2.82
Pipe 258	629.2065	6.19	422.8	4.51
Pipe 259	3.2589	8.06	687.04	4.32
Pipe 260	0.2184	4.21	128.35	2.96
Pipe 261	1740.9495	10.05	1122.3	4.54
Pipe 262	2084.0835	7.92	486.97	3.17
Pipe 263	507.2172	6.08	373.72	4.13
Pipe 264	79.8225	6.08	396.37	4.38
Pipe 265	7.4521	6.08	373.72	4.13
Pipe 266	847.781	6.08	265.76	2.94
Pipe 267	29.5688	6.08	273.31	3.02
Pipe 268	100.8141	6.08	328.42	3.63
Pipe 269	18.1285	6.08	343.52	3.8
Pipe 270	1567.5896	6.08	212.91	2.35
Pipe 271	132.9684	4.13	212.91	5.1
Pipe 272	132.1042	8.06	486.97	3.06
Pipe 273	315.7279	6.08	373.72	4.13
Pipe 274	153.3799	6.08	265.76	2.94
Pipe 275	72.1378	6.08	212.91	2.35
Pipe 276	365.617	4.13	212.91	5.1
Pipe 277	833.6024	10.05	774.63	3.13
Pipe 278	516.1818	10.05	747.13	3.02
Pipe 279	2058.4679	10.05	730.63	2.95
Pipe 280	602.738	10.05	741.63	3
Pipe 281	1022.7237	10.05	706.65	2.86
Pipe 282	3725.1013	10.05	627.78	2.54
Pipe 283	50.5676	10.05	647.25	2.62
Pipe 284	0.7011	8.06	668.15	4.2
Pipe 285	340.5727	10.05	654.4	2.65
Pipe 286	493.8555	10.05	676.4	2.74
Pipe 287	1.8811	10.05	684.65	2.77
Pipe 288	1134.7416	8.06	598.63	3.76
Pipe 289	824.4135	8.06	609.08	3.83
Pipe 290	1389.9775	8.06	598.63	3.76
Pipe 291	1532.4926	6.08	411.4	4.55
Pipe 292	1010.0169	4.13	122.15	2.93
Pipe 293	308.2974	4.13	66.77	1.6
Pipe 294	176.9193	4.13	69.52	1.66
Pipe 295	27.3365	4.13	112.25	2.69
Pipe 296	590.195	4.13	120.23	2.88
Pipe 297	125.1071	4.05	58.52	1.46
Pipe 298	701.5813	4.05	40.7	1.01

Pipe 299	138.0798	4.05	44.77	1.11
Pipe 303	1216.531	8.06	598.63	3.76
Pipe 304	2186.9112	8.06	598.63	3.76
Pipe 305	237.1998	7.92	588.45	3.83
Pipe 306	4.2012	7.92	574.7	3.74
Pipe 307	4.319	7.92	580.2	3.78
Pipe 308	680.7316	7.92	590.65	3.85
Pipe 309	15.3172	4.13	66.77	1.6
Pipe 310	548.6928	4.13	58.52	1.4
Pipe 311	717.2351	4.05	40.7	1.01
Pipe 312	1089.6186	4.05	24.2	0.6
Pipe 313	697.7943	4.05	16.5	0.41
Pipe 314	1158.4463	6.19	0	0
Pipe 315	570.1612	6.19	-15.38	0.16
Pipe 316	1216.43	6.19	0.01	0
Pipe 317	2025.4717	6.19	15.39	0.16
Pipe 318	2472.3432	6.19	15.38	0.16
Pipe 319	329.4413	6.19	0	0
Pipe 320	311.783	6.19	0.01	0
Pipe 321	68.1157	6.19	0.01	0
Pipe 322	830.3152	6.19	0	0
Pipe 323	419.241	6.19	0	0
Pipe 324	61.4558	6.19	0	0
Pipe 325	395.9871	6.19	0	0
Pipe 326	526.2339	5.96	0	0
Pipe 327	322.9342	4.13	148.29	3.55
Pipe 328	1074.3286	4.13	142.79	3.42
Pipe 329	1052.4366	4.13	33.39	0.8
Pipe 330	7.1328	4.13	90.54	2.17
Pipe 331	1080.0131	4.13	72.44	1.73
Pipe 332	1047.687	4.13	52.25	1.25
Pipe 333	4.1514	4.13	24.75	0.59
Pipe 334	398.7564	4.13	153.29	3.67
Pipe 335	578.8286	4.13	148.29	3.55
Pipe 336	881.9768	11.71	1508.14	4.49
Pipe 337	123.4026	11.46	1485.49	4.62
Pipe 338	110.8772	11.46	1226.84	3.82
Pipe 339	4.1322	11.46	1352.92	4.21
Pipe 340	2.981	11.46	1322.72	4.11
Pipe 341	531.4558	11.46	1281.2	3.99
Pipe 342	11.6172	11.46	1386.89	4.31
Pipe 343	240.1771	11.46	1415.28	4.4
Pipe 344	125.5416	11.46	1441.7	4.48

Pipe 345	74.2241	11.46	1462.84	4.55
Pipe 346	3.9429	11.46	1146.81	3.57
Pipe 347	100.312	11.46	985.62	3.07
Pipe 348	179.0795	9.66	879.94	3.85
Pipe 349	0.9627	9.66	919.19	4.02
Pipe 350	98.5857	9.66	889.75	3.89
Pipe 351	258.0087	9.66	944.1	4.13
Pipe 352	128.9873	11.46	1118.12	3.48
Pipe 353	226.5619	11.46	1053.72	3.28
Pipe 354	28.2372	9.66	879.94	3.85
Pipe 355	1056.9887	9.66	717.62	3.14
Pipe 356	7.8577	9.66	747.82	3.27
Pipe 357	1961.8867	5.96	415.25	4.78
Pipe 358	289.2241	7.75	685.53	4.66
Pipe 359	94.006	4.05	181.2	4.51
Pipe 360	5.2363	6.08	335.89	3.71
Pipe 361	199.5133	6.08	381.19	4.21
Pipe 362	1864.7421	6.08	449.14	4.96
Pipe 363	2.305	5.96	215.09	2.47
Pipe 364	3.2007	5.96	230.19	2.65
Pipe 365	194.8761	5.96	252.84	2.91
Pipe 366	0.4544	5.96	207.54	2.39
Pipe 367	1013.6057	5.96	275.49	3.17
Pipe 368	1393.7133	4.05	196.22	4.89
Pipe 369	33.0228	4.21	117.02	2.7
Pipe 370	4.3743	6.19	269.91	2.88
Pipe 371	19.6284	6.21	207.62	2.2
Pipe 372	93.8517	6.19	359.83	3.84
Pipe 373	778.724	8.06	495.73	3.12
Pipe 374	522.7932	8.06	635.33	4
Pipe 375	4.0009	16.53	3140.62	4.7
Pipe 376	0.4587	4.21	22.65	0.52
Pipe 377	1052.4366	4.13	4.79	0.11
Pipe 378	1013.6057	6.08	298.14	3.29
Pipe 379	11.0187	14.96	2487.86	4.54
Pipe 380	364.5279	18.37	3765.67	4.56
Pipe 381	5967.43	58.891	-33175.05	3.91
Pipe 382	5394.67	58.89	-33175.05	3.91
Pipe 383	1	58.89	-33175.05	3.91
Pipe 384	1	8.06	604	3.8
Pipe 385	1	9.87	906	3.8
Pipe 386	1	4.05	151	3.76
Pipe 387	1	9.55	1132.5	5.07

Pipe 388	1000	5.96	377.5	4.34
Pipe 389	1	5.96	377.5	4.34

APPENDIX C
PIPE BUDGET ESTIMATES FROM VENDORS

From: **Theetge, Mark A** <Mark.Theetge@hdsupply.com>
Date: Thu, Sep 15, 2016 at 8:55 AM
Subject: RE: Swalley Pipe Lengths
To: Kevin Crew <blackrockci@gmail.com>

Great to hear! I have attached basic pricing that I may end up refining for my own interest and share that later. The cost that I have used is based on actual footage which could include partial loads. The freight cost I have included is for the furthest distance which would be Kingman AZ. I have also included cost for a tech and equipment to weld the material. I used current project pricing levels and a conservative mark up about 12%. All of this could change with the market so for basic estimation only!!

If it was my district I might want to include cost for fusion equipment purchase in the cost of the project. For material 24" and down or possibly 18" and down based on the cooperation of other districts. Given Marc has a 36" machine and since there is not a whole lot of larger pipe it would make sense to rent possibly. Just a thought?

Thanks,

Mark A. Theetge

Fusible Plastics Specialist

HD Supply WaterWorks

M 503 341 3614

F 855 222-0361

	Proposed DR32.5		Proposed DR26		Proposed DR21	
54in	0.00		0.00		0.00	
48in	2,094.13	$105.50	0.00		0.00	
42in	4,559.92	$81.92	0.00		0.00	
36in	6,708.70	$62.89	0.00		0.00	
34in	1,932.25	$54.73	0.00		0.00	
32in	830.58	$4,703	0.00		0.00	
30in	2,558.88	$42.15	0.00		0.00	
28in	3,085.71	$37.05	1,664.91	$44.98	0.00	
26in	0.00	$0.00	2,745.63	$39.95	0.00	
24in	5,727.49	$26.86	2,533.51	$32.98	0.00	
22in	0.00	$0.00	0.00		0.00	
20in	6,350.76	$19.45	1,282.68	$24.15	0.00	
18in	5,644.83	$15.41	347.84	$23.97	319.85	$28.14
16in	2,295.26	$15.27	1,926.59	$15.61	3,038.68	$22.13
14in	9,163.29	$9.48	1,119.91	$12.78	1,565.95	$13.77
12in	8,351.11	$7.81	4,588.71	$9.56	2,437.56	$11.35
10in	9,020.98	$5.82	2,197.32	$7.23	2,380.32	$8.75
8in	13,531.69	$3.93	4,736.81	$4.68	525.96	$10.16

Finding of No Significant Impact
For
Arnold Irrigation District Infrastructure Modernization Project
Deschutes County, Oregon

I. Introduction

Arnold Irrigation District Infrastructure Modernization Project (the Project) is a federally-assisted action authorized for planning under Public Law 83-566, the Watershed Protection and Flood Prevention Act. This act authorizes the Natural Resources Conservation Service (NRCS) to provide technical and financial assistance to local project sponsors. The local sponsors of the Project are the Arnold Irrigation District (AID) and the Deschutes Basin Board of Control.

An environmental assessment (Plan-EA), attached and incorporated by reference into this finding, was undertaken in conjunction with the development of the watershed plan. The assessment was conducted in consultation with local, state, and tribal governments; federal agencies; and interested organizations and individuals. Data developed during the assessment are available for public review at the following location:

U.S. Department of Agriculture
Natural Resources Conservation Service
1201 NE Lloyd Blvd; Suite 900
Portland, Oregon 97232

II. Recommended Action

The proposed action under consideration would modernize irrigation infrastructure within the Project Area, which extends for approximately 11.9 miles along AID's Main Canal. The Project Area starts from about 850 feet to the east of Pima Road and extends approximately 11.9 miles to the east along the Main Canal, terminating near the canal's intersection with Horse Butte Road.

The proposed action would include construction activities associated with piping 11.9 miles of AID's Main Canal, updating 88 turnouts, and installing Supervisory Control and Data Acquisition Systems (SCADA) in two locations. A concrete check and pipe inlet structure would be installed at the inlet of the pipe (i.e., the western end of the pipe). SCADA would be installed at the inlet of the pipe and at the terminus of the pipe (i.e., the eastern end of the pipe).

The purpose of this project is to:

- Improve water conservation in District-owned infrastructure
- Improve water supply management and delivery reliability to District patrons

- Improve public safety on up to 11.9 miles of the District-owned Main Canal

Implementation of the Preferred Alternative would support the maintenance of agricultural production in a region undergoing rapid urbanization where environmental concerns necessitate federal action. The proposed action addresses the need to improve water delivery and reduce operational inefficiencies; improve diminished streamflow that limits fish and aquatic habitat; reduce conveyance water loss; and improve public safety. These measures would increase the reliability and efficiency of water delivered for irrigation, permanently reduce the amount of water loss, and increase the amount of water saved instream.

I must determine if the NRCS' Preferred Alternative will or will not be a major Federal action significantly affecting the quality of the human environment. The Plan-EA accompanying this finding has provided the analyses needed to assess the significance of the potential impacts from the selected alternative. The decision on which alternative is to be implemented and the significance of that alternative's impacts are discussed under part IV of this finding.

III. Alternatives

Nine alternatives were initially considered. When formulating an alternative, it was analyzed for satisfaction of the purpose and need statement and if it met the Federal Objective and Guiding Principles. Alternatives were further analyzed against four criteria: completeness, effectiveness, efficiency, and acceptability. Some of the initial alternatives considered did not meet the formulation criteria and were eliminated from further analysis (see Plan-EA Appendix D). Alternatives that met the formulation criteria, but did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or were unreasonable because of cost, logistics, existing technology, or social or environmental reasons, were removed from consideration, as described in the Plan-EA Section 5.2.

Two alternatives, the No Action Alternative and one Action Alternative were analyzed in full.

> *No Action Alternative* – AID would continue to operate and maintain its existing system in its current condition. This alternative assumes that modernization of the rest of the District's system would not be reasonably certain to occur. The No Action Alternative is a near-term continuation of the District's standard operating procedures under the Deschutes Basin Habitat Conservation Plan (HCP) requirements.
>
> *Piping Alternative*—AID would pipe 11.9 miles of their Main Canal, update 88 turnouts, and install SCADA in two locations.

Based on the evaluation in the Plan-EA, I have identified the Piping Alternative as the agency's Preferred Alternative. I have considered that the Preferred Alternative meets the criteria listed above and is the most practical means of improving water conservation, water delivery reliability, and public safety. No significant adverse environmental impacts will result from installation of the measures, it is the project sponsor's Preferred Alternative, and it has been identified as the National Economic Efficiency Alternative.

When choosing the agency's Preferred Alternative, in accordance with the Council on Environmental Quality's (CEQ) "40 Most Asked Questions" guidance on National Environmental Policy Act (NEPA), Question 37(a), NRCS has considered "which factors were weighed most heavily in the determination". Based on the Plan-EA, potential impacts to water, vegetation, fish and wildlife, wetlands, and human resources were heavily considered in the decision. As a result, the agency's Preferred Alternative would overall result in short- and long-term beneficial impacts to the environmental resources potentially impacted by the Preferred Alternative.

IV. Effects of the Recommended Action- Finding of No Significant Impact

To determine the significance of the action analyzed in this Plan-EA, the agency is required by NEPA regulations at 40 CFR Section 1508.27 and NRCS regulations at 7 CFR Part 650 to consider the context and intensity of the proposed action. Upon review of the NEPA criteria for significant effects and based on the analysis in the Plan-EA, I have determined that the action to be selected, the Preferred Alternative, would not significantly affect the quality of the human environment. Therefore, preparation of an environmental impact statement on the final action is not required under Section 102(2)(c) of NEPA, CEQ implementing regulations (40 CFR Part 1500-1508, Section 1508.13), or NRCS environmental review procedures (7 CFR Part 650). This finding is based on the following factors from CEQ's implementing regulations at 40 CFR Section 1508.27 and from NRCS regulations at 7 CFR Part 650: The environmental impacts of constructing the Preferred Alternative are not significant for the following reasons:

1) The Plan-EA evaluated both beneficial and adverse impacts of the Preferred Alternative. It is anticipated that the Preferred Alternative will result in long-term beneficial impacts to the human environment including natural resources (such as water and fish and aquatic resources), ecosystem services, and social and economic considerations. As a result of the analysis (discussed in detail in the Plan-EA Section 6 and incorporated by reference), the Preferred Alternative does not result in significant impacts to the human environment, particularly the significant adverse impacts which NEPA is intended to help decision-makers avoid, minimize, or mitigate.

2) The Preferred Alternative does not significantly affect public health or safety. The direct and indirect effects associated with the implementation of the Preferred Alternative are anticipated to provide long-term beneficial impacts that improve natural ecosystem functions and mitigate public safety risks.

3) As analyzed in Section 6 of the Plan-EA, there are no anticipated significant adverse effects to historic or cultural resources, fish and aquatic resources, soils, land use, public

safety, socioeconomic resources, vegetation, visual resources, water resources, wetland and riparian areas, wildlife resources, or wild and scenic rivers from selection of the Preferred Alternative. NRCS regulations (7 CFR Part 650) and policy (Title 420, General Manual, Part 401) require that NRCS identify, assess, and minimize or mitigate effects to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas. In accordance with these requirements, avoidance, minimization, or mitigation has been incorporated into the Plan-EA Section 6 and 8.3. Unlike the No Action Alternative, the Preferred Alternative is expected to reduce environmental risks associated with past, present, and future actions because overall, risks to public safety will be reduced, water reliability to patrons increased, and diminished streamflow that limits fish and aquatic habitat will be increased over years 4 through 7 of the HCP.

4) The effects on the human environment are not considered controversial for the Preferred Alternative. There are no impacts associated with the proposed action that would be considered controversial as defined 40 CFR 1508.27 (1/3/2017).

5) The Preferred Alternative is not considered highly uncertain and does not involve unique or unknown risks.

6) The Preferred Alternative will not establish a precedent for future actions with significant effects, nor does it represent a decision in principle about future considerations.

7) Particularly when focusing on the significant adverse impacts which NEPA is intended to help decision-makers avoid, minimize, or mitigate, the Preferred Alternative does not result in significant adverse cumulative impacts to the environment as discussed in Section 6.12 of the Plan-EA.

8) The Preferred Alternative will not cause the loss or destruction of significant cultural or historical resources, which include archaeological or built environment resources, as addressed in Section 6.1 of the Plan-EA. NRCS follows the federal regulations outlined in the National Historic Preservation Act (36 CFR 800), which calls for NRCS to develop consultation agreements with State historic preservation officers and federally recognized Tribes (or their designated Tribal historic preservation officers). These consultation agreements focus historic preservation reviews on resources and locations that are of special regional concern to these parties.

9) The Preferred Alternative will not adversely affect endangered or threatened species, or designated critical habitat, as discussed in Section 6.9 and 6.11 of the Plan-EA. During Section 7 informal consultation, the U.S. Fish and Wildlife Service offered no additional

information that would necessitate reconsideration of our May Effect-Not Likely to Adversely Affect determination. On July 29, 2022 U.S. Fish and Wildlife Service issued a Letter of Concurrence (2022-0062518-S7), which was received by NRCS on August 1, 2022.

10) The Preferred Alternative does not violate Federal, State, or local law requirements imposed for protection of the environment as noted in Section 8.5 of the Plan-EA and within this document. The major laws identified with the selection of the Preferred Alternative include the Clean Water Act, Endangered Species Act, National Historic Preservation Act, National Wild and Scenic Rivers Act, Bald and Golden Eagle Protection Act, and Migratory Bird Treaty Act. The Preferred Alternative is consistent with the requirements of these laws.

V. Consultation - Public Participation

NRCS announced the public scoping process on April 3, 2019, through a public notice and subsequent news release. Advertisements announcing the scoping period and associated scoping meeting were placed in a local newspaper. AID mailed a notice to their patrons. A project website, oregonwatershedplans.org, was launched to inform the public and share information.

The scoping process followed the general procedures consistent with NRCS guidance and PL 83-566 requirements. A scoping meeting was held April 17, 2019, at the Elk Meadow Elementary School in Bend, Oregon. During the scoping period, 141 comments regarding the project were received via phone, email, mail, and online form. These comments were received from 137 individuals, 2 non-governmental organizations, 1 state agency (Oregon Water Resources Department), and 1 federal agency (U.S. Fish and Wildlife Service). Additional scoping comments were received at the scoping meeting. All scoping comments are summarized in Section 3.3 of the Plan-EA.

Specific consultation was conducted with the State Historic Preservation Office and with the Confederated Tribes of Warm Springs to maintain the NRCS' government-to-government relationship between Tribes.

The Plan-EA was transmitted to all participating and interested agencies, groups, and individuals for review and comment from June 8, 2021 to July 8, 2021. In response to public comments, on July 8, 2021 NRCS extended the public comment period to end on July 23, 2021. A virtual public meeting was held on June 23, 2021 over Zoom Webinar to obtain public input for the plan and environmental evaluation. During the review period, 451 comments regarding the project were received. These comments were received from 438 individuals, 8 non-governmental organizations, 1 local agency (Deschutes County), and 1 federal agency (U.S.

Army Corps of Engineers). U.S. Army Corps of Engineers provided guidance that the U.S. Army Corps of Engineers will defer to commenting and consulting under Section 404 of the Clean Water Act on the implementation stage of proposed projects rather than on the Plan-EA (William Abadie, July 20, 2021).

VI. Conclusion

The Piping Alternative has been selected as the Preferred Alternative for implementation based upon best meeting the purpose and need while maximizing net economic benefits. The Piping Alternative is also the Preferred Alternative of the sponsors. The Plan-EA accompanying this finding has provided the analysis needed to assess the significance of the potential impacts from the Preferred Alternative. The decision on which alternative is to be implemented, and the significance of that alternative's impacts, are summarized in Section 6 of the Plan-EA (the Effects of the Recommended Action). Based upon a review of the Plan-EA and supporting documents, the Preferred Alternative is not a major Federal action significantly affecting the quality of the human environment. I have determined that implementing the Preferred Alternative will not significantly affect the quality of the human and/or natural environment, individually or cumulatively with other actions in the area. No environmental effects meet the definition of significance, in context or intensity, as defined at 40 CFR 1508.27 (1/3/2017). Therefore, an environmental impact statement is not required for the Project. This finding is based on the consideration of the context and intensity of impacts as summarized in the Arnold Irrigation District Infrastructure Modernization Project Plan-EA. With these findings, NRCS therefore has decided to implement the Preferred Alternative.

____(signature) 8 August 2022 (date)

Ronald Alvarado, State Conservationist

AID-NUID CONSERVED WATER AGREEMENT (PHASE I)

THIS AID-NUID CONSERVED WATER AGREEMENT (PHASE I) ("Agreement") is made this ___ day of December 2022, by and between the Arnold Irrigation District ("AID"), and the North Unit Irrigation District ("NUID") (collectively "the Districts"), both of which are irrigation districts operating pursuant to the provisions of Oregon Revised Statutes Chapter 545.

RECITALS

A. AID is set to receive grant funding from the Oregon Watershed Enhancement Board for a piping project referred to as Phase I. AID anticipates that the project will conserve up to 11.2 cfs (or up to 3,743 AF). A condition of the grant is that water conserved by the project will be permanently protected for instream purposes. Water conserved by the project will be made available by AID to NUID for use during the irrigation season, and in turn, NUID will store in and release water from Wickiup Reservoir equal to the amount it receives from AID.

B. AID and NUID now wish to memorialize their agreement as to the framework, process, and timeline documenting how water will be made available by AID to NUID, and how NUID will go about storing in and releasing water from Wickiup Reservoir equal to the amount it receives from AID.

Therefore, AID and NUID agree as follows:

1. CONSERVED WATER.

Once Phase I is fully constructed and implemented, AID will make water conserved by the project available to NUID for irrigation use during the irrigation season. AID and NUID will coordinate to determine how much water is available to NUID and how much water NUID is utilized during the irrigation season. NUID may divert the water at the North Canal Diversion Dam or through Central Oregon Irrigation District's ("COID") delivery system, subject to an agreement between COID and NUID. AID and NUID will report the total amounts to U.S. Fish and Wildlife and the Oregon Water Resources Department at the end of the irrigation season. The parties recognize that 11.2 cfs (or up to 3,743 AF) is the maximum amount that may be made available to NUID in a given season, and it will be less if AID's water rights are not satisfied to the fullest extent for the full AID irrigation season.

Prior to winter following the first irrigation season in which water is made available by AID to NUID, NUID will apply to the Oregon Water Resources Department (OWRD) to transfer a portion of NUID's Wickiup Reservoir storage right, so that NUID will be authorized to store in Wickiup Reservoir the equivalent of up to 11.2 cfs (or up to 3,743 AF) for irrigation or flow augmentation for fish and wildlife purposes. Once the transfer order is issued by Oregon Water Resources Department, NUID will then apply to OWRD for a secondary use permit, so that NUID will be authorized to use the stored water in Wickup Reservoir for irrigation or flow augmentation for fish and wildlife purposes in an amount that is the equivalent of up to 11.2 cfs (or up to 3,743 AF). The amount of stored water (in AF) to be used for flow augmentation for fish and wildlife under the secondary use permit issued to NUID in any given winter and early spring period shall equal the amount of water saved from the piping project that is made available by AID to NUID and utilized by NUID for irrigation use (in AF) during the irrigation season immediately preceding the given winter and early spring period. (Thus, if less than the full 3,743 AF is made available by AID to NUID during the irrigation season due to the lack of water availability (e.g., AID's water rights are regulated off due to drought conditions), then the difference between the maximum of 3,743 AF that could be stored for flow augmentation and the actual amount made available by AID to NUID and utilized by NUID in a given irrigation season may be stored and released as irrigation water under the final transfer order and secondary use permit described above.) The water to be released from Wickiup Reservoir during the winter and early spring period shall be passed through Oregon Spotted Frog habitat below Wickiup Reservoir, with the exact period of release subject to direction from the U.S. Fish and Wildlife Service consistent with the Deschutes Basin Habitat Conservation Plan and the corresponding incidental take permit issued to the districts.

2. GENERAL PROVISIONS.

2.1. Binding Effect. This Agreement is binding on and inures to the benefit of the Districts and their respective heirs, personal representatives, successors, and assigns.

2.2 Assignment. Neither this Agreement nor any of the rights, interests, or obligations under this Agreement may be assigned by any party without the prior written consent of the other District, which consent will not be unreasonably withheld.

2.3 No Third-Party Beneficiaries. Nothing in this Agreement, express or implied, is intended or may be construed to confer on any person, other than the parties to this Agreement, any right, remedy, or claim under or with respect to this Agreement.

2.4 Notices. All notices and other communications under this Agreement must be in writing and will be deemed to have been given if delivered personally, sent by electronic mail, mailed by certified mail, or delivered by an overnight delivery service (with confirmation) to the Districts at the following addresses or electronic mail addresses (or at such other address or electronic mail number as a District may designate by like notice to the other District):

To: North Unit Irrigation District
Attention: Josh Bailey, Manager
2024 NW Beach Street
Madras OR 97741

Email: jbailey@northunitid.com

To: Arnold Irrigation District
Attention: Steve Johnson, Manager
1055 SW Lake Court
Redmond OR 97756

Email: stevejohnson@arnoldirrigationdistrict.com

Any notice or other communication will be deemed to be given (a) on the date of personal delivery, (b) at the expiration of the fifth day after the date of deposit in the United States mail, or (c) on the date of confirmed delivery by electronic mail or overnight delivery service.

2.5 Amendments. This Agreement may be amended only by an instrument in writing executed by all the parties, which writing must refer to this Agreement.

2.6 Counterparts. This Agreement may be executed in counterparts, each of which will be considered an original and all of which together will constitute one and the same agreement.

2.7 Electronic Signatures. Electronic transmission of any signed original document, and retransmission of any signed electronic transmission, will be the same as delivery of an original. At the request of any District, the Districts will confirm electronic transmitted signatures by signing an original document.

2.8 Further Assurances. Each party agrees to execute and deliver such other documents and to do and perform such other acts and things as any other party may reasonably request to carry out the intent and accomplish the purposes of this Agreement. The parties agree to work with other basin districts to secure forbearance agreements to ensure the AID conserved water is available to NUID.

2.9 Time of Essence. Time is of the essence with respect to all dates and time periods set forth or referred to in this Agreement.

2.10 Expenses. Except as otherwise expressly provided in this Agreement, each party to this Agreement will bear its own expenses in connection with the preparation, execution, and performance of this Agreement and the transactions contemplated by this Agreement.

2.11 Waiver. Any provision or condition of this Agreement may be waived at any time, in writing, by the party entitled to the benefit of such provision or condition. Waiver of any breach of any provision will not be a waiver of any succeeding breach of the provision or a waiver of the provision itself or any other provision.

2.12 Governing Law. This Agreement will be governed by and construed in accordance with the laws of the state of Oregon, without regard to conflict-of-laws principles.

2.13 Attorney Fees. If any arbitration, suit, or action is instituted to interpret or enforce the provisions of this Agreement, to rescind this Agreement, or otherwise with respect to the subject matter of this Agreement, the party prevailing on an issue will be entitled to recover with respect to such issue, in addition to costs, reasonable attorney fees incurred in the preparation, prosecution, or defense of such arbitration, suit, or action as determined by the arbitrator or trial court, and, if any appeal is taken from such decision, reasonable attorney fees as determined on appeal.

2.14 Injunctive and Other Equitable Relief. The Districts agree that the remedy at law for any breach or threatened breach by a party may, by its nature, be inadequate, and that in addition to damages, the other District will be entitled to a restraining order, temporary and permanent injunctive relief, specific performance, and other appropriate equitable relief, without showing or proving that any monetary damage has been sustained.

2.15 Venue. Any action or proceeding seeking to enforce any provision of this Agreement or based on any right arising out of this Agreement must be brought against any of the Districts in Deschutes County Circuit Court or Jefferson County Circuit Court of the State of Oregon or, subject to applicable jurisdictional requirements, in the United States District Court for the District of Oregon, and each of the Districts consents to the jurisdiction of such courts (and of the appropriate appellate courts) in any such action or proceeding and waives any objection to such venue.

2.16 Entire Agreement. This Agreement (including the documents and instruments referred to in this Agreement) constitutes the entire agreement and understanding of the Districts with respect to the subject matter of this Agreement and supersedes all prior understandings and agreements, whether written or oral, between the Districts with respect to such subject matter.

THIS AGREEMENT is effective as of the date set forth above.

Arnold Irrigation District ("AID")

By: Robert B. Schroeder Date: 12/15/22
Its Board President

By: Walt Wandel Date: 12/15/2022
Its Board Secretary

North Unit Irrigation District ("NUID")

By: [signature] Date: 12/13/2022
Its Board President

By: Joshua Bailey Date: 12/13/2022
Its Board Secretary

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DESCHUTES BASIN BOARD OF CONTROL

As of April 2022	Total Cost Construction & Engineering	PL 83-566 Funding (1)	Required Match Funds	Portion of Cost Share Obtained	Cost Share Need	Approximate Pipe Linear Feet	Water Saved CFS	Jobs Created	Estimated Start Date	Estimated Completion Date
CENTRAL OREGON								3,161		
Smith Rock Way & King Way 1A (2)	$22 M			$2 M	0	35,480	13.6		OCT 20	COMPLETE
Smith Rock & King Way 1B	$11.2 M			$7 M	0	8,450	17.4		OCT 21	COMPLETE
Pilot Butte Canal Phases 2-14	$250 M	$187.5 M	$62.5 M	$0	$62 M	121,440	126		OCT 23	MAR 28
SWALLEY								150		
Rogers Way	$2 M	$1.4 M	$600 K			16,000	1.8			APR 20
MC-7	$3 M	$2.2 M	$800 K			7,000	3			APR 24
Elder Lateral	$1.6 M	$1.2 M	$400 K			10,500	1.3			APR 25
TUMALO								201		
Tumalo Feed VB	$6.9 M	$5.2 M	$1.7 M			11,300	7.3			COMPLETE
Tumalo Feed VB	$7.2 M	$4.5 M	$2.7 M			81,596	7.3			COMPLETE
Tumalo Feed VB	$6.2 M	$4.7 M	$1.6 M			25,519	4.2			COMPLETE
Pipes Group 6A	$5.9 M					12,299	1.4			MAR 23
Pipes Group 4	$5.7 M					52,248				MAR 24
Pipes Group 6B	$5.5 M					28,405				MAR 25
Measurement/Monitoring	$350 K		$350 K							MAR 23
NORTH UNIT								565		
31,32,34,43 Lateral Piping	$33 M	$25 M	$8 M	$2 M	$6 M	43,500	15		OCT 23	MAR 29
Main Canal Automation	$500 K		$500 K			N/A	5.5		MAR 22	MAR 24
41-9/58-3-2 Lateral Piping	$200 K		$150 K			3,500	1.3		OCT 22	APR 23
Main Canal Lining	$550 K	$55 K	$280 K	280 K	$0	0	10		OCT 22	APR 23
Bend Diversion Fish Screens (Design and SHPO complete)	$7 M	$0	$3.5 M		$3.5 M	N/A	N/A		UNKNOWN	UNKNOWN
LONE PINE	$10.3 M	$7.7 M	$2.6 M			59,396	8.8	111		MAR 23
ARNOLD							32.6	435		
Main Canal Phase 1	$8.72 M	$6.49 M	$2.22 M	0	$2.22 M	16,976	11.1		NOV 2022	MAR 2024
Main Canal Phase 2	$11.94 M	$8.89 M	$3.05 M	0	$3.05 M	23,142	12.6		NOV 2023	MAR 2025
Main Canal Phase 3	$3.85 M	$2.87 M	$980 K	0	$980 K	9,486	3.4		NOV 2024	MAR 2026
Main Canal Phase 4	$6.13 M	$4.57 M	$1.56 M	0	$1.56 M	13,265	5.4		NOV 2025	MAR 2027
OCHOCO								323		
Group 1 - McKay Switch	$20.3 M	$14.8 M	$5.5 M			77,230	11.2		OCT 22	MAR 24
Group 2 - Grimes Flat Piping	$5 M	$3.7 M	$1.3 M			43,166	4.9		JUL 23	MAR 24
Group 3 - IronHorse Piping	$6.5 M	$4.8 M	$1.7 M			7,500	1.1		JUL 22	MAR 23
TOTAL COMPLETED	$53.5 M						49.8			
TOTAL NEEDED	$350,380	$286 M	$350,102 M	$9 M	$79.31 M	545,053	256.4			
TOTAL				$2 M				4,946		

(1) Some project funding includes allowable non-construction technical assistance.
(2) Concurrent with this project, Central Oregon will be working with private landowners on the G-4 Lateral to improve on-farm efficiencies.

Attachment 10. Conservation Model - Diversion History

ARNOLD ID Certificate Diversion Rights

	Season 1	Season 2	Season 3	Season 4	Season 5	100% Availability
Certificate	85.953	112.41	150	112.41	85.953	
Certificate >2024	85.953	102.0	118.0	102.0	85.953	
Phase 1	8.0	10.4	11.2	10.0	8.2	
Phase 2	8.9	11.7	12.6	11.2	9.2	
Phase 3/4	6.2	8.1	8.7	7.8	6.4	
	62.9	71.8	85.5	73.0	62.2	

Estimated Water Conservation by Phase

Phase	Loss Measured/ (CFS)	Season 1		Season 2		Season 3		Season 4		Season 5		Total
		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		
		(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	acre-feet
1	11.2	8.0	275.0	10.4	309.9	11.2	2,710.3	10.0	296.2	8.2	228.1	3,819.5
2	12.6	8.9	308.6	11.7	347.8	12.6	3,041.4	11.2	332.4	9.2	255.9	4,286.2
3	3.4	2.4	82.7	3.1	93.2	3.4	815.1	3.0	89.1	2.5	68.6	1,148.7
4	5.4	3.8	131.7	5.0	148.4	5.4	1,297.8	4.8	141.8	3.9	109.2	1,828.9
Total	32.5	23.1	798.0	30.2	899.3	32.5	7,864.6	28.9	859.5	23.8	661.8	11,083.2

DateTime	100% 2019 arno_qj
4/1	0
4/2	0
4/3	0
4/4	0
4/5	0
4/6	0
4/7	0
4/8	0
4/9	0
4/10	0
4/11	0
4/12	0
4/13	0
4/14	21.61
4/15	42.92
4/16	51.83
4/17	56.52
4/18	64.26
4/19	69.84
4/20	69.46
4/21	68.87
4/22	70.63
4/23	71.35
4/24	73.44
4/25	78.31
4/26	77.87
4/27	77.83
4/28	75.71
4/29	75.07
4/30	76.69
5/1	78.96
5/2	80.81
5/3	82.41
5/4	82.43
5/5	82.34
5/6	84.52
5/7	89.31
5/8	90.6
5/9	88.05
5/10	92.21
5/11	94.53
5/12	94.37
5/13	94.36
5/14	92.87
5/15	89.51
5/16	88.46
5/17	86.56
5/18	86.18
5/19	85.36
5/20	84.38
5/21	82.98
5/22	82.97
5/23	83.83
5/24	84.66
5/25	84.58
5/26	84.42
5/27	83.88
5/28	85.06
5/29	86.9
5/30	88.83
5/31	90.2
6/1	90.58
6/2	91.32
6/3	92.74
6/4	93.11
6/5	92.49
6/6	91.51
6/7	90.34
6/8	91.85
6/9	92.42
6/10	93.03
6/11	96.2
6/12	98.09
6/13	94.43
6/14	93.04
6/15	93.39
6/16	93.55
6/17	94.61
6/18	96.01
6/19	96.41
6/20	95.09
6/21	93.95
6/22	94.37
6/23	94.5
6/24	95.07
6/25	98
6/26	97.24
6/27	95.31
6/28	93.72
6/29	93.41
6/30	93.9
7/1	93.65
7/2	93.31
7/3	94.43
7/4	95.54
7/5	97.26
7/6	99.26
7/7	99.16
7/8	99.76
7/9	98.44
7/10	98.6

Hypothetical Example

Availbe Nat Flow	Availability	Calculated Cons Water	
90.2	100%	11.2	Availability exceeds the 2019 baseline so entire conserved water amount of 11.2 would be used
89.5	96.8%	10.8	Availability is less than the 2019 baseline so conserved water amount is reduced to 10.8%

7/11	99.03
7/12	98.51
7/13	96.83
7/14	96.83
7/15	98.4
7/16	100.34
7/17	99.6
7/18	99.19
7/19	101.65
7/20	103.69
7/21	104.04
7/22	104.34
7/23	105.33
7/24	106.14
7/25	104.32
7/26	104.57
7/27	106.41
7/28	106.21
7/29	106.59
7/30	107.83
7/31	108.8
8/1	109.44
8/2	109.59
8/3	109.24
8/4	109.47
8/5	110.02
8/6	110.44
8/7	109.9
8/8	109.38
8/9	102.49
8/10	99.37
8/11	100.53
8/12	100.4
8/13	101.17
8/14	101.73
8/15	101.48
8/16	99.86
8/17	99.83
8/18	99.83
8/19	99.8
8/20	101.14
8/21	99.35
8/22	97.03
8/23	96.57
8/24	98.87
8/25	97.31
8/26	97.97
8/27	98.8
8/28	99.52
8/29	100.08
8/30	100.94
8/31	100.94
9/1	101.63
9/2	66.93
9/3	0
9/4	29.57
9/5	63.61
9/6	90.23
9/7	94.62
9/8	90.89
9/9	87.1
9/10	83.29
9/11	83.08
9/12	84.53
9/13	85.28
9/14	85.18
9/15	85.16
9/16	84.73
9/17	81.69
9/18	77.97
9/19	76.42
9/20	75.58
9/21	76.55
9/22	76.95
9/23	77.44
9/24	78
9/25	78.71
9/26	78.89
9/27	76.96
9/28	75.69
9/29	74.32
9/30	71.44
10/1	65.61
10/2	64.48
10/3	67.13
10/4	67.45
10/5	67.01
10/6	66.86
10/7	66.04
10/8	64.86
10/9	59.99
10/10	53.39
10/11	21.86
10/12	0
10/13	0
10/14	0
10/15	0
10/16	0
10/17	0
10/18	0
10/19	0
10/20	0
10/21	0
10/22	0
10/23	0
10/24	0
10/25	0
10/26	0
10/27	0
10/28	0
10/29	0
10/30	0
10/31	0
Total CFS	15,886
Total AF	31,510
1.9835	100%

Attachment 10. Conservation Model - Background Detail

ARNOLD ID	Certificate Diversion Rights					
	Season 1	Season 2	Season 3	Season 4	Season 5	100%
Certificate	85.953	112.41	150	112.41	85.953	
Certificate	85.953	102.0	118.0	102.0	85.953	
Phase 1	8.0	10.4	11.2	10.0	8.2	
Phase 2	8.9	11.7	12.6	11.2	9.2	
Phase 3/4	6.2	8.1	8.7	7.8	6.4	
	62.8	71.8	85.5	73.1	62.1	

Estimated Water Conservation by Phase

Phase	Loss Measured/ (CFS)	**Season 1**		**Season 2**		**Season 3**		**Season 4**		**Season 5**		**Total**
		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		Conserved Water Rate		
		(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	(cfs)	acre-feet	acre-feet
1	11.2	8.0	275.0	10.4	309.9	11.2	2710.3	10.0	296.2	8.2	228.1	3819.5
2	12.6	8.9	308.6	11.7	347.8	12.6	3041.4	11.2	332.4	9.2	255.9	4286.2
3	3.4	2.4	82.7	3.1	93.2	3.4	815.1	3.0	89.1	2.5	68.6	1148.7
4	5.4	3.8	131.7	5.0	148.4	5.4	1297.8	4.8	141.8	3.9	109.2	1828.9
Total	32.5	23.1	798.0	30.2	899.3	32.5	7864.6	28.9	859.5	23.8	661.8	11083.2

Total acre-feet conserved Pressurized Piping: 11,083.24

Conversions

1.9835 af/cfs/day

Table 1. Volume of available water for NUID to use on-farm following AID's Piping Alternative				
Project Group	Estimated Savings in AID Project (af/year)	Estimated Volume of Water Passed to NUID (af/year)	Estimated Losses in the Deschutes River between AID Diversion and NUID Diversion[1] (af/year)	Estimated Volume at Start of Main Canal Reach 1 - Deschutes River to Crooked River Inflow (af/year)
1	3819.45	3743.065751	143.26	3599.81
2	4286.15	4200.429816	160.76	4039.67
3	1148.74	1125.768663	43.09	1082.68
4	1828.89	1792.310494	68.60	1723.71
Total:	**11,083.24**	**10,861.57**	**415.71**	**10,445.87**
Test	-			
Variables		4,435.19		
Deschutes River				
3.83%		estimated losses in the Deschutes RIver between the AID diversion and		

	2019	2020	2021	2022	2023			
DateTime	arno_qj	arno_qj	arno_qj	arno_qj	arno_qj	Median	100%	71.1%
4/1	0		0	0		0		
4/2	0		0	0		0		
4/3	0		0	17.24		0		
4/4	0		0	34.4		0		
4/5	0		0	34.1		0		
4/6	0		0	40.43		0		
4/7	0		0	50.37		0		
4/8	0		0	54.64		0		
4/9	0		0	60.65		0		
4/10	0		0	60.51		0		
4/11	0		24.2	57.8		24.2		
4/12	0	37.25	40.8	56.13	31.29	37.25		
4/13	0	40.58	42.59	56.26	34.06	40.58		
4/14	21.61	45.09	48.09	56.2	33.61	45.09		
4/15	42.92	53.67	47.43	56.7	41.8	47.43		
4/16	51.83	58.78	51.48	57.58	48.2	51.83		
4/17	56.52	63.33	58.23	57.52	55.53	57.52		
4/18	64.26	65.63	62.65	58.64	63.67	63.67		
4/19	69.84	69.23	65.56	59.88	68.13	68.13		
4/20	69.46	72.67	67.92	61.78	73.18	69.46		
4/21	68.87	75.77	68.07	63.41	71.08	68.87		
4/22	70.63	76.74	68.7	66.23	70.76	70.63		
4/23	71.35	78.76	72.55	70.95	71.91	71.91		
4/24	73.44	80.28	74.31	72.96	77.16	74.31		
4/25	78.31	80.64	72.15	75.6	81.07	78.31		
4/26	77.87	82.04	71.14	77.68	82.53	77.87		
4/27	77.83	82.77	72.34	79.93	83.27	79.93		
4/28	75.71	82.6	74.22	82.58	85.18	82.58		
4/29	75.07	83.03	77.33	82.94	85.26	82.94		
4/30	76.69	83.22	80.46	83.21	85.7	83.21		
5/1	78.96	88.79	81.95	82.94	88.53	82.94		
5/2	80.81	90.15	83.34	83.51	90.43	83.51		
5/3	82.41	89.47	83.65	84.27	87.16	84.27		
5/4	82.43	87.34	80.82	84.81	85.1	84.81		
5/5	82.34	85.69	83.07	84.05	86.99	84.05		
5/6	84.52	86.81	85.3	81.74	85.72	85.3		
5/7	89.31	88.08	85.95	80.17	80.84	85.95		
5/8	90.6	89.79	85.55	78.21	79.7	85.55		
5/9	88.05	90.97	84.91	76.81	77.97	84.91		
5/10	92.21	92.45	84.49	75.59	76.69	84.49		
5/11	94.53	93.2	85.78	74.8	76.63	85.78		
5/12	94.37	91.97	86.66	74.9	79.87	86.66		
5/13	94.36	90.56	62.28	74.1	82.6	82.6		
5/14	92.87	90.44	0	74.22	85.67	85.67		
5/15	89.51	89.88	0	74.73	87.29	87.29		
5/16	88.46	90.19	0	76.67	88.32	88.32		
5/17	86.56	90.62	0	79.47	88.4	86.56		
5/18	86.18	88.06	0	79.72	88.92	86.18		
5/19	85.36	87.61	0	79.08	92.58	85.36		
5/20	84.38	88.05	0	78.21	94.12	84.38		
5/21	82.98	90.54	11.85	78.1	94	82.98		
5/22	82.97	91.07	75.46	78.11	92.86	82.97		
5/23	83.83	90.89	78.25	78.11	91.16	83.83		
5/24	84.66	90.49	72.68	78.46	88.92	84.66		
5/25	84.58	91.77	70.11	79.22	87.26	84.58		
5/26	84.42	93.6	72.23	79.84	86.65	84.42		
5/27	83.88	95.56	75.85	79.12	86.85	83.88		
5/28	85.06	96.72	78.28	77.7	86.04	85.06		
5/29	86.9	97.19	82.03	75.59	85.53	85.53		
5/30	88.83	94.72	85.45	74.17	86.18	86.18		
5/31	90.2	93.55	87.45	74.63	87.22	87.45		
6/1	90.58	92.2	89.67	74.93	87.33	89.67		
6/2	91.32	89.29	92.61	76.61	87.83	89.29		
6/3	92.74	88.93	94.87	77.97	88.74	88.93		
6/4	93.11	89.03	95.86	77.76	89.37	89.37		
6/5	92.49	88.28	95.5	76.75	90.62	90.62		
6/6	91.51	86.67	94.32	75.41	91.93	91.51		
6/7	90.34	85.55	92.51	75.02	93.43	90.34		
6/8	91.85	83.76	89.92	76.71	86.2	86.2		
6/9	92.42	82.46	88.83	77.87	88.77	88.77		
6/10	93.03	84.11	88.12	78.38	86.89	86.89		
6/11	96.2	85.39	87.5	79	86.61	86.61		
6/12	98.09	84.46	88.12	78.01	88.33	88.12		
6/13	94.43	84.83	89.17	77.25	89.8	89.17		
6/14	93.04	84.06	69.74	77.02	89.55	84.06		
6/15	93.39	82.72	56.46	77.91	88.46	82.72		
6/16	93.55	83.14	55.18	79.67	87.46	83.14		
6/17	94.61	82.26	55.86	79.83	86.82	82.26		
6/18	96.01	84.29	57.68	78.65	86.3	84.29		
6/19	96.41	86.51	58.46	77.88	85.88	85.88		
6/20	95.09	86.7	58.17	77.68	84.59	84.59		
6/21	93.95	87.15	61.22	79.07	82.69	82.69		
6/22	94.37	87.88	60.66	81.22	80.38	81.22		
6/23	94.5	89.3	59.17	82.15	79.71	82.15		
6/24	95.07	89.24	59.65	82.19	79.45	82.19		
6/25	98	89.67	60.63	82.96	79.68	82.96		
6/26	97.24	91.82	60.91	83.19	68.4	83.19		
6/27	95.31	92.61	61.06	83.96	77.61	83.96		
6/28	93.72	90.92	62.85	84.9	74.09	84.9		
6/29	93.41	86.92	63.79	84.74	71.02	84.74		
6/30	93.9	84.25	62.9	84.48	71.99	84.25		
7/1	93.65	83.6	60.19	84.22	73.5	83.6		
7/2	93.31	82.12	58.49	84.41	73.95	82.12		
7/3	94.43	84.08	58.5	84.9	74.15	84.08		
7/4	95.54	85.58	58.5	84.9	74.06	84.9		
7/5	97.26	86.43	60.52	84.9	74.02	84.9		
7/6	99.26	84.53	62.36	84.9	74.69	84.53		
7/7	99.16	82.04	61.69	84.9	75.57	82.04		
7/8	99.76	82.17	61.02	84.9	76.51	82.17		
7/9	98.44	82.06	61.37	84.85	77.48	82.06		
7/10	98.6	80.22	61.6	84.54	78.29	80.22		
7/11	99.03	64.51	62.17	85.88	78.81	78.81		
7/12	98.51	56.53	62.69	87.32	79.16	79.16		
7/13	96.83	56.83	61.56	87.14	79	79		

7/14	96.83	58.82	58.95	87	79.65	79.65
7/15	98.4	58.45	57.64	86.66	80.76	80.76
7/16	100.34	60.84	58.16	86.61	80.48	80.48
7/17	99.6	58.87	58.08	86.62	80.2	80.2
7/18	99.19	58.4	57.83	86.69	80.16	80.16
7/19	101.65	60.28	58.44	85.43	80.26	80.26
7/20	103.69	63.27	60.3	85.6	81.1	81.1
7/21	104.04	62.89		85.57	81.67	83.62
7/22	104.34	62.31	60	85.26	82.16	82.16
7/23	105.33	60.73	60.3	34.38	82.2	60.73
7/24	106.14	60.43	60.25	0	82.02	60.43
7/25	104.32	59.41	58.92	0	81.08	59.41
7/26	104.57	59.21	83.79	0	80.07	80.07
7/27	106.41	62.5	92.1	0	79.26	79.26
7/28	106.21	62.32	94.93	0	78.49	78.49
7/29	106.59	63.17	95.28	0	40.45	63.17
7/30	107.83	64.67	95.81	0	0	64.67
7/31	108.8	65.64	26.94	0	0	26.94
8/1	109.44	64.79	0	0	0	0
8/2	109.59	63.46	0	0	0	0
8/3	109.24	63	0	0	0	0
8/4	109.47	65.85	0	0	0	0
8/5	110.02	67.41	0	0	23.8	23.8
8/6	110.44	64.67	0	0	54.05	54.05
8/7	109.9	62.71	0	0	73.15	62.71
8/8	109.38	62.3	0	0	73.31	62.3
8/9	102.49	61.51	0	0	72.27	61.51
8/10	99.37	60.29	0	0	73.32	60.29
8/11	100.53	59.54	0	0	74.11	59.54
8/12	100.4	82.74	0	0	74.35	74.35
8/13	101.17	92.55	0	0	76.19	76.19
8/14	101.73	92.17	0	0	78.29	78.29
8/15	101.48	33.85	0	0	77.7	33.85
8/16	99.86	0	0	0	79.77	0
8/17	99.83	0	0	0	80.21	0
8/18	99.83	0	0	0	80.04	0
8/19	99.8	0	0	0	78.52	0
8/20	101.14	0	0	0	77.97	0
8/21	99.35	0	0	0	78.11	0
8/22	97.03	0	0	0	77.46	0
8/23	96.57	0	0	0	77.17	0
8/24	98.87	0	0	0	76.78	0
8/25	97.31	0	0	0	76.87	0
8/26	97.97	0	0	0	76.9	0
8/27	98.8	0	0	0	40.31	0
8/28	99.52	0	0	0	0	0
8/29	100.08	0	0	0	0	0
8/30	100.94	0	0	0	0	0
8/31	100.94	0	0	0	0	0
9/1	101.63	0	0	0	0	0
9/2	66.93	0	0	0	0	0
9/3	0	0	0	0	0	0
9/4	29.57	0	0	0	0	0
9/5	63.61	0	0	0	0	0
9/6	90.23	0	0	0	0	0
9/7	94.62	0	0	0	0	0
9/8	90.89	0	0	0	0	0
9/9	87.1	0	0	0	0	0
9/10	83.29	0	0	0	0	0
9/11	83.08	0	0	0	0	0
9/12	84.53	0	0	0	0	0
9/13	85.28	0	0	0	0	0
9/14	85.18	53	0	0	0	0
9/15	85.16	72.87	0	0	0	0
9/16	84.73	85.4	0	26.15	0	26.15
9/17	81.69	64.14	0	38.47	0	38.47
9/18	77.97	58.37	0	49.91	0	49.91
9/19	76.42	55.76	0	59.59	0	55.76
9/20	75.58	51.61	0	68.34	0	51.61
9/21	76.55	64.59	0	71.72	0	64.59
9/22	76.95	76.55	0	74.89	0	74.89
9/23	77.44	79.95	0	76.05	0	76.05
9/24	78	76.97	0	78.01	0	76.97
9/25	78.71	75.93	0	77.66	0	75.93
9/26	78.89	76.35	0	79.36	0	76.35
9/27	76.96	77.46	0	79.99	0	76.96
9/28	75.69	80.32	0	82	0	75.69
9/29	74.32	80.89	0	83.04	0	74.32
9/30	71.44	81.98	0	82.73	0	71.44
10/1	65.61	83.12	31.2	82.35	0	65.61
10/2	64.48	82.67	48.8	83.03	0	64.48
10/3	67.13	82.47	62.37	83.76	0	67.13
10/4	67.45	75.12	73.47	83.91	0	73.47
10/5	67.01	67.27	73.38	83.76	0	67.27
10/6	66.86	68.63	72.63	83.54	0	68.63
10/7	66.04	70.05	72.02	43.88	0	66.04
10/8	64.86	70.81	70.4		0	67.63
10/9	59.99	71.48	69.7		0	64.845
10/10	53.39	72.53	69.77		0	61.58
10/11	21.86	72.63	68.94		0	45.4
10/12	0	70.74	64.26		0	32.13
10/13	0	63.91	57.68		0	28.84
10/14	0	56.2	55.45		0	27.725
10/15	0	49.37	53.81		0	24.685
10/16	0	22.12	17.05		0	8.525
10/17	0	0	0		0	0
10/18	0	0	0		0	0
10/19	0	0	0		0	0
10/20	0	0	0		0	0
10/21	0	0	0		0	0
10/22	0	0	0		0	0
10/23	0	0	0		0	0
10/24	0	0	0		0	0
10/25	0	0	0		0	0
10/26	0	0	0		0	0
10/27	0	0	0		0	0
10/28	0	0	0		0	0
10/29	0	0	0		0	0
10/30	0	0	0		0	0
10/31	0	0	0		0	0
Total CFS	15,886	12,134	8,204	9,986	10,339	11,302
Total AF	31,510	24,067	16,273	19,808	20,508	22,417
1.9835	100%	76.4%	51.6%	62.9%	65.1%	71.1%

From: Steve Johnson <sjohnson@arnoldid.com>
Sent: Tuesday, April 2, 2024 3:40 PM
To: GRANTS Owrd * WRD
Cc: MCKAIN Emelie L * WRD
Subject: Application Modification Request

Arnold ID is requesting a modification to our recent application as stated below:

Reduce Diversion, Apply for New Secondary, and Reduce Current Secondary
Description: AID will implement a project resulting in conserved live flow water during the irrigation season. Once the district has implemented the project and confirmed the conserved water amount, the conserving district will reduce their water right certificate(s) by 100% of the amount of water conserved. Through an interdistrict forbearance agreement, the conserved live flow water will be made available to NUID for use as irrigation water during the same irrigation season. In turn, NUID will complete a transfer of character of use of its storage right to a combination of flow augmentation and irrigation. Once the transfer of character of use of its storage right is in place, NUID will further secure a new secondary use right in Wickiup Reservoir for flow augmentation and irrigation totaling 100% of the conserved water resulting from the project. The total secondary use right amount will equal the total storage right amount. NUID will release from Wickiup a volume of water as flow augmentation during the winter season in the OWRD grant proposal that is equivalent to the volume of conserved water NUID diverts during the prior irrigation season. Water released as flow augmentation will be protected from Wickiup to Lake Billy Chinook.

Please contact me if there are any questions.

Steve Johnson

District Manager
541.788.2003

ARNOLD IRRIGATION DISTRICT