WaterSMART Grants:
Water and Energy Efficiency Grants for Fiscal Year 2021

Cascade Orchards Irrigation Company
Irrigation Efficiency and Pump Exchange Project

September 16, 2020

SUBMITTED BY:
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Appendices

A  Letters of Support

B  Alternatives Analysis Study - Public Release Version, Cascade Orchards Irrigation Company

C  Cascade Orchard Irrigation Company – Proposed Pump Station
Executive Summary

Located in central Washington near the City of Leavenworth, Cascade Orchards Irrigation Company (COIC) provides water to 419 acres and 228 water users for irrigation between late May and mid-October. Their water right, the oldest and most senior on Icicle Creek, runs via gravity through 2.25 miles of open ditch and over 10,000 linear feet of aging lateral pipes. The COIC Irrigation Efficiency and Pump Exchange Project (project) will replace their aging irrigation system with an on-demand pressurized system, providing 25 pounds per square inch (psi) of pressure to every user. Through this project, COIC will improve water use efficiency by 53 percent, saving an estimated 1,088 acre-feet/year (afy). COIC will permanently remove a gravity diversion at river mile (RM) 4.5 on Icicle Creek and replace it with a pump station downstream at RM 1.9, delivering 11.9 cubic feet per second (cfs) and 4,012.6 afy to the most dewatered stretch of Icicle Creek. The project has been developed in close coordination with the Icicle Work Group (IWG), a stakeholder group that includes the Colville and Yakama Indian Tribes; federal, local, and state government agencies [including the U.S. Bureau of Reclamation Reclamation); agricultural water users (including COIC); and environmental groups that are working together to develop a collaborative, integrated strategy to restore flows to Icicle Creek. The total cost of construction and associated permanent water transactions associated with this project is $5.9 million, with approximately $2.1 million coming from State sources, $100,000 in match provided by COIC, $2.5 million in anticipated federal sources (including this proposal), and $1 million in funds from other funding sources (tribes, public utility districts, and/or other private funds). This project will begin construction in July 2021 and conclude in 2022.

Key Project Data

<table>
<thead>
<tr>
<th>Applicant</th>
<th>Cascade Orchards Irrigation Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Near Leavenworth, Chelan County, Washington Intake Facilities at RM 1.9 on Icicle Creek Latitude 47°34'12&quot; N, Longitude 120°40'00&quot; W</td>
</tr>
<tr>
<td>Relationship to Federal Facilities</td>
<td>Project is not on federal lands, but COIC serves the Leavenworth National Fish Hatchery, which is operated by the U.S. Fish and Wildlife Service (USFWS) through an agreement with the U.S. Bureau of Reclamation. LNFH is the largest COIC shareholder.</td>
</tr>
</tbody>
</table>

Background Information

The COIC Irrigation Efficiency and Pump Exchange Project is currently in design following more than 4 years of collaboration between COIC and key project partners to select a preferred improvement alternative, develop the project, and secure funding for implementation. Final design and bid documents will be completed early in 2021 to allow for bidding of the project in the late
winter or early spring of 2021 with construction starting in the summer of 2021. Construction will occur in three phases and will be completed in 2022 (Table 1).

Project Goals
• Provide 1,088.6 afy of conserved water and increase COIC efficiency by 53 percent.
• Upgrade aging infrastructure and water diversion and fish screening system with an on-demand pressurized irrigation water delivery system at COIC, improving water delivery to 228 water users in the service area.
• Permanently remove COIC’s intake from a shared diversion with LNFH, allowing instream flow and efficiency projects to proceed for both LNFH and COIC.

Water savings and instream flow benefits from the downstream change in their point of diversion will support habitat and fish passage needs for three species of fish listed under the Endangered Species Act (ESA): spring Chinook salmon (endangered), steelhead (threatened), and bull trout (threatened). The project will restore 11.9 cfs and 4,012.6 afy from the current diversion at RM 4.5 to RM 2.7 and an additional savings of 1,088 afy in the lower 2.7 miles of the stream due to conservation measures. These flows will be permanently protected in the Washington State Trust Water Rights Program.

Relationship to Federal Facilities
COIC currently shares surface water diversion facilities with the Leavenworth National Fish Hatchery (LNFH), which is operated by the U.S. Fish and Wildlife Service (USFWS) on behalf of the U.S. Bureau of Reclamation (Reclamation). The USFWS and Reclamation are engaged in implementation of improvements to LNFH needed to comply with the 2017 National Marine Fisheries (NMFS) Biological Opinion (2017 BiOp) for LNFH. The BiOp requires that Reclamation upgrade surface water diversion facilities to comply with current fish screening and passage requirements. Those upgrades are currently being designed by Reclamation with the anticipation that the improved diversion facilities will no longer be shared with COIC. Completion of the Project is critical to implementation of the LNFH surface water diversion upgrades.

Project Partners
The project has been developed in close coordination with IWG, a stakeholder group that includes the Colville and Yakama Indian Tribes; federal, local, and state government agencies (including Reclamation and the USFWS); agricultural water users (including COIC); and environmental groups that are working together to develop a collaborative and integrated strategy to shared water needs in the Icicle Creek watershed. The project has broad-based support from the COIC shareholders (Appendix A) and is an important first step in implementing the flow restoration strategy developed by the IWG:

• Provide 11.9 cfs and 4,012.6 afy of instream flow benefits to the target restoration reach of Icicle Creek.
Table 1: Summary of Project Work Completed to Date and Future Scope

<table>
<thead>
<tr>
<th>Completed Task</th>
<th>Initiated Task</th>
<th>Future Task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preliminary Project Development</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinate with local partners and IWG to identify project, Meet with</td>
<td>COIC to present project, Sign MOA with COIC to commence project work, and</td>
<td>October 2013 – March 2015</td>
</tr>
<tr>
<td>COIC to present project, Sign MOA with COIC to commence project work, and</td>
<td>contract funding for Phase I</td>
<td></td>
</tr>
<tr>
<td>contract funding for Phase I</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase I: Alternatives Analysis – Contract Date 3/6/15 – 12/31/15</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFPs, select consultants, water rights review, technical memo,</td>
<td>March - December, 2015</td>
<td></td>
</tr>
<tr>
<td>stakeholder meetings, and final report</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 2: Site Selection and Pre-Design Evaluation – Contract Date – 2/22/16 – 10/31/16</strong></td>
<td>Hold Shareholder Meetings to Evaluate Alternatives, Convene</td>
<td>February 2016 – March 2017</td>
</tr>
<tr>
<td></td>
<td>Shareholder Advisory Group to Recommend Alternatives, Shareholder</td>
<td></td>
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<tr>
<td></td>
<td>Vote on Project Alternatives, Complete site selection study, vote on</td>
<td></td>
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<tr>
<td></td>
<td>final sites. Release Final Report for Phase II</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3-4: Conceptual Design and Funding Proposal Contract Date – 11/1/16 – 10/1/20</strong></td>
<td>Develop Spec Sheets/Submit Funding Proposals</td>
<td>Jan-December 2017</td>
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<tr>
<td><strong>Phase 5: Design/Build and Final Implementation – Contracts TBA</strong></td>
<td>Conceptual Design</td>
<td>June 2017</td>
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<tr>
<td></td>
<td>Complete Preliminary (30%) Design</td>
<td>January 2020</td>
</tr>
<tr>
<td></td>
<td>Secure Water Rights Agreements and Landowner Easements</td>
<td>October 2020</td>
</tr>
<tr>
<td></td>
<td>Finalize all Funding Commitments and RFP’s/Contracting</td>
<td>May 2021</td>
</tr>
<tr>
<td></td>
<td>Complete Final Design</td>
<td>December 2020</td>
</tr>
<tr>
<td></td>
<td>Secure all Permits and DNS Designations</td>
<td>June 2021</td>
</tr>
<tr>
<td></td>
<td>Ecology Issues Final Report of Examination</td>
<td>June 2021</td>
</tr>
<tr>
<td></td>
<td>Completion of Construction – Pipelines</td>
<td>December 2021</td>
</tr>
<tr>
<td></td>
<td>Completion of Construction – Pump Station</td>
<td>March 2022</td>
</tr>
<tr>
<td></td>
<td>Final Project Payment</td>
<td>May 2022</td>
</tr>
<tr>
<td></td>
<td>Final Project Report and Certification of Completion</td>
<td>July 2022</td>
</tr>
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</table>
Project Location

The proposed COIC Icicle Creek Flow Restoration project will be located within the COIC service area, which is in unincorporated Chelan County, Washington, just south of the City of Leavenworth (Figure 1). COIC serves water for irrigation to rural residential properties located south of the Wenatchee River and west of Icicle Creek. New intake and pumping facilities will be constructed on the left bank of Icicle Creek near the east end of Shore Street at RM 1.9 (Latitude 47°34'12" N, Longitude 120°40'00" W). New distribution pipelines will extend to COIC water users primarily in County rights-of-way or in the existing COIC ditch easement (Figure 2). The project is located in Sections 13, 14, 23, and 26 of Township 24N, Range 17E.
Source: Basemap prepared from Chelan County GIS Data

Figure 2
Existing COIC Delivery System

WaterSMART Grant Application
COIC Irrigation Efficiency and Pump Exchange Project
Technical Project Description

This proposal seeks funding to support construction of the COIC Irrigation Efficiency and Pump Exchange Project, which will include a modernized intake screening system, a 240-horsepower pump station, and approximately 25,000 linear feet of new delivery pipelines. These facilities will replace the existing irrigation delivery system that serves approximately 419 irrigated acres and 228 water users as shown on Figures 2 and 3. As part of the project, COIC will permanently disable its current gravity-fed diversion system at RM 4.5 on Icicle Creek and replace it with the new intake system downstream.

A more detailed summary of the key facilities included as part of the project is provided below by Project Engineer David Rice, P.E. of Anchor QEA.

Intake Screen
The project will include fish screening facilities designed to meet the most current requirements for screening of diversions from the Washington Department of Fish and Wildlife (WDFW) and the National Marine Fisheries Service 2008 Anadromous Salmonid Passage Facility Design Guidelines. A cone screen with a mechanical brush for self-cleaning is proposed at the intake on Icicle Creek. Based on the peak design flow rate (8 cfs) and the conditions in Icicle Creek at the point of diversion, a 66-inch diameter screen is recommended. The screen will be fabricated with non-corrosive stainless-steel wedge-wire mounted on a fabricated steel base. The screen base will be mounted to the top of a pre-cast concrete intake sump that will be buried in the bottom of the Icicle Creek Channel.

Intake Pipeline
A short 24-inch-diameter high-density polyethylene (HDPE) intake pipeline will convey water from the inlet sump through the left bank of Icicle Creek to a settling basin structure.

Settling Basin
A reinforced concrete basin will be constructed upstream of pumping facilities to allow for settling and removal of sediment. The reinforced concrete settling basin will be approximately 32 feet long and 12 feet wide with a baffle and a weir near the outlet to the pump station wet well that will help capture debris and sediment.

Pump Station
The settling basin will deliver water to a wet well under the proposed pump station. Four vertical turbine pumps will deliver water from the wet well to the system, including two 90-horsepower pumps, one 40-horsepower pump, and one 15-horsepower pump. The pumps will each include a variable frequency drive. The pumps and controls will be designed so that the pump station can operate on demand to deliver the full range of flows expected over the irrigation season, from very low flows up to the 8-cfs peak design flow, while maintaining a pressure of at least 25 psi at the highest, most remote customer service location. Each pump discharge line will include butterfly valves for isolation, a check valve with a cushioned swing, and combination air release valves. The pump station will also include a pressure relief valve, flush line, flow meter,
miscellaneous pipe, and fittings. Pumps, controls, and other equipment will be housed inside a temperature-controlled building.

**Main Delivery Pipeline**
The main delivery pipeline will extend west from the pump station in the Shore Street right-of-way to the existing COIC ditch easement. One branch of the pipeline will extend south in the ditch easement to the last customer at the south end of Icicle Road (Icicle River R.V. Resort). Another branch of the pipeline will extend north in the ditch to Wilson Street. The main pipeline will consist of solid-wall, butt-fused HDPE pipe ranging from 6 to 18 inches in diameter.

**Laterals**
Laterals will extend from the main pipeline to customers east of the existing COIC ditch. The laterals will replace existing laterals in Wilson Street, Prowell Street, East Leavenworth Road, Fish Hatchery Road, and Cemetery Road. The laterals will consist of solid-wall, butt-fused HDPE pipe ranging from 6 to 10 inches in diameter.

**Valves, Fittings, and Appurtenances**
Gate valves will be provided for isolation at key locations throughout the distribution system. Additional fittings and appurtenances will include combination air release valves, drain valves, customer turnout connections, and fire access connections. Pressure reducing valves will be supplied on customer services where pressures are anticipated to exceed 65 psi.

These key components will create a fully closed, pressurized delivery system that will operate on demand to delivery water to COIC water users. Efficiencies will be gained by mostly eliminating seepage losses, leakage, and evaporation from the system. In addition, there will be no routine spilling or discharge from the ends of the system. The water delivered to the system through the pump station will be just what is needed to meet COIC water users’ demands.
LEGEND:
- Parcel
- COIC Assessed Parcel
- COIC Irrigated Area
- Stream or River
- Contours (10-ft Interval)
- Existing Open Ditch
- Existing Closed Pipe
- Existing Ditch Structure
- Proposed Pressurized Delivery Pipeline
- Direction of Flow

Miles

0 1/4

SOURCE: Aerial photographs provided through Esri and partners. Open ditch, closed pipe, turnout locations, and ditch structure GPS data were collected by Aspect Consulting. Contours from LiDAR data were provided through Puget Sound LiDAR Consortium.

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet

VERTICAL DATUM: NAVD 88

Figure 3
Proposed COIC Deliver System
WaterSMART Grant Application
COIC Irrigation Efficiency and Pump Exchange Project
E.1.1 Evaluation Criteria A – Quantifiable Water Savings

Summary of Water Savings

The water saving benefits includes conservation efficiencies realized by a new pressurized pipe irrigation system and through instream flow benefits in Icicle Creek via moving COIC’s diversion downstream (pump exchange). This project provides conservation savings totaling 1,088.6 afy in perpetuity and will improve the efficiency of COIC’s system by an estimated 53 percent. This includes 168.6 af in ditch seepage loss and 920 af of eliminated spill losses. In addition, the movement of the diversion point downstream will add 11.9 cfs and 4,012 af to Icicle Creek above the new pump station site. This reach, where flows drop below 15 cfs in extremely dry years, has been identified by the Icicle Strategy Instream Flow Committee as the highest priority flow restoration reach on Icicle Creek.

A 2015 seepage loss study measured 0.5 cfs (168.6 afy over 170 days) of losses in COIC’s open, earthen ditch. COIC’s excess water (i.e., water not required for irrigation) spills into the Wenatchee River just upstream of the confluence with Icicle Creek. Gravity-fed systems require water in the ditch to keep the laterals charged throughout the irrigation season. The excess is greater when demand for irrigation water is low, but daily irrigation demand can spike from April through October depending on weather. Diversion records from 2015 to 2020 show that up to 2,064.7 afy of water is diverted. Average annual irrigation requirements for COIC’s 419 acres are 976 acre-feet, leaving a total of 1,088.6 acre-feet of conservation savings.

<table>
<thead>
<tr>
<th>Total Diverted</th>
<th>Irrigation Delivery</th>
<th>Conveyance System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CFS</td>
<td>AF</td>
</tr>
<tr>
<td>Current</td>
<td>8.00</td>
<td>2,064.70</td>
</tr>
<tr>
<td>Proposed</td>
<td>1.75-5.92</td>
<td>976.10</td>
</tr>
<tr>
<td>Savings</td>
<td>0.5-6</td>
<td>1088.60</td>
</tr>
</tbody>
</table>

Current Losses

Approximately 0.5 cfs and 168.6 afy of water is lost via seepage and evaporation from the existing COIC ditch. In addition, an estimated 920 afy is discharged through a tailwater spill at the downstream end of the ditch to the Wenatchee River. Both of these losses will be eliminated by the new system, resulting in 1,088.6 afy of conserved water.

A range of cfs values is provided, reflecting monthly variations in crop demand vs tailwater/seepage amounts over the course of the irrigation season. A comparison of average daily diversion, max diversion, daily crop use, and seepage/tailwater losses is shown on Figure 4.
Support/Document Estimated Water Savings

Replacing the existing irrigation delivery system with a closed, pressurized, and fully piped irrigation system will eliminate seepage, ditch evaporation, and tailwater losses from the system. An on-demand pressurized irrigation season eliminates the need to run water through the ditch to maintain service, which currently tails out into the Wenatchee River at the bottom of the COIC ditch system. Fully piping the new system will also eliminate all ditch seepage losses. We calculated anticipated savings by subtracting the known seepage losses and the calculated irrigation demand by crops from COIC’s measured diversion records.

COIC maintains daily readings on their diversion using a calibrated staff gauge and weir in the headworks box. Washington State quantifies water rights as the highest water use in the past 5 years, so for the purpose of these calculations we are using COIC’s 2015 diversion of 2,064.7 acre-feet. Annual diversions are shown in Table 3 below:

### Table 3: COIC Water Use Records - 2015-2020

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acre-Feet</td>
<td>2064.7</td>
<td>1853.2</td>
<td>1822.2</td>
<td>1829.2</td>
<td>1677.2</td>
<td>1749.2</td>
</tr>
</tbody>
</table>

*2020 Records are through September 14

We used data from Washington State Irrigation Guide published by Washington State University and used by the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) for crop irrigation estimates. Data provided for pasture and turf irrigation demand in the Leavenworth, Washington, area indicates that on average 18.17 inches of irrigation is required. Field visits indicated a mixture of flood, solid-set, and gated pipe irrigation systems that operate at an average efficiency of 65 percent, requiring 27.95 inches (2.33 feet) of irrigation annually. On the 419 acres served by COIC, this totals 976.1 afy of on-farm irrigation (2.33 feet x 419 acres). This means that of the 2,064.7 acre-feet allowed for diversion by COIC under their...
current water right, 1,088.6 acre-feet will be conserved by switching to the new system – a 53 percent decrease from current usage. As shown in Table 2 above, 168.6 acre-feet of this comes from elimination of seepage loss and an additional 920 acre-feet comes from elimination of tail water losses.

Upon installation, performance of the new system will be verified by metering near the point of diversion, measuring annual water use. A magnetic flow meter will be installed on the discharge side of the pump station and will be linked to the monitoring and control equipment in the pump station to allow continuous access to flow data. The meter will be tied to the control system, where use will be monitored by COIC and reported to the Washington State Department of Ecology (Ecology). Water use metering will be much more accurate than the weir device that is currently used to monitor and report gravity diversions at COIC’s headworks.

**Additional Icicle Creek Instream Flow Benefit (4,012.6 acre-feet and 11.9 cfs/year)**

There are additional benefits to instream flow that will be realized by moving COIC’s point of diversion downstream. COIC’s 11.9 cfs water right, the most senior on the system, runs through a shared diversion system operated by Reclamation on behalf of the LNFH. A complex, but notable, component of this arrangement is a series of agreements from 1939 and 1940 in which Reclamation agreed to maintain the shared diversion and COIC agreed to provide any water not pulled into their system for temporary use by LNFH.

The mechanism used to protect instream flows will be a permanent trust water right deeded to the State of Washington for permanent management and protection in the Washington State Trust Water Rights Program, as allowed under Chapter 90.42 of the Revised Code of Washington (RCW). Table 4 summarizes the reaches and associated benefits anticipated from this trust water right. Because of the complex plumbing of COIC’s rights with the hatchery, the amount of water protected is different depending on whether it’s above the hatchery outflow at RM 2.7, between the hatchery outflow and new pump station site at RM 1.9, and below the new pump station site.

**Table 4: Icicle Creek Instream Flow Benefits**

<table>
<thead>
<tr>
<th></th>
<th>RM 4.5 to RM 2.7</th>
<th>RM 2.7 to RM 1.9</th>
<th>RM 1.9 to RM 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CFS AF</td>
<td>CFS AF</td>
<td>CFS AF</td>
</tr>
<tr>
<td>Current</td>
<td>0.00 0.00</td>
<td>3.90 1315.06</td>
<td>3.90 1315.06</td>
</tr>
<tr>
<td>Proposed</td>
<td>11.90 4012.62</td>
<td>10.00 3379.76</td>
<td>5.98 2403.66</td>
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<tr>
<td>Benefit</td>
<td>11.90 4012.62</td>
<td>6.10 2064.7</td>
<td>3.23 1088.60</td>
</tr>
</tbody>
</table>

The calculations for determining the available water protected instream were conducted by Greg McLaughlin of Washington Water Trust, who has completed dozens of trust water rights permits with landowners and the department of Ecology since 2006. Dan Haller, of Aspect Consulting and a State Certified Water Rights Examiner, reviewed the calculations. Water rights being added to instream flow go under a detailed extent and validity review to establish the legal standing of the water right, confirm its priority date, quantify the extent of beneficial use in the last five years, and determine if any proposed changes to the water rights impair other users or the public interest. The Washington Department of Ecology issues guidance on how irrigation rights can be applied to the
state water trust in accordance with RCW 90.42. The tables below show the work completed to establish the full nature of beneficial use of the COIC water rights, and how they translate to managed trust water rights reaches. Additional explanation is available upon request from Mr. McLaughlin of Mr. Haller. Figures 5A and 5B and Table 5 provide a schematic of the proposed system and a table of trust water calculations.

Table 5: Trust Water Calculations for Instream Flow Reaches

<table>
<thead>
<tr>
<th>Water Rights Calculator Cascade Orchards Irrigation Company Irrigation Efficiency and Pump Exchange Project</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>419 Acres, Pasture/Turf at 65% Efficiency - Leavenworth, WA - Irrigation Data from Washington Irrigation Guide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Irrigation Demand (inches)</td>
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<td>0.00</td>
<td>0.00</td>
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<td>18.17</td>
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<td>Irrigation Applied 65% Eff (inches)</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>5.51</td>
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<td>0.00</td>
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<td>Max CFS Return Flow</td>
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<td>0.00</td>
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<td>0.63</td>
<td>0.00</td>
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<td>1.48</td>
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Instream Flow Reach 1: RM 4.5 - RM 2.7

<table>
<thead>
<tr>
<th>Cubic Feet/Sec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
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Instream Flow Reach 2: RM 2.7 - RM 1.9

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NOTES:
1. FLOW RATES REPRESENT TYPICAL FLOW RATES DURING THE LATE SUMMER PEAK IRRIGATION DEMAND.
2. FLOWS TO HATCHERY INCLUDE FLOWS DIVERTED UNDER LNFH WATER RIGHT AND FLOWS DELIVERED TO HATCHERY UNDER COIC'S WATER RIGHT AND 1939 AGREEMENT WITH LNFH.

CASCADE ORCHARDS IRRIGATION CO.
- 5.9 CFS PEAK/977 ACRE-FEET ANNUAL DELIVERIES TO IRRIGATORS
- 0.5 CFS PEAK/169 ACRE-FEET ANNUAL SEEPAGE/LEAKAGE/EVAPORATION

Figure 5A
COIC Existing System Flow Schematic
WaterSMART Grant Application
COIC Irrigation Efficiency and Pump Exchange Project
NOTES:
1. FLOW RATES REPRESENT TYPICAL FLOW RATES ANTICIPATED DURING THE LATE SUMMER PEAK IRRIGATION DEMAND.
2. FLOWS TO HATCHERY INCLUDE FLOWS DIVERTED UNDER LNFH WATER RIGHT.
3. THE NEW COIC PUMP STATION WILL OPERATE TO MEET FLUCTUATING DEMAND. THE TYPICAL DEMAND DURING THE MONTH OF PEAK USE WAS ESTIMATED TO BE 5.9 CFS, BUT PEAK INSTANTANEOUS DEMAND COULD BE AS HIGH AS 8.0 CFS, DUE TO WEATHER, IRRIGATION PATTERNS, AND PEAKING.

CASCADE ORCHARDS IRRIGATION CO.
- 5.9 CFS PEAK/977 ACRE-FEET ANNUAL DELIVERIES TO IRRIGATORS
- 0.0 CFS PEAK/0 ACRE-FEET ANNUAL SEEPAGE/LEAKAGE/EVAPORATION

Figure 5B
COIC Proposed System Flow Schematic
WaterSMART Grant Application
COIC Irrigation Efficiency and Pump Exchange Project
E.1.2. Evaluation Criteria B – Water Supply Reliability

- *Will the project address a specific water reliability concern? Please address the following:*
  - Explain and provide detail of the specific issue(s) in the area that is impacting water reliability, such as shortages due to drought, increased demand, or reduced deliveries. Will the project directly address a heightened competition for finite water supplies and over-allocation (e.g., population growth)?

There are multiple competing demands for water in the Icicle Creek Watershed and the Wenatchee River. These include out-of-stream water supply needed for irrigation, operation of the LNFH, domestic use by the City of Leavenworth, and rural growth in Chelan County. Instream flows are also needed to support habitat and fish passage needs for three species of fish listed under the ESA: spring Chinook salmon (endangered), steelhead (threatened), and bull trout (threatened).

During late summer and early fall, when natural flows are lowest, it is a challenge to meet all out-of-stream demands, while meeting instream flow targets for fish. This has been demonstrated by the minimum instream flows established in chapter 173-545 of the Washington Administrative Code not being met, interruptible water users not receiving water, agricultural water users being rationed during drought, and litigation over water rights, while collective urban and rural water rights are not sufficient to support population projections through 2050.

The IWG was convened in 2012 to find collaborative solutions for water management and has developed a comprehensive strategy that addresses all of the diverse interests and needs. The COIC Project is an important project for the IWG as it will increase instream flow significantly and replace aging infrastructure with a more efficient on-demand system.

- *Describe how the project will address the water reliability concern?*

The Project will enhance COIC’s ability to provide reliable irrigation water and also create more reliable flows in Icicle Creek. Improvements to reliability can be characterized in three ways. First, the change of diversion will reduce water currently diverted at RM 4.5 by 11.9cfs. This will benefit critical reach fish habitat and reduce demand for out-of-stream use. Second, this project will replace an aging infrastructure with a reliable, highly efficient intake, pumping and delivery system that will allow COIC to meet customer demand in a timely manner with reduced concern for interruptions more typical of the legacy system. Third, this project will provide 25 psi through out the irrigated service area which will negate current requirements for each user to pressurize their own system.

- *Will the project make water available to achieve multiple benefits or to benefit multiple water users?*

Yes. This project is an important part of the Icicle Strategy, which collectively addresses many water-related issues in the Icicle Watershed, including meeting municipal and domestic needs, instream flow needs for fish, commercial agriculture, and the operation of the LNFH. Limits on future water allocations under the Wenatchee Instream Flow Rule make projects like this essential to offset out-of-stream needs and enable local governments to plan for growth. This
project will have direct benefits to COIC shareholders by improving the reliability of their water supply. The LNFH is currently working with Reclamation to remove the shared water intake system on Icicle Creek and replace it by May 2023 to comply with the NMFS fish screening criteria and to meet requirements of the 2017 BiOp. This new system relies on the successful completion of this project, ensuring that COIC and LNFH no longer have a shared water intake.

- **Will the project benefit species (e.g., federally threatened or endangered, a federally recognized candidate species, a state listed species, or a species of particular recreational, or economic importance)? Please describe the relationship of the species to the water supply, and whether the species is adversely affected by a Reclamation project.**

Yes. Low stream flows are identified as a priority ecological concern to be addressed in both Icicle Creek and the Wenatchee River by the Upper Columbia Regional Technical Team, a committee of fish biologists tasked with providing expertise in the implementation of the Upper Columbia Salmon Recovery Plan.

The 2014 Revised Biological Strategy, produced by the Upper Columbia Salmon Recovery Board in partnership with local biologists, lists Icicle Creek as the 3rd-ranked restoration and 3rd-ranked protection priority in the Wenatchee Basin. Within the Icicle Creek Assessment Unit, increased flows to address instream habitat and temperature is the top habitat protection priority after assessing and addressing passage at the boulder field near Snow Creek. This addresses flow as a limiting factor in a reach identified as Major Spawning Area (MASA) for steelhead, and a target reach for juvenile steelhead rearing, which is the critical life stage and species addressed by this project (flow is not currently a barrier to steelhead spawning, which occurs in the late Spring). Secondary benefits will also accrue to bull trout, which are listed as threatened under the ESA.

Robert Granger of the Washington Department of Fish and Wildlife (WDFW) completed a weighted usable area (WUA) curve analysis identifying impacts to habitat from increased flow (provided as Appendix C of this project application). Mr. Granger estimated up to an 8.1 percent increase in WUA for juvenile steelhead rearing and up to 4.2 percent increase in WUA for bull trout as a result of this project, with relatively higher percentage increases during low flow events or drought years. Icicle Creek experienced its lowest flows in RM 2.7-3.9 in 2015 and 2016, dropping to 15 cfs in those years. These are potential indicators of future climate impacts on Icicle Creek.

Increasing stream flows is a significant part of the Icicle Strategy’s goals, which aims to add over 40 cfs to Icicle Creek. Both Icicle Creek and the Wenatchee River are habitat for three species of fish listed under the ESA: spring Chinook salmon (endangered), steelhead (threatened), and bull trout (threatened). Other species of interest include summer Chinook salmon, sockeye salmon, Westslope cutthroat trout, and Pacific lamprey. This project improves spawning and rearing habitat for steelhead and bull trout by restoring up to 11.9 cfs in the primary reach of Icicle Creek (RM 4.5 to 2.7) with streamflow benefits of 8.5 cfs below this reach. The instream flow acquisition associated with this project represents up to 12-20 percent of the target flows of 60-100 cfs identified for Icicle Creek in the target reaches to sustain baseline habitat conditions for steelhead and bull trout, as determined by the instream flow subcommittee of the IWG in 2015.
The LNFH produces spring Chinook salmon and is one of three fish hatcheries authorized by Congress as mitigation for the construction of Grand Coulee Dam. Hatchery production enables both a tribal fishery and a non-tribal recreational fishing season. Both the Yakama Nation and the Colville Confederated Tribes exercise federally recognized fishing rights on Icicle Creek. LNFH is also currently working with Reclamation on a project to reduce impacts of the hatchery on natural-origin steelhead and bull trout using Icicle Creek, and implementation of this project will facilitate those planning efforts.

- **Will the project benefit a larger initiative to address water reliability?**

Yes. This project is one of many projects identified in the Icicle Strategy that collectively will meet many diverse goals. The IWG is made up of a diverse set of stakeholders, including all four major water users within the Icicle Watershed: Icicle Peshastin Irrigation District (IPID), City of Leavenworth, COIC, and LNFH. Other IWG members include local, state, and federal agencies, tribes, irrigation and agricultural interests, and environmental organizations. The collective goals (guiding principles) of the IWG include: improving instream flow, a sustainable LNFH, meeting tribal treaty and federally protected harvest rights, providing water to meet municipal and domestic demand, improve agricultural reliability, improve ecosystem health, protect non-treaty harvest, and comply with all state and federal laws and wilderness acts.

- **Will the project benefit Indian tribes?**

Yes. This project will benefit the Yakama Nation and Colville Confederated Tribes fishery that occurs at the LNFH by improving conditions for hatchery-produced spring Chinook salmon. As part of the Icicle Strategy, implementation of this project will also help garner support for all Icicle Strategy projects, including those that protect and improve the tribal fishery on Icicle Creek. This project also improves habitat for ESA-listed fish species, which are important for both the Yakama Nation and Colville Confederated Tribes. Representatives from both tribes participate regularly in the development and coordination of this project.

- **Will the project benefit rural or economically disadvantaged communities?**

Yes. The increased instream flows resulting from this project will help offset future out-of-stream uses for growth. The Wenatchee Instream Flow rule limits access to water for domestic use until instream flow improvements are made. This project will enable the City of Leavenworth and Chelan County to meet future water needs, which are clearly identified in the Icicle Strategy.

- **Describe how the project will help to achieve these multiple benefits.**

The Icicle Strategy is a programmatic approach to water resource management, meaning that the IWG is committed to implementing a set of projects that meet all of the goals. This project helps meet the instream flow and agricultural reliability goals and will result in a reduced diversion at the LNFH intake, which will allow for construction of a smaller and more efficient fish screen there. The change in point of diversion from COIC’s current shared diversion with LNFH at RM 4.5 to a pump station downstream will result in an increase of 11.9 cfs that will remain instream and improve habitat for ESA-listed fish.
• Does the project promote and encourage collaboration among parties in a way that helps increase the reliability of the water supply?

Yes. COIC has been a member of the Icicle Work Group (IWG) since it began in 2012, and the Project is a "core project" for this effort. The purpose of the IWG is to develop a comprehensive Icicle Creek Water Resource Management Strategy through a collaborative process that will achieve diverse benefits defined by a set of guiding principles: improved stream flow, a sustainable fish hatchery, ensuring that Tribal Treaty and federally-protected fishing rights are met, provide additional water to meet municipal and domestic demand, improve agricultural reliability, improve ecosystem health, and protect non-treaty harvest all while complying with all state and federal laws and Wilderness Acts. These benefits will extend to new domestic and agricultural uses, non-consumptive uses, fish, wildlife, and habitat while protecting treaty and non-treaty fishing interests is the vision of the IWG. This project is an important early action project from the Icicle Strategy and has the full support of the IWG and is included in the preferred alternative and is critical to meeting the instream flow and agricultural reliability goals.

Included in this application is a letter of support from the Co-Conveners of the IWG.

• Is there widespread support for the project?

Yes. Chelan County and Ecology adopted a Final Programmatic Environmental Impact Statement (PEIS) for the Icicle Strategy in January 2019. The PEIS went through a public comment period where water efficiency projects received overwhelming public support. Widespread outreach was conducted on the Icicle Strategy throughout Leavenworth, Chelan County, and the Seattle area. In the early planning phases of this project, COIC held over a dozen meetings with shareholders to determine support for this project and help guide design. COIC established a Shareholder Advisory Committee to continue to help guide development of this project and address questions along the way. Following the alternatives analysis in 2015, 75 percent of the shareholders at COIC voted in favor of proceeding with this project.

• What is the significance of the collaboration/support?

The collaborative nature of the Icicle Strategy is helping move many important projects to implementation. This is helping with funding coordination and sequencing projects in a way that helps all IWG members see their needs being met. This effort also helps communicate projects like this COIC project to the public.

• Is the possibility of future water conservation improvements by other water users enhanced by completion of this project?

Yes, the completion of this efficiency project will be an example to other smaller irrigation districts in the region of how collaborative water management and system improvements can be done.

• Will the project help to prevent a water-related crisis or conflict? Is there frequently tension or litigation over water in the basin?

Yes. One impetus to form the IWG was to resolve longstanding water resource conflicts in a collaborative way as an alternative to litigation. Litigation focused on water resource issues at the LNFH and between the City of Leavenworth and Ecology. The City and Ecology has litigation on
hold as they develop non-litigious solutions through the Icicle Strategy. Completion of this project will enable the LNFH to construct a new water intake and fish screen that is compliant with NMFS fish screening criteria and ensure LNFH meets requirements of the 2017 BiOp.

- **Describe the roles of any partners in the process. Please attach any relevant supporting documents.**

This project is a key project included in the Icicle Strategy. All IWG members support this project as is reflected in the attached letter of support written on behalf of the IWG by Chelan County and Ecology. USFWS and Reclamation have been working with COIC on this project to ensure COIC’s intake is separated from the LNFH at RM 4.5. Many project partners participate in regular project coordination meetings including Reclamation, USFWS, Chelan County, and Ecology. WDFW has assisted in the evaluation of biological benefits of this project. COIC Board members and members of the Shareholder Advisory Committee meet regularly to work through development of this project. Washington Water Trust has assisted COIC as a co-project sponsor and has lead the development of this project, secured funding and oversees engineering contractors. Other project funding partners include Ecology’s Office of Columbia River, Bonneville Power Administration, Washington State Salmon Recovery Board, and the Priest Rapids Coordinating Committee.

**E.1.3 Evaluation Criteria C – Implementing Hydropower**

This project does not have a hydropower component. However, providing pressurized water throughout the service area will eliminate the need for multiple smaller electrical pumps and likely achieve overall power savings by the 228 users within service area.

**E.1.4 Evaluation Criteria D – Complimenting On-Farm Irrigation Improvements**

COIC is comprised of 419 acres of irrigable land. The primary opportunity for conservation is by upgrading the water delivery system to all 228 users, resulting in an additional 1,088.6 afy of conserved water. A majority of the land within the service area is comprised of rural residential properties and the water is primarily used for irrigating small pastures, gardens, and landscaping rather than irrigating large agricultural properties. While the proposed project does not specifically include property-owner conservation measures, the project is being completed as a key early action as part of the Icicle Strategy. One of the other key components of the Icicle Strategy is water conservation. As part of that action, local governments will carry out efforts to educate and help individual property owners conserve water. COIC has expressed an interest and willingness in helping its shareholders learn about and participate in these efforts.

**E.1.5. Evaluation Criterion E—Department of the Interior and Bureau of Reclamation Priorities (10 points)**

Through the IWG, communication on water management issues in the Icicle Watershed has been expanded significantly. Reclamation is among the more active of IWG members that include irrigation districts, local agricultural representatives, state and federal agencies, Chelan County,
tribes, municipalities, and environmental organizations. This diverse group meets monthly to discuss the goals established in the Icicle Strategy and the projects that will achieve these goals, including this project. This group works collaboratively to address these important issues and communicate its efforts to the public. Updating this infrastructure with modern irrigation technology will increase COIC's water conservation and water use efficiency and will provide significant instream flow benefits. This project will also enable LNFH to make necessary infrastructure improvements in a more efficient and cost-effective way and has been coordinating closely with Reclamation on these overlapping projects.

E.1.6. Evaluation Criterion F—Implementation and Results

E.1.6.1 Subcriterion F.1 - Project Planning

In 2015, the Washington Water Trust and Anchor QEA completed an alternatives analysis for COIC with the support of the IWG. The alternatives analysis provided a comprehensive look at the COIC system and evaluated four alternatives for replacing or upgrading the system to improve water use efficiency. The alternatives analysis included a review of the existing system, evaluation of existing water supply needs, assessment of delivery system conditions and deficiencies, and an evaluation of proposed alternatives for improving the system. The alternatives analysis included hydraulic analysis, identification of major materials needed for implementation of each alternative, and a preliminary opinion of probable costs associated with each improvement alternative. A copy of the COIC Alternatives Analysis Study - Public Release Version is included in Appendix B for reference. This study represents the most detailed and comprehensive planning document prepared to date and provided a basis for selection and design of a preferred alternative.

The preferred improvement alternative identified by the alternatives analysis included a closed, pressurized delivery system designed to deliver up to 8 cfs to COIC from intake and pumping facilities somewhere near the confluence of Icicle Creek and the Wenatchee River. Multiple public meetings were held with COIC shareholders to discuss the proposed improvement alternative and a vote was held to confirm broad support for the project and identify specific requirements or contingencies for the design and implementation of the project.

The next step in planning for the project included a thorough siting analysis for the potential intake and pumping facilities. Grant funding was then provided by the Priest Rapids Coordinating Council Habitat Subcommittee in 2017 to complete preliminary design of the preferred alternative. A preliminary design report and 30 percent complete designs were prepared with that funding by Washington Water Trust and Anchor QEA. Following completion of the COIC Alternatives Analysis Study, COIC formed a Shareholder Advisory Group (SAG). The COIC SAG has been actively involved in development and planning of the project through siting of the intake and pump station facilities, the preliminary design phase, and into the detailed design phase of the project.

E.1.6.2. Subcriterion F.2 — Performance Measures

The benefits for this project will be measured in terms of annual flow pumped by the new system, using a flow meter with a totalizer to document actual acre-feet of water delivered each
year. These amounts will be easily compared with COIC’s past diversion records to determine water conserved by the new system. In addition, Washington Water Trust, in cooperation with the Ecology and the Water Team at the WDFW, engages in annual streamflow monitoring to measure flows of water acquired into the Washington State Trust Water Rights Program. This team will conduct annual flow measurements within each of the three target restoration reaches during both medium and lower water times of the year and upload the data into StreamNET, following protocols developed by the Columbia Basin Water Transactions Program on behalf of the Bonneville Power Administration.

E.1.6.3. Subcriterion F.3—Readiness to Proceed

The project is currently in the detailed design phase. This application is for funding to support construction of the project in 2021 and 2022. Table 5 below, provides a timeline for key project activities that are complete, are currently underway, or will yet be completed.

Table 5: Detailed Project Timeline

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The preliminary design recommended that the detailed design and construction of the project proceed in three phases, as follows:

- **Phase 1 – Lateral Improvements**
- **Phase 2 – Main Pipeline**
- **Phase 3 – Intake and Pumping Facilities**

Each phase has unique schedule constraints.

- The lateral improvements will generally be constructed parallel and adjacent to existing laterals but will need to be tied over to existing customer service connections that will be active during the irrigation season. While some of the work can proceed during the irrigation season, most of the construction work will need to be completed after the irrigation season and prior to the following irrigation season.

- Main pipeline construction will include segments that are located in the existing ditch easement. The ditch will need to be cleared and pipe installed in the ditch alignment. Work on this phase cannot proceed until after the irrigation season and must be completed prior to the following irrigation season.

- The intake and pumping facilities will not impact existing irrigation operation and can generally be constructed any time, except that the in-water improvements must be constructed within the in-water work window specified in the hydraulic permit approval (HPA) from WDFW. The standard in-water work window for Icicle Creek is from mid-July through August. An extension may be granted to allow for work to coincide with the lowest water levels, which occur in September.

All phases of the project will need to be complete and operational at the beginning of the irrigation season following the start of pipeline construction. Due to winter weather, the windows for construction will be limited to the early fall and early spring. The current project schedule targets completion of all work by the end of April 2022, prior to the 2022 irrigation season.

After finalization of the easement agreement, cultural resources review will be completed to ensure that no resources are found that would prevent construction of the facilities at the new location. Field work will also be completed, including topographic survey and geotechnical
investigations, to support the detailed design. Detailed design will move forward with the goal of
developing the design to the level of detail needed to support permitting by late October or early
November 2020.

E.1.7. Evaluation Criterion G— Nexus to Reclamation Project Activities (4 Points)

- Is the proposed project connected to Reclamation project activities? If so, how?

This project is a key project included in the Icicle Strategy’s preferred alternative identified in
the Final PEIS focused on implementing projects to resolve longstanding water resource
conflicts within the Icicle Creek basin. COIC along with Reclamation and the USFWS are,
among others, members of the IWG. Reclamation funds the LNFH, which produces spring
Chinook salmon. LNFH is one of three hatcheries that make up the Leavenworth Complex.
These hatcheries are part of an extensive FCRPS (Federal Columbia River Power System)
hatchery program funded by Bonneville Power Administration, the U.S. Army Corps of
Engineers, and Reclamation.

One of the Icicle Work Group’s (IWG) guiding principles is a Sustainable LNFH, with several
projects identified to meet this goal. The LNFH currently shares an unscreened water intake
system with COIC; the two entities have been operating together under and inter-governmental
agreement since 1939 where water is diverted through a pipeline to a bifurcation facility that
divides flow between COIC and LNFH. Reclamation operates and maintains the shared surface
water diversion infrastructure. In exchange, COIC has agreed to provide excess water to LNFH.

The LNFH is working with Reclamation to remove the intake system and replace it by May 2023
with one that is fully compliant with the NMFS fish screening criteria. This project is also part of
several requirements Reclamation is implementing under the 2017 BiOp. The new water intake
system is designed and scheduled with the assumption that COIC will be successful in moving
their point of diversion downstream. Completion of this COIC project and termination of the
1939 agreement are both critical to successful implementation of the LNFH surface water
diversion upgrades being completed by Reclamation.

- Does the applicant receive Reclamation project water?

No, but as mentioned above, COIC and LNFH (funded by Reclamation) share the same point of
diversion and water intake infrastructure. LNFH is also a COIC shareholder.

- Is the project on Reclamation project lands or involving Reclamation facilities?

This project is closely connected to operation of the LNFH, funded by Reclamation. COIC and
LNFH meet regularly, along with representatives from Reclamation and Washington Water Trust
to coordinate on project implementation. The work scheduled for LNFH will be complemented
and made much simpler with the successful implementation of the COIC project.

- Is the project in the same basin as a Reclamation project or activity?

Yes. Reclamation is responsible for funding the LNFH as mitigation for the construction of
Grand Coulee Dam. LNFH is located on Icicle Creek and currently shares a water intake
structure with COIC. LNFH is one of COIC’s largest shareholders in terms of potentially irrigable acreage.

- *Will the proposed work contribute water to a basin where a Reclamation project is located?*

Yes. The water saved by moving COIC’s point of diversion downstream will remain in Icicle Creek in permanent trust.

- *Will the project benefit any tribe(s)?*

Yes. This project will benefit the Yakama Nation and Colville Confederated Tribes fishery that occurs at the LNFH by improving conditions for hatchery-produced spring Chinook salmon. As part of the Icicle Strategy, implementation of this project will also help garner support for all Icicle Strategy projects, including those that protect and improve the tribal fishery on Icicle Creek. This project also improves habitat for ESA-listed fish species, which are important for both the Yakama Nation and Colville Confederated Tribes. Representatives from both tribes participate regularly in the development and coordination of this project.

E.1.8. Evaluation Criterion H— Additional Non-Federal Funding (4 points)

*Up to 4 points may be awarded to proposals that provide non-Federal funding in excess of 50 percent of the project costs. State the percentage of non-Federal funding provided using the following calculation:*

\[
\text{Total Non-Federal percentage} = \frac{\text{\$3,100,000 Non-Federal Funds}}{\text{\$5,900,000 Total Project Cost}}
\]

Total Non-Federal percentage = 52.5 percent

We are seeking funding from several funders for this project. Funding already obtained or committed from non-federal funds includes $495,000 in state funds, and we will seek an additional $1.605 million in state funds and $1 million in other local funds, and $2.1 million in federal funds, including the WaterSmart Grant.

**Funding Plan**

The Project includes $4.4 million for construction costs and $1.5 million in water acquisition costs. The water acquisition costs are associated with the deeding of all the water rights to be protected instream to the Washington State Trust Water Rights Program and are tied to the permanent commitment by COIC to the new downstream pump station site. COIC will pay all pumping and maintenance and operation costs associated with the new system in perpetuity, as well as commit to replacing infrastructure that reaches the end of its lifespan. These costs, which will average about $50,000/year in perpetuity by COIC, are not reflected in the current grant proposal. The water acquisition costs will be obtained from the Columbia Basin Water Transactions Program, operated on behalf of the Bonneville Power Administration (BPA) and Washington State programs for water acquisitions. The remaining costs for the $4.4 million in construction costs would be requested and secured within the period of WaterSMART grant.
contracting period between September 2020 and April 2021. They include $495,000 in funds obtained from the Salmon Recovery Funding Board operated by the State of Washington, $1,305,000 in a separate funding request being submitted to the Washington State Irrigation Efficiency Grants Program, $500,000 in funding from the Tributary Committee and Priest Rapids Coordinating Committee operated by Chelan County PUD and Priest Rapids Coordinating Committee, and $1.6 million in BPA funding for tribal accord agreements and targeted restoration programs.
### Project Budget Table

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Grant Application – Cascade Orchards Irrigation Company
12-inch Gate Valve and Box | EA | $5,000 | 0 | $0 | 1 | $5,000 | 0 | $0 | 1 | $5,000
10-inch Gate Valve and Box | EA | $2,300 | 2 | $4,600 | 0 | $0 | 0 | $0 | 2 | $4,600
8-inch Gate Valve and Box | EA | $1,800 | 3 | $3,400 | 0 | $0 | 0 | $0 | 3 | $3,400
4-inch Gate Valve and Box | EA | $1,000 | 4 | $2,000 | 0 | $0 | 0 | $0 | 4 | $2,000
Combination Air Release Valve Assembly | EA | $2,200 | 5 | $13,200 | 8 | $17,600 | 0 | $0 | 14 | $30,800
Flush Valve Assembly | EA | $5,000 | 6 | $25,000 | 0 | $0 | 0 | $0 | 7 | $30,000
Turnout Connections | EA | $2,000 | 200 | $400,000 | 88 | $176,080 | 0 | $0 | 288 | $578,000
Subtotal - Pipelines | | $1,179,000 | $968,000 | 0 | $61,000 | $2,208,000

Intake and Screening Facilities
- Reinforced Concrete Settling Basin | CY | $750 | 0 | $0 | 0 | $0 | 96 | $72,000 | 0 | $72,000
- Excavation for Intake Facilities | CY | $8 | 0 | $0 | 0 | $0 | 226 | $18,144 | 0 | $18,144
- Shoring for Trench Excavation | LS | Varies | 0 | $0 | 0 | $0 | 1 | $6,000 | 0 | $6,000
- Grating | SF | $30 | 0 | $0 | 0 | $0 | 384 | $11,520 |aw | $11,520
- Wedge Wire Cone Screen w/ External Brush Cleaning System | LS | $40,000 | 0 | $0 | 0 | $0 | 1 | $40,000 | 0 | $40,000
- Screen Supports and Base | LS | $10,000 | 0 | $0 | 0 | $0 | 1 | $10,000 | 0 | $10,000
- Fittings | LS | $5,000 | 0 | $0 | 0 | $0 | 1 | $5,000 | 0 | $5,000
Subtotal - Intake and Screening Facilities | | $0 | $0 | $163,000 | $163,000

Pump Station and Wet Well
- Reinforced Concrete Wet Well Structure | CY | $750 | 0 | $0 | 0 | $0 | 59 | $44,250 | 288 | $44,250
- Reinforced Concrete Pump Station Slab | CY | $750 | 0 | $0 | 0 | $0 | 23 | $17,230 | 288 | $17,230
- Excavation for Intake Facilities | CY | $8 | 0 | $0 | 0 | $0 | 590 | $4,719 | 288 | $4,719
- Shoring for Trench Excavation | LS | Varies | 0 | $0 | 0 | $0 | 1 | $6,000 | 288 | $6,000
- Grating | SF | $30 | 0 | $0 | 0 | $0 | 21 | $630 | 288 | $630
- Pump Station Building | SF | $275 | 0 | $0 | 0 | $0 | 384 | $105,600 | 384 | $99,900
- Vertical Turbine Pump, 90 HP VFD | EA | $90,000 | 0 | $0 | 0 | $0 | 3 | $90,000 | 288 | $90,000
- Vertical Turbine Pump, 45 HP VFD | EA | $20,000 | 0 | $0 | 0 | $0 | 1 | $20,000 | 288 | $20,000
- Vertical Turbine Pump, 20 HP VFD | EA | $13,000 | 0 | $0 | 0 | $0 | 1 | $13,000 | 288 | $13,000
- 3-Phase Power Extension Allowance | LS | $200,000 | 0 | $0 | 0 | $0 | 1 | $200,000 | 288 | $200,000
- Electrical and Control | LS | $100,000 | 0 | $0 | 0 | $0 | 1 | $100,000 | 288 | $100,000
- Pump Station Discharge Pipe, Fittings, Valves, Meter | LS | $35,000 | 0 | $0 | 0 | $0 | 1 | $35,000 | 288 | $35,000
Subtotal - Pump Station and Wet Well | | $0 | $0 | $636,000 | $636,000

Construction Subtotal
| $1,279,000 | $1,033,000 | $929,000 | $3,241,000
Mobilization / Demobilization | 10.9% | $127,900 | $103,300 | $92,900 | $324,000
Sales Tax | 8.2% | $104,878 | $84,706 | $76,178 | $265,762
Subtotal - Construction Contract | | $1,512,000 | $1,231,206 | $1,098,097 | $3,831,302
Contingency | 15.0% | $226,800 | $183,150 | $164,700 | $574,650
Total Construction Cost | | $1,738,800 | $1,414,356 | $1,262,797 | $4,406,052

Water Acquisition Cost | | $1,500,000
Total Project Cost | | $5,900,000

1) Lateral improvements include all laterals outside the main canal and the portion of the main pipeline that will parallel the existing lateral in Wilson Street.
2) Main line improvements include all segments of the main line within the existing ditch easement and between the pump station and Wilson Street. It also includes the lateral at the north end of the existing ditch along Icicle Road.
3) Intake and pumping facilities include the screened intake, settling basin, pump station, wet well, and pipe connecting these facilities.
4) Pipe unit costs include trenching, furnishing and installing pipe, fittings, and appurtenances including turnout connections for water users; backfilling; compaction of backfill; and surface repair.
5) Subtotals and totals are rounded to the nearest $1,000.
6) Costs are in 2017 dollars.
Project Budget

COIC is requesting funds from WaterSMART to complete construction activities and associated grant implementation costs. The portion of this project to be covered by the grant request is anticipated to offset the $4.4 million in construction costs which will be shared by other funding sources, and is anticipated to include:

- $180,000 in equipment to procure pumps, the pump station building, reinforced concrete slabs, and the wet well structure.
- $90,000 in equipment costs to offset the cost of pipe in the mainline
- $125,000 in construction costs for pipe and the pump station
- $15,000 in demolition and removal costs for existing pipe
- $15,000 in architectural and engineering fees associated with ensuring construction follows design plans
- $25,000 in administrative and legal expenses associated with grant management and project coordination
- $50,000 in contingency costs associated with construction.

COIC has been working with ANCHOR QEA to design the project in accordance with irrigation needs, who also provided the project cost estimates after reviewing site data and conducting site surveys. The system will optimize delivery of water for the normal 6 cfs operating range, with the capacity to delivery up to 8 cfs of water. COIC is requesting funds from WaterSMART to install the portions of this project most closely related to the conservation and water reliability benefits discussed elsewhere in this proposal. COIC holds an easement within the entire service area for the anticipated location of the new pipeline and is in final negotiations for the acquisition of the property to be used for the pump station site. Coordination with county, state, and federal permitting agencies has occurred throughout the project planning phases. The project is scheduled to go out to be in early 2021.

Project managers Tim Walsh of COIC and Greg McLaughlin of WWT will be responsible for progress reporting to the Bureau of Reclamation and submission of reimbursement requests.
# Required Permits or Approvals

## Table 5: List of Permits Required

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APPENDIX A

Letters of Support
Dear Ned Weakland:

On behalf of the members of the Icicle Work Group, we are pleased to submit this letter of support for the Cascade Orchard Irrigation Company’s (COIC) application to the Bureau of Reclamation’s WaterSMART grant program for a Water and Energy Efficiency Project. COIC’s proposal includes a change in their point of delivery from its existing location at river mile 4.5 on Icicle Creek to a location several miles downstream. COIC’s current intake is shared with the Leavenworth National Fish Hatchery (LNFH), funded by Reclamation as mitigation for construction of Grant Coulee Dam. This project will also convert the existing open ditch to pressurized pipe.

The Icicle Work Group was formed in December 2012 to “find collaborative solutions for water management within the Icicle Creek drainage” while meeting the various needs and interests within the basin. The Icicle Work Group has made great progress and has developed a strategy that will result in lasting solutions in the basin. Chelan County and Washington State’s Department of Ecology’s Office of Columbia River completed a Final Programmatic Environmental Impact Statement (FPEIS) in 2019, prepared in compliance with Washington’s State Environmental Policy Act (SEPA) with Chelan County and Ecology as co-lead agencies. The Plan’s preferred alternative identifies a mix of projects to achieve water supplies and instream flows. COIC’s irrigation efficiency project is included in this preferred alternative and is a critical component of our long-term strategy.

The Icicle Work Group is made up of a diverse set of stakeholders including all four major water right holders within Icicle Creek: City of Leavenworth, Icicle-Peshastin Irrigation District, Cascade Orchard Irrigation Company and the Leavenworth National Fish Hatchery (funded by
the Bureau of Reclamation and managed by the U.S. Fish and Wildlife Service). Members also include federal, state and local agencies, Tribes and environmental organizations.

We hope that Reclamation will support this project and the efforts of the Icicle Work Group. The workgroup values the opportunity to cost share on this conservation and efficiency project to address water supply needs in the Icicle Basin.

Please let us know if we can provide any additional information.

Thank you for your consideration.

Sincerely,

[Signatures]

C. Thomas Tebb, L.H.g., L.E.G.
Director, Office of Columbia River
Co-convener, Icicle Work Group

Mike Kaputa, Director
Chelan County Natural Resource Dept.
Co-convener, Icicle Work Group

GT:cms (200908)
September 10, 2020

To: Ned Weakland  
Bureau of Reclamation  
Financial Assistance Support Section  
PO Box 25007, MS 84-27815  
Denver, CO  80225

RE: Cascade Orchard Irrigation Company Irrigation Efficiency and Pump Exchange Project

Dear Mr. Weakland:

On behalf of the US Fish and Wildlife Service, and specifically as the Manager of the Leavenworth Fisheries Complex which includes the Leavenworth National Fish Hatchery (LNFH), I am submitting this letter of support for the Cascade Orchard Irrigation Company’s (COIC) application to the Bureau of Reclamation’s WaterSMART grant program for a Water and Energy Efficiency Project. This project will convert the existing open ditch water delivery system to a pressurized pipe system and change the point of delivery from its existing location at river mile 4.5 on Icicle Creek to a location several miles downstream. The change in diversion location and conversion to a pressurized system will yield immediate instream flow benefits to Icicle Creek.

The LNFH, funded by Reclamation as mitigation for construction of Grand Coulee Dam, currently shares with COIC the unscreened water intake system. The LNFH is working with Reclamation to remove the intake system and replace it by May 2023 with an intake system that is fully compliant with the National Marine Fisheries Service’s fish screening criteria. The new intake system for the hatchery however has been designed and scheduled with the assumption that the COIC project will be successful in changing their point of diversion prior to completion of the new intake system for LNFH (no longer shared with LNFH). Therefore, successful and timely completion of the COIC project is integrally linked to the success of the new intake structure for LNFH.

The LNFH, along with Reclamation, is a member of the Icicle Work Group which formed in December 2012 to “find collaborative solutions for water management within the Icicle Creek drainage” while meeting the various needs and interests within the basin. The Icicle Work Group has made great progress and has developed a strategy that will result in lasting solutions in the basin. Chelan County and Washington State’s Department of Ecology’s Office of Columbia River completed a Final Programmatic Environmental Impact Statement (FPEIS) in 2019, prepared in compliance with Washington’s State Environmental Policy Act (SEPA) with Chelan County and Ecology as co-lead agencies. The Plan’s preferred alternative identifies a mix of
projects to achieve water supplies and instream flows. COIC's irrigation efficiency project is included in this preferred alternative and is a critical component of our long-term strategy.

The Icicle Work Group is made up of a diverse set of stakeholders including all four major water right holders within Icicle Creek: City of Leavenworth, Icicle-Peshastin Irrigation District, Cascade Orchard Irrigation Company and the LNFH. Members also include federal, state and local agencies, Tribes and environmental organizations.

I hope that Reclamation will support the COIC project and the efforts of the Icicle Work Group. Again, a successful COIC project is, by extension, an essential element of Reclamation and the U.S. Fish and Wildlife Service's LNFH effort to replace the existing and shared water intake structure on Icicle Creek. In addition, your support for the COIC project would greatly benefit the Icicle Work Group efforts to achieve water conservation goals that are critical to address water supply and instream flow needs in the Icicle Basin. Please let me know if you have any questions or need any additional information.

Thank you for your consideration.

Sincerely,

Jim Craig
Manager, Leavenworth Fisheries Complex

Cc:

G. Thomas Tebb, L.H.g., L.E.G.  Mike Kaputa, Director
Director Office of Columbia River  Chelan County Natural Resource Dept.
Co-convener, Icicle Work Group  Co-convener, Icicle Work Group
APPENDIX B

Alternatives Analysis Study -
Public Release Version, Cascade
Orchards Irrigation Company
ALTERNATIVES EVALUATION STUDY – PUBLIC RELEASE VERSION
CASCADE ORCHARDS IRRIGATION COMPANY

Prepared for
Cascade Orchards Irrigation Company
12786 Shore St
Leavenworth, Washington 98826

Prepared by
Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

Aspect Consulting, LLC
401 Second Avenue South, Suite 201
Seattle, Washington 98104

Washington Water Trust
1530 Westlake Ave N, Suite 400
Seattle, Washington 98109

December 2015
ALTERNATIVES ANALYSIS STUDY – PUBLIC RELEASE VERSION
CASCADE ORCHARDS IRRIGATION COMPANY

Prepared for
Cascade Orchards Irrigation Company
12786 Shore Street
Leavenworth, Washington 98826

Prepared by
Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

Washington Water Trust
1530 Westlake Avenue N, Suite 400
Seattle, Washington 98109

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Seattle, Washington 98104

December 2015
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<tr>
<td>afy</td>
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<tr>
<td>COIC</td>
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<tr>
<td>cfs</td>
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</tr>
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</tr>
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**Alternatives Analysis Study – Public Release Version**

**Cascade Orchards Irrigation Company**

**December 2015**
1 INTRODUCTION

This report summarizes an appraisal-level analysis of alternatives that would improve the Cascade Orchards Irrigation Company (COIC) delivery system. COIC operates a network of open ditches and pipelines that deliver water for irrigation to properties west of Icicle Creek and south of the Wenatchee River near Leavenworth, Washington. These facilities are supplied through an Icicle Creek diversion, which is shared with Leavenworth National Fish Hatchery (LNFH). LNFH is operated by the U.S. Fish and Wildlife Service (USFWS) for the U.S. Department of Reclamation (Reclamation) as mitigation for hydropower facilities on the Columbia River.

COIC's legal predecessors developed lands for irrigation near Leavenworth in 1901 by diverting water from Icicle Creek and developing infrastructure to irrigate up to 600 acres, and a subsequent water rights adjudication granted them the most senior water rights on Icicle Creek. In 1939 and 1940, COIC entered into three agreements with the U.S. government to allow an easement for the planned construction of LNFH, to share a surface water diversion on Icicle Creek, and to provide excess water to LNFH from the COIC water rights. Since that time, COIC and LNFH have shared a diversion at Icicle Creek river mile (RM) 4.5 and have jointly operated the diversion under the general understanding of these agreements.

The present-day COIC irrigation system delivers their 11.9 cubic feet per second (cfs) water right via about 2 miles of mostly unlined ditch following Icicle Creek Road to the northwest of Icicle Creek, and discharging into the Wenatchee River just upstream from its confluence with Icicle Creek. This alternatives analysis study seeks to evaluate COIC's water rights and water needs, identify alternatives for improved water delivery, and evaluate potential conservation and financial benefits for projects at COIC.

1.1 Background

Icicle Creek is a major tributary to the Wenatchee River and provides habitat for fish species listed under the Endangered Species Act (ESA), including Chinook salmon, bull trout, and steelhead. The primary out-of-stream water uses in the Icicle Creek Subbasin include irrigation, fish rearing at LNFH, and municipal use. Out-of-stream water use has reduced
flows in lower Icicle Creek and impacted passage and habitat conditions for ESA-listed species. Improving instream flows in lower Icicle Creek is one of the primary goals of resource managers and stakeholders in the Icicle Creek Subbasin.

In October 2014, Washington Water Trust (WWT) signed a Memorandum of Agreement to evaluate conservation alternatives and conduct a review of water rights for COIC. The intent was to provide technical information and water rights data to help inform a feasibility study for four improvement alternatives that would enhance flows in lower Icicle Creek. This analysis identifies instream flow benefits and construction costs for alternatives that would improve instream flows in Icicle Creek by replacing the COIC diversion on Icicle Creek with a pumped diversion on the Wenatchee River and/or improving the efficiency of the COIC delivery system.

WWT developed an initial suite of alternatives for this project prior to drafting this alternatives analysis report. At this time, these alternatives include the following:

- **Alternative 1:** A pressurized, on-demand system supplied via a pump station on the Wenatchee River or Icicle Creek that would replace the existing ditch system. The COIC portion of the diversion on Icicle Creek would no longer operate, and saved water would be protected by the Washington State Department of Ecology’s (Ecology’s) Trust Water Rights Program (TWRP).

- **Alternative 2:** A pressurized, on-demand system supplied via a pump station as in Alternative 1. The infrastructure would be sized to accommodate additional pumping and delivery to meet other COIC needs or deliver water to LNFH to help address some of their water supply concerns. The COIC portion of the Icicle Creek diversion would no longer operate, with saved water protected in the TWRP.

- **Alternative 3:** Use the existing infrastructure, while reducing seepage losses in the system via piping or lining of the open, unlined ditch. This alternative would have lower construction costs, but in turn may have fewer funding opportunities with less water available for protection. The COIC portion of the historical Icicle Creek diversion would continue to operate.

- **Alternative 4:** Evaluate COIC’s current water use patterns to identify efficiency improvement opportunities, landscaping changes, or other conservation measures that could create savings and that might make water available for future uses at COIC or
be marketed for municipal and/or mitigated uses. Alternative 4 would be considered in addition to Alternatives 1, 2, and 3.

Improving the COIC delivery system is one of several potential projects currently being evaluated by stakeholders within the Icicle Creek Subbasin. A stakeholder group, the Icicle Work Group (IWG), was convened two years ago by Chelan County Natural Resources Department and Ecology to take a comprehensive look at water resource management in the Icicle Creek Subbasin. The IWG consists of LNFH; federal, state, and local agencies; irrigation districts (including COIC); the City of Leavenworth; non-profit organizations (including WWT); environmental groups; and other stakeholders. The IWG is working to identify and evaluate projects to improve management of water in the Icicle Creek Subbasin and improve instream flow conditions in Lower Icicle Creek. This alternatives analysis was funded under a grant from Ecology's Office of the Columbia River. Projects endorsed by the IWG are collectively intended to meet the following nine Guiding Principles:

1. **Streamflow that:**
   - Provides passage
   - Provides healthy habitat
   - Serves channel formation function
   - Meets aesthetic and water quality objectives
   - Is resilient to climate change

2. **Sustainable hatchery that:**
   - Provides healthy fish in adequate numbers
   - Is resource efficient
   - Significantly reduces phosphorus loading
   - Has appropriately screened diversion(s)
   - Does not impede fish passage

3. **Tribal Treaty and federally-protected fishing/harvest rights are met at all times.**

4. **Provide additional water to meet municipal and domestic demand.**

5. **Improve agricultural reliability that:**
   - Is operational
   - Is flexible
- Decreases risk of drought impacts
- Is economically sustainable

6. Improve ecosystem health, including protection and enhancement of aquatic and terrestrial habitat.
7. Comply with state and federal law.
8. Protect Non-Treaty Harvest.

Improvement of the COIC delivery system would meet multiple prongs of the IWG Guiding Principles. This project has the potential to do the following:

- Restore up to 11.9 cfs of flow to lower Icicle Creek by relocating the diversion to the Wenatchee River (Guiding Principle No. 1).
- Assist in providing a sustainable hatchery by conveying additional water supplies to the hatchery (Guiding Principle No. 2).
- Conserve water by reducing consumptive use, which could be used to improve municipal and domestic water demand (Guiding Principle No. 4).
- Improve the reliability of water supply for agriculture within the COIC service area (Guiding Principle No. 5)
- Potentially benefit habitat (Guiding Principle No. 6) and Treaty and Non-Treaty Harvest (Guiding Principles No. 3 and No. 8) by improving flows in lower Icicle Creek.

1.2 Scope of Work

The scope of this study is to provide initial technical information for the alternatives described previously, which are intended to reduce surface water diversions from Icicle Creek by improving efficiency and/or replacing the existing surface water diversion with a pumped diversion on the Wenatchee River. WWT contracted with Anchor QEA, LLC, to provide technical support and coordination for this analysis. The following elements were completed as part of the scope of this analysis.
1. Collection and Review of Background Information

- Anchor QEA and WWT worked with COIC and others to collect and review critical project information, including information on the existing COIC system, topography, water rights documentation, flow data, and GIS data.
- Anchor QEA and WWT identified additional information needed to complete this analysis and met with COIC to discuss the project and data needs.

2. Summary of Existing Needs and Conditions

- Anchor QEA worked with WWT and others to perform field investigations to better understand existing water use, water needs, efficiency, and existing delivery system conditions.
- Anchor QEA worked with WWT to identify design constraints, COIC’s irrigation and water supply needs, and water delivery challenges.
- Anchor QEA and WWT prepared a written summary of the existing COIC irrigation system, water supply needs, and delivery system conditions, included in Section 2 of this report.

3. Evaluation of the Alternatives

- The primary objectives of this project were to evaluate three potential efficiency improvement alternatives and to review potential savings realized from reduced water use plants on individual properties.
- Anchor QEA and WWT worked with COIC and other stakeholders to complete the following for each alternative:
  - An analysis of Wenatchee River hydrology to inform feasibility for pumping from the Wenatchee River
  - A hydraulic analysis to evaluate hydraulic profiles, pressures, and sizes of pipes and pumps
  - A list of major materials and estimated quantities for each alternative
  - A preliminary Opinion of Probable Construction Costs and a life cycle cost analysis to evaluate the present value of long-term operating costs, such as power, operations, and maintenance costs
  - A summary table comparing and contrasting the alternatives
4. **Preparation of a Summary Report**

   - This report summarizes the results of the alternatives analysis.

### 1.3 Purpose

This analysis aims to evaluate opportunities and constraints for the above-listed COIC delivery system improvement alternatives. Goals of the alternatives analysis include the following:

- Evaluate efficiency improvement alternatives for the COIC delivery system.
- Provide a basis for comparing the costs, benefits, opportunities, and constraints of the alternatives.
- Summarize the analysis in enough detail to enable COIC and other stakeholders to weigh the alternatives, plan for future improvements, and pursue funding for an improvement project.

Participating in the study does not obligate COIC in any way to proceed with an improvement project. However, WWT anticipates that the information provided will inspire a careful evaluation of the alternatives and whether they match the long-term interests and goals of COIC water users. Conservation projects that benefit fish, wildlife, and other natural resources can be translated into funding proposals to finance system upgrades and provide additional financial incentives to COIC.
2 EXISTING CONDITIONS

2.1 Description of Existing Facilities

The COIC service area is located in Chelan County, Washington, south of the town of Leavenworth, as shown in Figure 2-1. COIC conveys water to customers for irrigation primarily through a system of open, unlined ditch and closed lateral pipelines. The existing ditch system and service area are shown on Figure 2-2. This section provides a brief description of existing facilities, from the diversion at Icicle Creek to the tailwater at the Wenatchee River, and identifies some operational challenges and deficiencies associated with the existing delivery system.

2.1.1 Shared Diversion with LNFH

COIC diverts surface water through diversion facilities on the left bank (looking downstream) of Icicle Creek, approximately 4.5 miles upstream of the confluence of Icicle Creek and the Wenatchee River. Diversion facilities are shared with LNFH and were constructed in the early 1940s under agreements between COIC and the U.S. government, established with the development of the hatchery. The facilities are designed to divert up to 54 cfs, which is equal to the combined total of the instantaneous surface water rights for COIC and LNFH. The diversion facilities consist of the following:

- A reinforced concrete diversion dam spanning Icicle Creek, and a fish ladder
- A reinforced concrete headgate structure (with a debris rack) that diverts water to a reinforced concrete channel constructed on the left bank of Icicle Creek
- A small control shed where the canal transitions to a buried pipeline
- Approximately 1,200 to 1,300 feet of buried pipeline extending from the control shed to a bifurcation structure near a campground on Icicle Road

Photographs 1, 2, and 3 in Appendix A show the shared diversion facilities on Icicle Creek.
Figure 2-1
Location Map
Alternatives Analysis Study
Cascade Orchards Irrigation Company

SOURCE: Basemap prepared from Chelan County GIS Data
HORIZONTAL DATUM: Washington State Plane North, NAD 83
2.1.2 Bifurcation, Screening, and Measurement Structure

A bifurcation structure on the left bank of Icicle Creek splits the flow of water conveyed to COIC from water conveyed to LNFH near a recreational vehicle campground on Icicle Road. The structure consists of a buried valve with an exposed hand-wheel actuator. The valve is housed in a concrete masonry unit structure with a wood and metal cover that opens to provide access to the hand-wheel. The valve is opened to divert water from the pipeline to an open reinforced concrete structure adjacent to the valve enclosure. Water rises through an opening in the bottom of the structure.

An overflow pipe allows for water and fish to spill from the structure back to Icicle Creek. A rotating drum fish screen in the structure prevents fish from passing into the irrigation system. The screen is powered by a paddle wheel that rotates in the water downstream of the screen. The fish screen and paddle wheel are operational, but are aging, outdated, and in need of upgrading. The reinforced concrete structure is also deteriorating.

Downstream of the paddle wheel, water flows over a small suppressed rectangular weir. A staff gage upstream of the weir is read daily during the irrigation season and the flow rate is determined based on a rating curve for the weir. Downstream of the weir, water flows through a debris rack into a 24-inch-diameter steel pipeline. The valve enclosure, bifurcation structure, screening, and weir facilities are shown in Photographs 4 through 8 in Appendix A.

2.1.3 Pipeline to Sleeping Lady

A 24-inch-diameter welded-steel pipeline conveys water through the campground to an outlet on the parcel occupied by the Sleeping Lady Resort. The pipeline is approximately 1,180 feet long and, for most of its length, is installed slightly above the existing ground level. The pipe is supported by regularly spaced reinforced concrete supports. The pipeline and supports appear to generally be in good condition. The pipeline is shown in Photograph 9 in Appendix A.
2.1.4 Open Ditch

From the Sleeping Lady Resort to the tailwater pipeline at the downstream end of the COIC system, water is conveyed mostly through an open, unlined ditch. The ditch is approximately 1.9 miles long and has an average slope of approximately 0.0011 feet per foot of length. The ditch is typically about 8 to 10 feet wide and 1 to 2 feet deep, with heavily vegetated ditch banks. Most of the ditch runs through natural pine forest. However, seepage from the ditch also appears to support a healthy mix of cottonwood trees and other riparian plants. Photographs 10, 11, and 12 in Appendix A show typical sections of the open ditch.

2.1.5 Culverts

The ditch passes through several culverts. Culverts typically consist of buried concrete, corrugated metal, or plastic pipe installed at locations where roads and driveways cross the ditch. Some typical culverts are shown in Photographs 13 and 14 in Appendix A.

2.1.6 Turnouts

Several turnouts were observed along the open ditch. These turnouts typically deliver water to properties adjacent to the ditch and consist of a screened pump intake or a screened pipe inlet. Photographs 15 and 16 in Appendix A show examples of turnouts located on the open ditch bank.

2.1.7 Laterals

The COIC delivery system also includes a series of laterals that extend east from the open ditch into the valley. The laterals primarily serve properties east of Icicle Road and are generally aligned with existing roadways. The laterals consist of closed, 6-inch-diameter pipelines that operate under pressure resulting from the difference in elevation between water level in the open ditch and the lateral. The laterals range in length from 500 feet to more than 3,400 feet and are typically supplied through some type of small, wooden, screened structure on the ditch bank. Photographs of lateral intake structures on the open ditch are shown in Photographs 17 and 18 in Appendix A.
2.1.8 Tailwater to Wenatchee River

Excess water conveyed through the open ditch is spilled to the Wenatchee River through a pipeline that discharges to the right bank of the Wenatchee River approximately 0.7 miles upstream of its confluence with Icicle Creek. The open ditch conveys water to the pipeline at a small reinforced concrete structure with a debris rack adjacent to Icicle Road. The pipeline is approximately 270 feet long. A staff gage located upstream of the inlet structure in the open ditch provides a way for the ditch rider to monitor and manage the spill. The inlet structure at the tailwater pipeline is shown in Photograph 19 in Appendix A.

2.2 Operational Challenges and Deficiencies

Like other irrigation systems built in the first half of the 20th century, COIC’s infrastructure is aging and requires frequent repairs and regular maintenance. Although the system is well maintained, additional upgrades will likely be needed in the near future to repair and replace deteriorating infrastructure, improve efficiency, and improve operations and maintenance (O&M). The following sections identify some key deficiencies that will likely need to be addressed.

2.2.1 Shared Diversion, Bifurcation, Screening, and Measurement

The shared diversion with LNFH is aging, and it is anticipated that the facilities will require improvement in the near future. The USFWS and Reclamation have identified the need to upgrade the diversion and anticipate that they will be required to replace the facilities to meet current fish passage and screening guidelines. Although COIC operates a fish screen and bypass within their portion of the bifurcation structure, the fish screen is outdated and would likely need to be updated or replaced with screening closer to the point of diversion. When USFWS and Reclamation are required to replace the diversion facilities, COIC’s share in the cost of those upgrades is likely to represent a major expense, unless another water supply alternative is adopted.

The existing diversion, bifurcation, screening, and measurement facilities are also outdated and deteriorating. None of the equipment is automated. Some of the concrete is spalling and cracking. Repairs and maintenance associated with an aging facility can be expected to increase until the facilities are replaced.
2.2.2 Open Ditches and Culverts

Water is lost through seepage and evaporation from the open, unlined ditch. However, a seepage analysis summarized in Section 3 indicates that seepage and evaporation losses are low in comparison to other ditch systems of similar size and configuration. Open ditches are also subject to leaks and failure, especially where located on the side of a steep hill or in a slide area. The COIC ditch is generally not located on steep hillsides or in slide areas that are at a high risk of failure, and so ditch failures have not historically been an issue.

Significant maintenance is required each fall and spring to clean and prepare open ditches for the irrigation season. To keep the ditch operating at capacity, COIC has to remove fallen trees, trim vegetation, and remove sediment from the ditch. Because most of the ditch is surrounded by trees, cleaning and maintenance can be challenging, especially following a stormy winter, when large volumes of trees, branches, and debris have to be removed from the ditch before it can be filled with water.

2.2.3 Laterals and Turnouts

Lateral pipelines and turnouts typically have to be screened to keep out needles, twigs, leaves, and other floating debris. Cleaning and maintenance of screening facilities is required to maintain capacity and operation. Turnout screens are typically maintained by the water users, while lateral intake facilities and pipelines are maintained by COIC. COIC has indicated that the lateral pipelines range in age, condition, and material. Lateral pipelines were installed and replaced over several years and the type and condition of lateral pipe is not known for all of the laterals. Laterals occasionally leak or break and require repair. Locating the pipe and finding the appropriate fitting and repair equipment can be a challenge and results in interruptions to service.
3 WATER SUPPLY NEEDS

3.1 Existing Water Use

COIC measures water entering and exiting the system using weirs. The upper weir is located just downstream of the COIC-LNFH bifurcation, and the lower weir is located just upstream of the point where COIC tailwater discharges to the Wenatchee River. Diversion statistics for the upper weir (water measured entering the system) for 2011 through 2014 are summarized in Table 3-1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Irrigation Season (days)</th>
<th>Average Diversion¹ (cfs)</th>
<th>Peak Average Daily Diversion¹ (cfs)</th>
<th>Total Annual Diversion (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>171</td>
<td>6.0</td>
<td>8.0</td>
<td>2,046</td>
</tr>
<tr>
<td>2012</td>
<td>167</td>
<td>6.5</td>
<td>6.8</td>
<td>2,109</td>
</tr>
<tr>
<td>2013</td>
<td>169</td>
<td>5.9</td>
<td>7.7</td>
<td>1,935</td>
</tr>
<tr>
<td>2014</td>
<td>168</td>
<td>6.1</td>
<td>6.6</td>
<td>2,001</td>
</tr>
</tbody>
</table>

Notes:
COIC = Cascade Orchard Irrigation District
cfs = cubic feet per second
1 Diversions are from Ecology’s records and represent flows measured by COIC at the weir in the bifurcation structure.

In Table 3-1, the Peak Average Daily Diversion represents measurements by COIC at the weir below the LNFH bifurcation. The Average Diversion rate was calculated by dividing the sum of the Peak Average Daily Diversion values by the number of days in the irrigation season. The Total Annual Diversion was calculated as the sum of water diverted in each day of the irrigation season using the conversion formula that 1 cfs diverted for 24 hours is equal to 1.98 acre-feet. Table 3-1 should not be taken as the only source of quantifying potential maximum instantaneous demand of the water right. Peak flow rates could be higher under transient conditions such as during the peak hours of use on hot days or during initial season canal activation. In addition, as mentioned elsewhere in this document, COIC has a contract with Reclamation to deliver excess water to LNFH, which would occur above the bifurcation.
WWT worked independently with COIC to provide an internal assessment of the validity and extent of their water rights. This is included in a great deal of detail in a report provided to COIC. The methods included review of geospatial data to determine actual use of water on COIC to help for their planning purposes, application of Ecology guidance documents to validate and quantify their water rights, and completion of a seepage loss study to help inform the various alternatives. WWT is not an arbiter of water rights, and the final quantification of their water rights can only be validated via application of state law through subsequent change applications with Ecology. While many of the details of this analysis are still under legal review by COIC’s legal counsel, WWT nevertheless found strong evidence of beneficial use of water by COIC up to and including their historical rights as documented by adjudicated Certificate No. 1 on Icicle Creek and subsequent change applications. All of these are a matter of public record, and should be taken as the current quantities for water rights at COIC.

WWT worked with Blue Water GIS to complete an evaluation of COIC’s on-property water use and estimate current extent of beneficial use on properties served by the water right. The evaluation was completed using ARCGIS data for parcels assessed by COIC from Chelan County Assessor’s parcel database and 2009 and 2013 aerial photography from the National Agriculture Imagery Program (NAIP). The following methodology was used:

1. Blue Water GIS grouped contiguous parcels listed under the same owner to facilitate evaluation of the data by landowner.

2. Blue Water GIS delineated irrigated areas based on whether areas appeared to be irrigated in aerial photographs. Approximately 1,100 acres were reviewed and 280 separate polygons were delineated representing discrete lawn, pasture, or crop areas using 2009 and 2013 NAIP aerial photographs. An assumed crop type (mostly grass/lawn) was assigned to each area and one of the following levels of confidence were assigned to each delineated area for each aerial photograph:
   - Low = “Possible” irrigation, not necessarily green, but including any type of field showing evidence of recent cultivation
   - High = “Likely” irrigation, partial or some green denoting irrigation

3. Blue Water GIS intersected the delineated irrigated areas with the layer of parcels grouped by landowner and deleted all polygons with no owners and less than 0.1 acre.
of irrigated area. The result was a GIS database with irrigated acreage estimated for each landowner by crop type and confidence level.

4. Blue Water then imported the GIS database file into Microsoft Access to query the data and exported the data tables into Microsoft Excel for further analysis.

The results of this analysis are confidential because they contain sensitive information regarding beneficial use of the water rights. However, WWT found considerable evidence supporting the validity of COIC water rights and subsequent beneficial use in line with the original intent as listed in the water right certificates and subsequent changes. Current active certificates authorize an 11.9 cfs water right for service to up to 600 irrigated acres, with additional considerations outlined in 1940 change applications and documented by 1939 agreements with the U.S. government, which address the shared diversion and delivery system with the LNFH.

3.2 Water Rights Evaluation

As a disclaimer, authors of this report are not arbiters of water rights in the state of Washington. Authority for adjudicating or determining the extent and validity of water rights is reserved only to superior courts, Ecology, or other entities with jurisdiction under Washington State law. None of the material provided in this section, or elsewhere in this report, is either given or intended to be construed as legal advice. All water rights holders are encouraged to consult an attorney with a specialization in water law in Washington State when making decisions about their water rights.

COIC operates an irrigation delivery system serving water rights for up to 600 irrigated acres in the lower reaches of Icicle Creek Subbasin in the Wenatchee River Watershed. Ditch facilities were constructed in soils composed primarily of granitic sand and fluvially reworked volcanic deposits. Icicle Creek drains a large alpine basin, including numerous lakes, some of which are used as irrigation reservoirs. The lower reaches of the Icicle Creek Subbasin offer a beautiful environment, supporting year-round recreational activities, and a home to resorts and the renowned destination town of Leavenworth, Washington.
The 1929 Icicle Creek water right adjudication awarded COIC the only Class I water right, with a 1905 priority date. Land use has changed over the years from mixed agriculture to domestic lawn and garden with some agriculture. The most notable change in the area came about shortly after this adjudication, with the establishment of LNFH on approximately 150 acres of historical floodplain that was originally part of the Cascade Orchards plat. The U.S. Department of the Interior, through the U.S. Bureau of Reclamation (Reclamation), contracted with COIC to purchase land and water rights. The intent of Reclamation's interest in locating a hatchery in the upper Wenatchee River drainage was to mitigate for the impact of the Grand Coulee Dam on the salmon fisheries in the Columbia River system. Surface water rights obtained for LNFH from the Wenatchee River were later transferred to Icicle Creek for LNFH operations, though LNFH subsequently discontinued the use of Wenatchee River water for hatchery operations. COIC's current water rights are summarized in Table 3-2.

Table 3-2
COIC Water Rights

<table>
<thead>
<tr>
<th>Document Number</th>
<th>Priority Date</th>
<th>Qj (cfs)</th>
<th>Qa (acre-feet)</th>
<th>Area (acres)</th>
<th>Place of Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4-*35001JWRIS</td>
<td>01/01/1905</td>
<td>12</td>
<td>Not listed</td>
<td>600</td>
<td>See Figure 2-1</td>
<td>Class 1 water right on Icicle Creek, Changed by Certificate of Change No S4-CV1P170</td>
</tr>
<tr>
<td>S4-CV1P170</td>
<td>07/06/1940</td>
<td></td>
<td></td>
<td></td>
<td>Change to Icicle Creek Certificate No. 1.</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
COIC = Cascade Orchard Irrigation District
Qa = annual water right withdrawal volume
Qj = instantaneous water right withdrawal limit

3.2.1 1905 – Adjudicated Water Right Certificate No. S4-*35001JWRIS
The 1929 Icicle Creek Water Right Adjudication Decree authorized COIC the diversion of up to 12.0 cfs from Icicle Creek for the irrigation of 600 acres within "Cascade Orchards, according to the official plat thereof on file in the office of the County Auditor of Chelan County." The only Class I water right on Icicle Creek, Icicle Creek Certificate No. 1
Water Supply Needs

("S4-*35001JWRIS")\(^1\) cites a point of diversion (POD) located in the SE \(\frac{1}{4}\), NE \(\frac{1}{4}\), Section 27, T 24 N, R 14 EWM.\(^2\) The water right priority date is 1905. The irrigation season identified in the Report of Referee is somewhat ambiguous. It states that “Some of the lands irrigated from Icicle Creek do not require irrigation before May 1st, while on other lands water is applied about April 15th and some years even earlier. The irrigation season on all lands extend to September 15th.”

### 3.2.2 Authorized Changes to S4-*35001JWRIS (S4-CV1P170)

S4-CV1P170 was a change to S4-*35001JWRIS authorized July 6, 1940, and changes the purpose and place of use for a 0.10 cfs portion of the Water Right (and 0.103 cfs of Surface Water Claim No. 006167), as follows:

0.1 cfs appurtenant to the following described lands for irrigation S\(\frac{1}{2}\) Lot 10, Block 6, Cascade Orchards, Section 23, T 24 N, R 17 EWM and Lot 5, Block 1, First Addition to Cascade Orchards, Section 26, T 24 N, R. 17 EWM and 0.103 cfs now appurtenant to certain lands for irrigation, which make up a right-of-way for a canal and fish rearing ponds in Section 23, T 24 N, R. 17 EWM, more particularly described in a contract between the USA and the COIC, dated November 6, 1939.

Certificate of Change No. S4-CV1P170 authorized a change in the place of use (POU) and purpose for 0.203 cfs of water from Icicle Creek from irrigation to “a supply for fish hatchery, rearing ponds and appurtenant facilities, and domestic use.” It is possible that 0.1 cfs of the water is authorized under S4-*35001JWRIS and 0.103 cfs is not; the 0.103 may be appurtenant to lands not included in the Cascade Orchards plat. This would explain the existence of Water Right Claim No. 006167, described below. The Purpose of Use for this

\(^1\) S4-*35001JWRIS is a filing nomenclature used by the Washington Department of Ecology to organize water rights into a coded tracking system, beginning in 1972 with the Water Rights Information System (WRIS) and migrated into an updated “Water Rights Application Tracking System” (WRATS) in 1995. Icicle Creek Certificate No. 1 is filed under the WRATS system as S4-*35001JWRIS.

\(^2\) A note on the water right certificate (and confirmation on map) confirms that Range 14 was listed in error and this POD is in fact in Range 17.
portion of the water right is to "supply for fish hatchery, rearing ponds and appurtenant facilities and domestic use on the following described property."

It should be noted that this change leaves 11.9 cfs for COIC. Ecology’s Water Rights Acquisition Tracking System (WRATS) database lists COIC’s water right as allowing for diversion of up to 11.9 cfs and 2064.5 acre-feet per year (afy) for the irrigation of 600 acres with a year-round period of use. The basis for Ecology’s assignment of 2064.5 acre-feet in WRATS is unknown. Ecology has not made a tentative determination of the extent and validity of this water right after it was adjudicated and so the assignment of this quantity is not likely binding in any way.

3.2.3 2004 – Application for Change No. CS4-ADJ35P1
The information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.2.4 Water Right Claim No. 006167 (54-006167CL)
The information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.2.5 Additional changes to the Water Rights
The information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.2.6 Contracts with LNFH (U.S. Government)
The information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.2.7 Discussion
3.2.7.1 Adjudicated Water Right Certificate No. S4-35001JWRIS
The state quantifies water rights in instantaneous water right withdrawal limit (Qi) and annual water right withdrawal volume (Qa) amounts based on a duty for the region
reflecting the climate, soil, and crop type. While the annual quantity for COIC’s adjudicated water right was not elucidated in the decree, the Report of Referee did quantify the instantaneous water duty for the right at 1 cfs per 50 acres of land, which equates to 12 cfs for 600 acres. Diverting 12 cfs over a 180-day irrigation period, April 15 through September 15, would yield 4,276.8 acre-feet ($12 \times 180 \times 1.98 = 4276.8$), a duty of 7.128 acre-feet per acre (afa).

After being changed to provide water for the hatchery, S4-*35001JWRIS now authorizes the diversion of 11.9 cfs and 2,064.5 afy for the purpose of irrigation on 600 acres according to Ecology’s records. As stated previously, the basis for Ecology establishing this annual quantity in WRATS is unknown, and the assignment of 2,064.5 acre-feet for this water right is not likely to be binding absent a tentative determination of the extent and validity of this water right. Note that the adjudicated right reflects a debit of 0.10 cfs, but Certificate No. CS4-CV1P070 authorized the change of 0.203 cfs. The source of the additional 0.103 cfs is unclear.

Additional information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.2.7.2 Water Right Claim No. 006167 (S4-006167CL)

The information provided by WWT in this section is not publicly available, so it is not further described in the public version of this report.

3.3 Existing Conveyance Efficiency

Open ditch systems lose water through seepage and evaporation. The efficiency of an open, unlined ditch system varies based on the type of soil the ditch was constructed in, shading and vegetation, length of ditch, and ditch maintenance. Some open ditch systems in north central Washington operate at efficiencies less than 50%, meaning that more than half of the water diverted from the source is lost through seepage, evaporation, leaks, or spills before making it to water users’ turnouts for irrigation. The existing COIC ditch was evaluated to estimate the rate at which water is lost through seepage and to determine the efficiency of the COIC open ditch delivery system. This section summarizes the seepage loss analysis.
3.3.1.1 **Purpose and Methods**

The purpose of the seepage loss study was to provide information regarding potential ditch losses in COIC's unlined ditch supplied by the surface water right on Icicle Creek. On August 10, 2015, representatives from WWT, the Washington State Department of Fish and Wildlife (WDFW), Aspect Consulting, and Chelan County Natural Resources joined COIC president Dan Wilkinson to measure ditch flow rates and estimate losses on this system. The team used velocity meters and the cross sectional method for stream gaging. In this method, technicians divide the stream channel into numerous cross sections, measuring the width and depth of each subsection. The width and depth of each subsection are multiplied to estimate the area. Hand-held velocity meters are then used to determine the average velocity of the water in each subsection. The flow rate in each subsection is then calculated as the product of the area and the measured velocity, and the flow rates of each subsection are totaled to determine the overall flow rate at that cross section of the stream or ditch.

Ditch losses were estimated by comparing flows measured at different cross sections along the open ditch from the upstream end to the downstream end. Measurements were made during a single day. Prior to completing flow measurements, all water users were notified by letter to turn off their systems so that there would not be any withdrawals from the open ditch system, though it is possible that some use was still occurring, for example, where users had their sprinkler systems on timers and failed to turn them off. During the seepage analysis, a technician from Aspect Consulting collected GPS data for the major components of the COIC system, which were used to develop the map shown in Figure 2-1.

3.3.1.2 **Results**

Two teams completed measurements at five locations along the open ditch. Though all of those performing measurements had experience doing cross-sectional flow measurements, two different types of flow meters were used, resulting in some inconsistency between the readings. It should be noted, however, that the weir at the top of the COIC system, which is periodically calibrated, was measuring 6.0 cfs during the study, or about the average amount between the two sets of readings. Therefore, it is likely that the flows at each point in the system were within 0.4 cfs of the actual reading, or about a 7% error.
The purpose of the exercise was to determine and compare the ditch loss to the overall flow rate diverted. Ditch losses and the percentage of loss in a reach of the ditch were then estimated by comparing the numbers from the same team down the canal. As can be seen in Table 3-3, the losses measured by the two teams were 0.26 cfs and 0.32 cfs of loss from the top of the system down to the Wilkinson property, just upstream of Shore Street. The ditch was observed to be overflowing at Shore Street. Consequently, the measurements completed at the downstream end of the system do accurately reflect seepage loss. The ditch cross section appears to be tapered at the lower end and is not sized to convey the flow rates that were measured during the seepage analysis. Flow rates are typically lower at the end of the ditch due to irrigation withdrawals upstream.

**Table 3-3**

**COIC Seepage Analysis Summary**

<table>
<thead>
<tr>
<th>Location</th>
<th>Team 1&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Team 2&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured Flow (cfs)</td>
<td>Total Gain/(Loss)&lt;sup&gt;3&lt;/sup&gt; (cfs)</td>
</tr>
<tr>
<td>Top Weir</td>
<td>5.61</td>
<td>-</td>
</tr>
<tr>
<td>Bayne Property</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wilkinson Property</td>
<td>5.35</td>
<td>0.26</td>
</tr>
<tr>
<td>Shore Street</td>
<td>5.36</td>
<td>0.25</td>
</tr>
<tr>
<td>DS End of Open Ditch&lt;sup&gt;4&lt;/sup&gt;</td>
<td>4.80</td>
<td>0.81</td>
</tr>
</tbody>
</table>

**Notes:**
cfs = cubic feet per second  
COIC = Cascade Orchard Irrigation District  
DS = downstream  
1 Staff from Washington Water Trust/Washington Department of Fish and Wildlife  
2 Staff from Chelan County Natural Resources Department  
3 Represents water loss measured from Top Weir to measurement location.  
4 The loss measured below Shore Street was largely due to ditch overtopping, which occurred because the downstream end of the ditch is not sized to accommodate the flow rates that were being conveyed under Shore Street.

The results of the seepage loss study suggest that seepage losses are relatively small. The first team measured a 4.6% loss from the bifurcation to the Wilkinson property. The second team measured a 4.9% for the same segment of the ditch, which includes approximately 1.6 miles of the total 1.9 miles between the bifurcation and the tailwater pipeline. The variations in
measurements are within the margins of error of the measuring devices, and represent only very small losses. Further discussion is provided in Section 5 regarding the potential benefits and costs of improving the existing system by piping or lining (Alternative 3), rather than relocating the point of diversion to the Wenatchee River or some other point downstream (Alternatives 1 and 2). The seepage analysis suggests that simply piping or lining the existing ditch is likely to yield only 0.5 cfs of water savings. The analysis indicates that the open COIC ditch, although unlined, is operating at a high level of efficiency compared with other similar systems.

3.4 Consumptive Use and Water Supply Needs

The improvement alternatives evaluated in this study would include closed pipe systems (Alternatives 1 and 2) or piping or lining of the existing system (Alternative 3) that would improve efficiency of delivery. The improvements will need to be sized to allow COIC to continue to use their water rights to meet crop irrigation requirements, account for inefficiencies in water user irrigation systems, and account for any remaining inefficiencies in the COIC delivery system.

Crop irrigation requirements, assumed inefficiencies, and deliveries required for the existing COIC system were evaluated using methods and guidelines provided in Ecology Guidance Document 1210 (Ecology 2005). This guidance provides a means of using irrigated acreage, crop type, irrigation types, and regional crop use data to calculate estimated water use in an irrigated place of use. Authority for the use of this Guidance Document is granted to Ecology in making tentative determinations of the extent and validity of the beneficial use of water rights, as further codified under the Washington State Water Code under RCW’s 90.03.290, 90.03.380, and 90.44. 100, further implemented by Ecology Policy Numbers 1120 and 1210.

Beneficial use calculations provide instantaneous and annual quantity estimates of water rights based on available data and standards for calculations with the date provided in the Guidance and Policy Documents referenced above. As noted in Section 3.1, WWT used ArcGIS digitization services provided by Blue Water GIS to delineate potentially irrigated acreage.

Additional data provided to COIC by WWT in this section is not publicly available, so it is not further described in the public version of this report.
4 DESCRIPTION OF POTENTIAL IMPROVEMENT ALTERNATIVES

Four potential improvement alternatives have been identified for evaluation as part of this appraisal study. The first two alternatives would include replacing the existing gravity ditch and diversion system with a pressurized pump and pipe system. Table 4-1 summarizes the general characteristics and options associated with these three alternatives.

Table 4-1
Description of Potential Improvement Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Description</th>
<th>Water Supply</th>
<th>Water Delivery System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Replace existing system with a pressurized, on-demand, system supplied by a river pump station. Discontinue operation of COIC diversion. Put water into trust.</td>
<td>Replace existing gravity diversion facilities with a pump station on the Wenatchee River near the Icicle Road Bridge or on Icicle Creek near Shore Street.</td>
<td>Install pressurized delivery pipeline in alignment of existing ditch and replace existing laterals with new pipelines.</td>
</tr>
<tr>
<td>2</td>
<td>Replace existing system with a pressurized, on-demand, system supplied by a river pump station. Discontinue operation of COIC diversion. Put water into trust. Add capacity for other needs, such as fire protection, or supply for LNFH.</td>
<td>Replace existing gravity diversion facilities with a pump station on the Wenatchee River near the Icicle Road Bridge or on Icicle Creek near Shore Street.</td>
<td>Install pressurized delivery pipeline in alignment of existing ditch and replace existing laterals with new pipelines.</td>
</tr>
<tr>
<td>3</td>
<td>Improve existing infrastructure by piping or lining to improve efficiency.</td>
<td>Maintain operation of existing diversion.</td>
<td>Replace existing open ditch with gravity pipelines or line existing ditch. Existing laterals to remain.</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate consumptive use and identify opportunities to provide additional water savings via water user conservation.</td>
<td>Would be combined with Alternative 1, 2, or 3.</td>
<td>Would be combined with Alternative 1, 2, or 3.</td>
</tr>
</tbody>
</table>

Notes:
COIC = Cascade Orchard Irrigation District
LNFH = Leavenworth National Fish Hatchery
4.1 Alternative 1 – Pressurized System to Serve COIC Only

Alternative 1 would replace the existing COIC delivery system with a pressurized, on-demand system supplied by a pump station located near the confluence of the Wenatchee River and Icicle Creek. The proposed improvements that would be included as part of this alternative are shown conceptually in Figure 4-1.

4.1.1 Water Supply

Alternative 1 would change the POD for the COIC water supply to a surface water pump station located near the confluence of the Wenatchee River and Icicle Creek. The pump station would be designed as follows:

- **Location** – The pump station would likely be sited at one of the following locations:
  - On the right bank (looking downstream) of the Wenatchee River downstream of the Icicle Road Bridge and upstream of the existing tailwater discharge
  - On the left bank (looking downstream) of Icicle Creek near the end of Shore Street

- **Intake Configuration** – The intake would likely include an inclined screen intake or an intake screen manifold on the end of a suction pipe designed to meet current NMFS and WDFW guidelines. The intake would be designed to fit into the river bank and divert flows over a range of river flow conditions.

- **Wet Well/Intake Structure** – The intake would likely divert surface water into a reinforced concrete wet well for pumping. The pumps would be mounted above the wet well.

- **Capacity** – Three different supply capacities were evaluated to provide a range of design costs for consideration by COIC and other stakeholders. Table 4-2 summarizes the capacities that were evaluated.
### Table 4-2
**Alternative 1 – Water Supply Capacities Evaluated**

<table>
<thead>
<tr>
<th>Option</th>
<th>Capacity for COIC (cfs)</th>
<th>Capacity for LNFH/Other Uses (cfs)</th>
<th>Total Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
COIC = Cascade Orchard Irrigation District
LNFH = Leavenworth National Fish Hatchery

#### 4.1.2 Water Delivery System

Water would be delivered through a pressurized pipe system, consisting primarily of pressure-rated PVC irrigation pipe, valves, fittings, and other appurtenances. The main distribution pipeline would extend approximately 1.9 miles from the pump station to the property boundary between the Sleeping Lady Resort and the recreation vehicle campground on Icicle Road. The laterals would also be replaced by pressurized pipelines.

#### 4.2 Alternative 2 – Pressurized System to Serve COIC and Additional Demand

Alternative 2 would also replace the existing COIC delivery system with a pressurized, on-demand system supplied by a pump station located near the confluence of the Wenatchee River and Icicle Creek. The primary difference between Alternatives 1 and 2 is that Alternative 2 would include capacity to supply additional needs beyond just the COIC irrigation demand. Those needs might include water for fire protection, or excess capacity to supply LNFH to reduce their reliance on their surface water diversions from Icicle Creek.

For the sake of this study, it was assumed that additional capacity would be provided from the pump station to LNFH, although the place of use for the additional flow rates may vary depending on the type of additional use identified. The proposed improvements that would be included as part of this alternative are shown in conceptually in Figure 4-2.
4.2.1 Water Supply

Alternative 2 would change the POD for the COIC water supply to a surface water pump station located near the confluence of the Wenatchee River and Icicle Creek. The pump station would be designed as follows:

- **Location** – The pump station would likely be sited at one of the following locations:
  - On the right bank (looking downstream) of the Wenatchee River downstream of the Icicle Road Bridge and upstream of the existing tailwater discharge
  - On the left bank (looking downstream) of Icicle Creek near the end of Shore Street

- **Intake Configuration** – The intake would likely include an inclined screen intake or an intake screen manifold on the end of a suction pipe designed to meet current NMFS and WDFW guidelines. The intake would be designed to fit into the river bank and divert flows over a range of river flow conditions.

- **Wet Well/Intake Structure** – The intake would likely divert surface water into a reinforced concrete wet well for pumping. The pumps would be mounted above the wet well.

- **Capacity** – Two different supply capacities were evaluated to provide a range of design costs for consideration by COIC and other stakeholders. Table 4-3 summarizes the capacities that were evaluated.

<table>
<thead>
<tr>
<th>Option</th>
<th>Capacity for COIC (cfs)</th>
<th>Capacity for LNFH/Other Uses (cfs)</th>
<th>Total Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
COIC = Cascade Orchard Irrigation District
LNFH = Leavenworth National Fish Hatchery
4.2.2 Water Delivery System
Water would be delivered through a pressurized pipe system, consisting primarily of pressure-rated PVC irrigation pipe, valves, fittings, and other appurtenances. The main distribution pipeline would extend approximately 1.9 miles from the pump station to the property boundary between the Sleeping Lady Resort and the recreation vehicle campground on Icicle Road. The laterals would also be replaced by pressurized pipelines.

4.3 Alternative 3 – Upgrade Existing Gravity System
Alternative 3 would upgrade existing infrastructure to improve efficiency by piping or lining the existing unlined ditch. The COIC portion of the shared diversion facilities would continue to operate as they currently do. Potential upgrades are illustrated in Figure 4-3.

4.3.1 Water Supply
Alternative 3 would maintain the POD for the COIC water supply on Icicle Creek. The water supply would continue to be a shared facility with LNFH and COIC would likely be required to share in the maintenance and likely upgrade or replacement of those facilities with the USFWS and Reclamation to maintain supply to both COIC and LNFH.

4.3.2 Water Delivery System
The existing delivery system would continue to be used in its present configuration, except that unlined portions of the COIC ditch would be replaced with one of the following, or a combination of the two:

- **Gravity Pipeline** – A gravity pipeline would likely consist of corrugated high-density polyethylene or PVC pipe. The pipeline would be designed to be water tight, but would not be designed to operate under pressure. Existing lateral pipelines would remain and would be fed through connections to the proposed pipeline. The system would still require spilling of excess water at the existing tailwater location.

- **Lining** – Ditch lining would be installed over existing unlined ditch sections that would likely consist of a geomembrane liner with 3 inches of shotcrete topping. The liner would reduce seepage, but the ditch would still be open and would require cleaning and maintenance to remove trees, branches, and debris.
4.4 Alternative 4

Alternative 4 would identify water savings measures that could be implemented by water users to improve water use efficiency. Opportunities may include the following:

- **Water Efficient Landscaping** – Most of the properties that currently use COIC water for irrigation are rural residential lots. Although there is still limited agricultural use, most of the water is used to irrigate lawn, pasture, and small gardens. Replacement of lawn or other high water-use landscaping with native plants and low-water use landscaping would reduce consumptive use.

- **Improved Irrigation Efficiency** – Many of the properties that currently irrigate with COIC water use solid set or drip irrigation systems that are generally very efficient. COIC may wish to evaluate whether there are opportunities to help water users' who do not have efficient irrigation systems upgrade their facilities to improve water use efficiency and further reduce consumptive use.

- **Irrigation Timing** – COIC does not currently restrict or require water users to rotate the timing of irrigation. Because many of the parcels are residential and many of the homes are vacation homes, the peak weekend water demand in the summer is likely very high compared to overall average water demand. Encouraging members to stagger irrigation and to time their irrigation during the early morning hours and late evening hours could result in a reduced peak demand on the system and reduced evapotranspiration. In addition, some municipalities offer rebates and assistance to water users who want to purchase sprinkler timers, soil moisture meters, or other devices that allow water users to reduce overwatering.

This alternative is not intended to be a stand-alone alternative, but should be considered as an addition to Alternatives 1 through 3. This costs and benefits of this alternative have not been evaluated in detail, but this alternative is included for consideration because reducing consumptive use could result in water savings that could be used for future growth or marketed for other downstream water needs.
Beginning to Prowell Street
Replace Ex Open Ditch Section with
24" Ø Corrugated HDPE Gravity Pipe
or Line Ex Ditch with 3" Shotcrete
Over Geomembrane Liner

Proposed Gravity
Pipeline or Ditch Lining

Existing Open Ditch
Existing Closed Pipe
Existing Turnout
Existing Ditch Structure
Direction of Flow
Operational Spill

Legend:
Parcel
COIC Irrigated Area
Stream or River
Contours (10-ft Interval)

Scale in Feet

Wenatchee River
Wilson Street
Shore Street
Prowell Street
E Leavenworth Road
Fish Hatchery Road
Leavenworth National Fish Hatchery

Prowell Street to Tailwater
Replace Ex Open Ditch Section with
24" Ø Corrugated HDPE Gravity Pipe
or Line Ex Ditch with 3" Shotcrete Over Geomembrane Liner
5 ALTERNATIVES ANALYSIS

5.1 Water Supply Feasibility

Two options are proposed for future water supply for the COIC system. The options include replacing the existing surface water diversion shared with LNFH on Icicle Creek with a pumped diversion near the confluence of the Wenatchee River and Icicle Creek (Alternatives 1 and 2), or maintaining operation of the existing diversion (Alternative 3).

5.1.1 New Surface Water Diversion (Alternatives 1 and 2)

5.1.1.1 Wenatchee River Hydrology

Flows in the Wenatchee River are measured by the U.S. Geological Survey (USGS) at gages downstream of Leavenworth at Peshastin (Gage No. 12459000) and upstream of Leavenworth near Plain (USGS Gage No. 12457000). Flow exceedance hydrographs are included in Figures 5-1 and 5-2.

5.1.1.2 Icicle Creek Hydrology

The USGS also operates a gage (Gage No. 12458000) on Icicle Creek upstream of Snow Creek. The gage does not measure inflows to and diversion from Icicle Creek downstream of the gage, including the surface water diversions to Icicle and Peshastin Irrigation District (IPID) and COIC/LNFH, as well as inflow from Snow Creek and other smaller tributaries. Ecology has maintained a gage on (Gage No. 45B070) on Icicle Creek near the East Leavenworth Bridge. The gage was manually monitored from May 2007 to October 2010 and has been monitored continuously with telemetry since October 2010. Figure 5-3 illustrates the variation in flows on Icicle Creek at the East Leavenworth Bridge. These flows are similar to those that would be expected just upstream of the confluence of the Wenatchee River and Icicle Creek.

The primary areas of concern related to instream flows for Icicle Creek are downstream of the IPID and COIC/LNFH diversions and upstream of East Leavenworth Road. As a result, moving the existing diversion downstream to a point near the confluence of the Wenatchee River and Icicle Creek would allow for restoration of COIC’s full diversion flow rate to the critical reach on Icicle Creek.
Legend:

USGS Gage No.: 12459000
Period of Record: 1/1930 - Present

Figure 5-1
Daily Mean Flow Exceedance Probability
Wenatchee River at Peshastin
COIC Alternatives Analysis Study
Figure 5-2
Daily Mean Flow Exceedance Probability
Wenatchee River at Plain, WA
COIC Alternatives Analysis Study
Figure 5-3
Comparison of Annual Flow Variation
Icicle Creek near Leavenworth
COIC Alternatives Analysis Study
5.1.1.3 Geomorphology

To ensure long-term viability of the water supply from a surface water pump station, it is critical to understand both channel variability and transport of sediment and bedload at a proposed pump station location. In addition, the depth of water at the proposed pump location also has to be adequate for diversion of water over a wide range of flow conditions, including low late summer flow conditions.

Geomorphology of the Wenatchee River and Icicle Creek were reviewed near the confluence and two locations were identified where river conditions would likely be suitable for a surface water pump station:

- **Wenatchee River Near Icicle Road Bridge** – The COIC ditch discharges excess water back to the Wenatchee River just downstream of Icicle Road (Photographs 20 and 21, Appendix A). There river flows around a bed rock outcropping, on the right bank, between the Icicle Road Bridge and the existing tailwater discharge. The water on the right bank of the river is deep, even during low flow conditions, and would be suitable for pumping. Construction and access would be challenging at this location due to bed rock, steep slopes, and private property constraints.

- **Icicle Creek Near End of Shore Street** – Icicle Creek is easily accessible from the end of Shore Street. The creek bends to the east just downstream of Shore Street and there is a relatively deep pool on the outside of the bend near the left bank of the river (Photograph 22). The left bank is stabilized with exposed rock along the outside of the bend and large trees on the bank indicate that the creek channel is relatively stable at this location. The bank is lower and would provide more direct access to a pump station site than at the site on the Wenatchee River. The site is located on private property and would need to be evaluated further to assess the impact of sediment deposition and bedload movement. Sand deposition is occurring just upstream of the proposed site and a gravel bar is present across the creek from the site.

5.1.1.4 Screening

A river pump station facility would require fish screening consistent with NMFS and WDFW guidelines. Different types of screens are available for surface water diversions that meet NMFS and WDFW guidelines. In order to minimize maintenance, ensure performance, and
secure approval by WDFW, the screen would need to be self-cleaning. For the size and type of pumping facilities that would be required for the alternatives identified in this report, likely screen types would include:

- **Inclined Plate Screen** - An inclined plate screen would be equipped with an air-burst system or a mechanical brush for self-cleaning and would be installed on a structure built to match the river bank.

- **Traveling Water Screen** – A traveling water screen would rotate on a conveyor and lift debris out of the water to be removed with internal jets or a brush.

- **End-of-Pipe Screen** – A manifold of cylindrical or conical shaped screens could be installed on a suction line with internal spray, air-burst system, or brushes for self-cleaning. The screen and suction line would be submerged in the river and removed at the end of each irrigation season.

Table 5-1 provides a summary of likely fish screen sizing requirements for the range of flow rates evaluated for Alternatives 1 and 2.

<table>
<thead>
<tr>
<th>Design Flow Rate (cfs)</th>
<th>Maximum Approach Velocity (fps)</th>
<th>Effective Screen Area (ft²)</th>
<th>Screen Area with FOS (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.4</td>
<td>10.00</td>
<td>12.70</td>
</tr>
<tr>
<td>6</td>
<td>0.4</td>
<td>15.00</td>
<td>19.05</td>
</tr>
<tr>
<td>8</td>
<td>0.4</td>
<td>20.00</td>
<td>25.40</td>
</tr>
<tr>
<td>12</td>
<td>0.4</td>
<td>30.00</td>
<td>38.10</td>
</tr>
<tr>
<td>24</td>
<td>0.4</td>
<td>60.00</td>
<td>76.20</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
FOS = factor of safety, assumed to be 27%
fps = feet per second
ft² = square feet
5.1.2 **Maintain Existing Surface Water Diversion (Alternative 3)**

5.1.2.1 *River Hydrology*

Alternative 3 would maintain operation of the current diversion facilities on Icicle Creek. The facilities would be subject to the flow conditions and variations in flow that occur in Icicle Creek at the current diversion location. As noted previously, COIC has the first priority water right on Icicle Creek and COIC has generally had sufficient water supply, even under low flow conditions. However, flow conditions downstream of the diversion to East Leavenworth Road have impacted fish passage and habitat conditions, and there will continue to be pressure on water users to leave more flow in Icicle Creek to improve those conditions.

5.1.2.2 *Coordination with LNFH*

COIC shares and operates diversion facilities with LNFH under the agreements cited in Section 3 of this report. Continued operation of existing diversion facilities will require continued coordination with LNFH to ensure that water supply needs are met for both COIC and LNFH. LNFH is under increasing pressure to replace diversion facilities with facilities that meet current NMFS and WDFW guidelines for screen and fish passage. LNFH and Reclamation will likely be required to replace these facilities in the near future. COIC may likely be required to share in the cost of replacing these facilities and would be impacted by the work that would need to be done.

5.2 **Hydraulic Analysis**

Hydraulic analyses were completed to determine preliminary sizing for pumping facilities and delivery pipelines for the purpose of developing preliminary opinions of probable costs. The hydraulic analyses were based on the flow rates outlined in Section 4.
5.2.1 Alternatives 1 and 2

A spreadsheet analysis was used to estimate hydraulic losses and pumping requirements for the range of flow rates evaluated for Alternatives 1 and 2. The analysis used the following assumptions and criteria for pipe sizing:

- The Hazen-Williams formula was used to estimate hydraulic losses in delivery pipelines, with a Hazen-Williams coefficient, C, of 140.
- Delivery pipe was assumed to be pressurized PVC irrigation pipe.
- The analysis assumed an allowance for minor losses in bends, valves, pipe entrances, pipe exits, and other fittings equal to 10% of the friction loss in a reach of delivery pipeline.
- Pumps and pipe were sized to maintain pressures at the highest end of the system, near the recreation vehicle campground on Icicle Road, between 20 and 30 pounds per square inch.

Table 5-2 summarizes the results of the hydraulic analysis for Alternative 1. Facility sizing and configuration for Alternative 1 is shown in Figure 4-1.

<table>
<thead>
<tr>
<th>Item</th>
<th>4-cfs Capacity</th>
<th>6-cfs Capacity</th>
<th>8-cfs Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Station Design Flow</td>
<td>4 cfs</td>
<td>6 cfs</td>
<td>8 cfs</td>
</tr>
<tr>
<td>Pumping, TDH</td>
<td>183 feet</td>
<td>188 feet</td>
<td>192 feet</td>
</tr>
<tr>
<td>Main Line Sizing</td>
<td>6-inch to 15-inch</td>
<td>6-inch to 15-inch</td>
<td>6-inch to 18-inch</td>
</tr>
<tr>
<td>Main Line Pressures</td>
<td>20 psi to 73 psi</td>
<td>20 psi to 76 psi</td>
<td>20 psi to 77 psi</td>
</tr>
<tr>
<td>Lateral Sizing</td>
<td>6-inch to 8-inch</td>
<td>6-inch to 8-inch</td>
<td>8-inch to 10-inch</td>
</tr>
<tr>
<td>Lateral Pressures</td>
<td>31 psi to 64 psi</td>
<td>30 psi to 65 psi</td>
<td>34 psi to 67 psi</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
psi = pounds per square inch
TDH = Total Dynamic Head

Table 5-3 summarizes the results of the hydraulic analysis for Alternative 2. Facility sizing and configuration for Alternative 2 is shown in Figure 4-2.
Table 5-3
Summary of Hydraulic Analysis – Alternative 3

<table>
<thead>
<tr>
<th>Item</th>
<th>12-cfs Capacity</th>
<th>24-cfs Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Station Design Flow</td>
<td>12 cfs</td>
<td>24 cfs</td>
</tr>
<tr>
<td>Pumping/TDH</td>
<td>180 feet</td>
<td>180 feet</td>
</tr>
<tr>
<td>Main Line Sizing</td>
<td>6-inch to 21-inch</td>
<td>6-inch to 30-inch</td>
</tr>
<tr>
<td>Main Line Pressures</td>
<td>20 psi to 72 psi</td>
<td>20 psi to 72 psi</td>
</tr>
<tr>
<td>Lateral Sizing</td>
<td>6-inch to 21-inch</td>
<td>8-inch to 30-inch</td>
</tr>
<tr>
<td>Lateral Pressures</td>
<td>31 psi to 62 psi</td>
<td>34 psi to 62 psi</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second
psi = pounds per square inch
TDH = Total Dynamic Head

5.2.2 Alternative 3
A spreadsheet analysis was also used to estimate hydraulic conditions under a gravity flow scenario for Alternative 3. The analysis used the following assumptions and criteria for pipe sizing:

- Manning’s formula was used to estimate the depth in each pipeline, with a Manning’s coefficient, \( n \), of 0.012.
- Delivery pipe was assumed to be smooth-walled, corrugated, high density polyethylene.
- Pipe was sized so that the depth of flow at the peak flow rate would typically be less than 90% of the pipe diameter.

Table 5-4 summarizes the results of the hydraulic analysis for Alternative 3. Facility sizing and configuration for Alternative 3 is shown in Figure 4-3.
Table 5-4
Summary of Hydraulic Analysis – Alternative 1

<table>
<thead>
<tr>
<th>Item</th>
<th>Full Piping Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Diversion Flow Rate</td>
<td>8 cfs</td>
</tr>
<tr>
<td>Main Line Sizing</td>
<td>21-inch to 24-inch</td>
</tr>
<tr>
<td>Lateral Sizing</td>
<td>Same as Existing</td>
</tr>
<tr>
<td>Lateral Pressures</td>
<td>Same as Existing</td>
</tr>
</tbody>
</table>

Notes:
cfs = cubic feet per second

5.3 Cost Analysis

5.3.1 Implementation Costs

Opinions of probable construction and implementation costs were developed for each of the alternatives and for each different capacity option evaluated. Table 5-5 provides a summary of the Opinion of Probable Construction Costs for the alternatives and options evaluated as part of this study. A more detailed breakdown of materials and work and their related costs is included in Appendix B.

The opinions of probable construction costs incorporate the following:

- A 10% allowance for mobilization/demobilization
- An 8.2% sales tax rate

The total construction costs and total project costs are reported in ranges. The low end of the range includes a 15% contingency and the high end of the range includes a 30% contingency. Other project implementation costs would include the following:

- **Engineering, Permitting, and Administration** – A 20% allowance for engineering, permitting, and administration.
- **Land Acquisition** – Most of the alternatives would require additional easements or land to construct a new pump station or pipeline. An allowance was provided for each alternative. Actual land acquisitions costs would be subject to negotiation with private property owners.
Table 5-5
Summary of Opinion of Probable Implementation Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-cfs</td>
<td>6-cfs</td>
<td>8-cfs</td>
</tr>
<tr>
<td>Site and Preparation Work</td>
<td>$109,000</td>
<td>$104,000</td>
<td>$104,000</td>
</tr>
<tr>
<td>Pressurized Delivery Pipelines</td>
<td>$697,000</td>
<td>$774,000</td>
<td>$878,000</td>
</tr>
<tr>
<td>Gravity Delivery Pipelines</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Ditch Lining</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>River Pump Station</td>
<td>$431,000</td>
<td>$569,000</td>
<td>$673,000</td>
</tr>
<tr>
<td>Subtotal - Construction Cost</td>
<td>$1,237,000</td>
<td>$1,447,000</td>
<td>$1,655,000</td>
</tr>
<tr>
<td>Mobilization/Demobilization (10%)</td>
<td>$123,700</td>
<td>$144,700</td>
<td>$165,500</td>
</tr>
<tr>
<td>Sales Tax (8.2%)</td>
<td>$101,434</td>
<td>$118,654</td>
<td>$135,710</td>
</tr>
<tr>
<td>Total Construction Cost^2</td>
<td>$1,681,000</td>
<td>$1,967,000</td>
<td>$2,249,000</td>
</tr>
<tr>
<td></td>
<td>$1,901,000</td>
<td>$2,223,000</td>
<td>$2,543,000</td>
</tr>
<tr>
<td>Total Non-construction Costs^2, 3</td>
<td>$386,000</td>
<td>$443,000</td>
<td>$505,000</td>
</tr>
<tr>
<td></td>
<td>$430,000</td>
<td>$495,000</td>
<td>$564,000</td>
</tr>
<tr>
<td>Total Project Implementation Cost^2</td>
<td>$2,067,000</td>
<td>$2,410,000</td>
<td>$2,754,000</td>
</tr>
<tr>
<td></td>
<td>$2,331,000</td>
<td>$2,718,000</td>
<td>$3,107,000</td>
</tr>
</tbody>
</table>

Notes:
1 Costs are in 2015 dollars. Actual costs will vary based on materials and labor costs at the time of construction.
2 The high end of the range of Total Construction, Total Non-construction Costs, and Total Project Costs includes a 30% construction contingency. The low end of the range includes a 15% construction contingency.
3 Non-construction costs include an allowance for engineering, permitting, and administration (estimated as 20% of the Total Construction Cost) and an allowance for land acquisition (See Appendix B for additional details).
5.3.2 Long-term Operating Costs

Long-term operating costs were also evaluated. Long-term operating costs will include O&M costs, administrative costs, pumping power costs, and the cost of funding replacement of the facilities when they have reached the end of their life cycle.

O&M costs were estimated based on our understanding of the costs associated with operating similar irrigation systems of similar size. Assumed costs include salary and benefits for the manager, administrative costs, transportation costs, utilities, phones, maintenance, small repairs, supplies, and contracted labor costs.

Opinions of annual pumping power costs were developed using Chelan County Public Utility District (PUD) Rate Schedule No. 5 for Irrigation Service. Pumping costs were estimated based on delivery of an annual volume of water proportional to the capacity of the pump station.

Replacement costs were evaluated to determine the annual deposit that would need to be made to an account to fund replacement of the facilities at the end of the assumed life cycle for the project. For this analysis, the following design life cycles were assumed:

- Pipe and infrastructure – 50 years
- Pumps and electrical equipment – 25 years

It is unlikely that all of the facilities would need to be completely replaced at the end of their assumed life cycle. For this reason, the analysis was performed for three levels of replacement: 25, 50, and 100%. The life cycle replacement cost analysis is included in Appendix C. The analysis assumed an annual interest on the replacement fund of 3% and an annual inflation rate of 3%.

Two methods of annual deposit to a replacement fund were evaluated. The first would be a constant annual deposit through the life of the project. The second would be an increasing annual deposit, escalated at the assumed annual inflation rate. The analysis of both methods is included in Appendix C.
Table 5-6 summarizes the opinions of annual long-term operating costs for each alternative (in 2015 dollars). The annual replacement fund costs shown represent the first annual deposit that would be needed to the replacement fund, assuming the following:

- Escalation of the annual replacement fund deposit would be at an annual rate of 3%.
- 25% of pipe and infrastructure would need to be replaced within the 50-year design life cycle for those components.
- 100% of pumps and electrical equipment would need to be replaced within the 25-year design life cycle for those components.

Table 5-7 includes a summary of annual replacement fund costs at years 1, 25, and 50 of the 50-year design life cycle. All costs are reported in 2015 dollars.

For Alternative 1, it was estimated that O&M costs would range from $62,000 for a 4-cfs system to $64,000 for an 8-cfs system during the first year of operation. Pumping costs for Alternative 1 would range from just over $5,000 per year for a 4-cfs system to more than $10,000 for an 8-cfs system. Replacement fund costs during the first year of the project would range from just over $26,000 for a 4-cfs system to more than $39,000 for an 8-cfs system.

The operating costs would increase for Alternative 2 due to the larger size and initial cost of the facilities required. It was estimated that O&M costs would range from $66,000 for a 12-cfs system to more than $70,000 for a 24-cfs system during the first year of operation. Pumping costs would range from just over $15,000 for a 12-cfs system to more than $29,000 for a 24-cfs system. Replacement fund costs during the first year of the project would range from just over $50,000 for a 12-cfs system to more than $81,000 for a 24-cfs system.

O&M costs for the improvements to the existing system would be similar to, or slightly lower than, costs currently incurred by COIC. Potential savings would result from eliminating the need to clean or shape piped portions of the ditch. No pumping costs would be incurred. Replacement fund costs during the first year of the project were estimated to range from just over $6,600 for a fully piped system to more than $4,900 for a fully lined system. It should be noted that there may likely be costs associated with upgrade and/or replacement of existing diversion facilities for Alternative 3 that have not been evaluated and are not included in this opinion of long-term operating costs.
### Table 5-6
**Summary of Long-term Operating Costs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-cfs</td>
<td>6-cfs</td>
<td>8-cfs</td>
</tr>
<tr>
<td>Annual O&amp;M/Administration</td>
<td>$62,000</td>
<td>$63,000</td>
<td>$64,000</td>
</tr>
<tr>
<td>Annual Pumping Power Cost²</td>
<td>$5,114</td>
<td>$8,046</td>
<td>$10,559</td>
</tr>
<tr>
<td>Subtotal – Operating Costs</td>
<td>$67,114</td>
<td>$71,046</td>
<td>$74,559</td>
</tr>
<tr>
<td>Annual Replacement Fund Cost³</td>
<td>$26,410</td>
<td>$33,659</td>
<td>$39,236</td>
</tr>
<tr>
<td>Total with Replacement Fund Costs</td>
<td>$93,500</td>
<td>$104,700</td>
<td>$113,800</td>
</tr>
</tbody>
</table>

Notes:
1. Costs shown are in 2015 dollars. Long-term cost analysis assumes that costs will increase with inflation.
2. Pumping power costs are based on Chelan County PUD Rate Schedule 5 for Irrigation Service.
3. The annual replacement fund cost represents the deposit required during the first year of funding to fund replacement of 25% of all pipe and infrastructure during a 50-year design life cycle and 100% of all pumps and electrical equipment during a 25-year design life cycle.

### Table 5-7
**Summary of Annual Replacement Fund Costs**

<table>
<thead>
<tr>
<th>Design Life Cycle Year</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-cfs</td>
<td>6-cfs</td>
<td>8-cfs</td>
</tr>
<tr>
<td>1</td>
<td>$26,410</td>
<td>$33,659</td>
<td>$39,236</td>
</tr>
<tr>
<td>25</td>
<td>$53,685</td>
<td>$68,422</td>
<td>$79,759</td>
</tr>
<tr>
<td>50</td>
<td>$112,405</td>
<td>$143,259</td>
<td>$166,997</td>
</tr>
</tbody>
</table>

Notes:
1. Costs represent replacement fund deposit required to fund replacement of 25% of all pipe and infrastructure during a 50-year design life cycle and 100% of all pumps and electrical equipment during a 25-year design life cycle.
2. Costs shown are in 2015 dollars. Long-term cost analysis assumes that costs will increase with inflation.
6 SUMMARY AND RECOMMENDATIONS

6.1 Summary and Comparison of Alternatives

Table 6-1 provides a comparison of Alternatives 1, 2, and 3 evaluated as part of this alternatives analysis. The comparison of alternatives indicates the following:

6.1.1 Alternative 1

Alternative 1 would result in construction of a pressurized delivery system supplied by a pump station near the confluence of the Wenatchee River and Icicle Creek. COIC's portion of the diversion facilities shared with LNFH on Icicle Creek would no longer operate. Saved water would be put into trust. The alternative would benefit the critical reach of Icicle Creek by moving COIC's diversion and associated water right downstream. If withdrawals up to the limit allowed by the water right were moved to the new POD, the benefit to flows in Icicle Creek would be as much as 11.9 cfs. In addition to leaving flow in lower Icicle Creek, the improvements would also increase the efficiency of the COIC system and a range of design capacities, from 4 cfs to 8 cfs, were evaluated for this alternative to cover the range of potential future water needs. It is likely that a pressurized system would need to be sized to deliver a flow rate near the middle of that range.

Alternative 1 would be less expensive than Alternative 2, but more expensive than Alternative 3. The Opinion of Probable Costs indicates that total project costs for a 6-cfs capacity system would be approximately $2.4 to $2.7 million. That represents a cost of $203,000 to $228,000 per cfs of benefit in Icicle Creek, assuming a maximum 11.9-cfs maximum in lower Icicle Creek.

Some of the key challenges associated with implementation of Alternative 1 include the following:

- **Private Property Impacts** – Construction of a pump station on the Wenatchee River or on Icicle Creek near the confluence with the Wenatchee River would require acquisition of and access through private property. In addition, those who own property along the existing open ditch have already or are likely to express concern
about losing access to the open, flowing water and the impact that enclosing the ditch will have on trees and drainage in and around their properties.

- **Permitting** – Construction of the pump station on the bank of the Wenatchee River or Icicle Creek would be subject to environmental permitting requirements. Permitting requirements and/or fatal flaws have not yet been identified.

- **Pump Station Construction** – Pump station construction would also require a system to control the flow of water and excavation into the river bank. Construction of a pump station along the Wenatchee River near the Icicle Road Bridge would also be challenging due to the height of the river bank and the presence of bedrock.

- **Long-term O&M** – There are power and O&M costs associated with pump station operation that COIC does not currently deal with. COIC would likely have to contract certain O&M tasks, such as a maintenance of electrical equipment and pumps, which would add cost. However, some of those costs would be offset because the O&M required for the delivery system would be reduced.

- **Impacts to Icicle Road** – Construction of the pressurized delivery system would require installation of pipe across Icicle Road at four locations.

- **Water Right Transfer** – Implementation of this alternative would require successful transfer of the POD on COIC’s water right to the Wenatchee River or to a point on Icicle Creek near Shore Street. If a pump station site is selected on the Wenatchee River upstream of the confluence with Icicle Creek, COIC would have to demonstrate that any uses of Wenatchee River water from the pump station to the confluence would not be impaired by the project.

### 6.1.2 Alternative 2

Alternative 2 would also result in construction of a pressurized delivery system supplied by a pump station near the confluence of the Wenatchee River and Icicle Creek. COIC’s portion of the diversion facilities shared with LNFH on Icicle Creek would no longer operate. Saved water would be put into trust. The alternative would benefit the critical reach of Icicle Creek by moving COIC’s diversion and associated water right downstream. It could also potentially increase that benefit by supplying LNFH with surface water deliveries to offset the surface water and groundwater withdrawals that support hatchery operations. One of the key constraints on water supply for LNFH is that the water used for the hatchery
Summary and Recommendations

process has to be the right temperature and water quality to ensure successful fish rearing. The USFWS has indicated that additional supply from the Wenatchee River would not likely meet temperature and water quality constraints for supply to LNFH. However, if this approach proved to be less expensive than other water supply options being considered, there may be opportunities to condition the water prior to use to meet those constraints.

If withdrawals up to the limit allowed by the water right were moved to the new point of diversion, the benefit to flows in Icicle Creek would be as much as 11.9 cfs. Additional benefit could be realized by conveying 8 to 16 cfs to LNFH or providing excess capacity of fire protection flows. A range of design capacities, from 12 cfs to 24 cfs, were evaluated for this alternative to cover the range of potential future water needs.

Due to the large pump and pipe sizes that would be needed to provide additional capacity, Alternative 2 would be the most expensive alternative. The Opinion of Probable Cost indicates that the total project cost for a 12-cfs capacity system would be approximately $3.4 to $3.9 million. That represents a cost of $172,000 to $194,000 per cfs of benefit in Icicle Creek, assuming a maximum 19.9-cfs benefit to Icicle Creek, which would include the flow associated with the 11.9-cfs COIC water right plus up to 8 cfs delivered through the system to LNFH. The Opinion of Probable Cost indicates that the total project cost for a larger 24-cfs capacity system would be approximately $5.0 to $5.7 million. That represents a cost of $181,000 to $204,000 per cfs of benefit in Icicle Creek, assuming a maximum 27.9-cfs benefit to Icicle Creek, which would include the flow associated with the 11.9-cfs COIC water right plus up to 16 cfs delivered through the system to LNFH.

Similar key challenges would apply to the implementation of Alternative 2 as those that were noted for Alternative 1. Private property, permitting, and construction challenges would be more pronounced due to the larger size of facilities required for Alternative 2.

6.1.3 Alternative 3

The seepage loss study suggests that up to 0.5 cfs of water could be saved by increasing the efficiency of the canal through piping or lining. The Opinion of Probable Cost indicates that piping unlined portions of the ditch would result in a total project cost of $1.4 to
$1.5 million. That represents a cost of $2.7 to $3.1 million per cfs of benefit to Icicle Creek, which is much more expensive than other water efficiency projects that have typically qualified for funding in the Wenatchee River Basin.

An additional savings of more than 1,000 acre-feet on an annual basis could also be realized by retrofitting the diversion on Icicle Creek with an adjustable gate structure that limits diverted water in the amounts needed by season to significantly reduce the volume of water carried through the system and spilled to the Wenatchee River. The current intake is adjusted manually and is typically set to deliver excess water to ensure that adequate water is available at the bottom of the system. The excess water is spilled to the Wenatchee River.

6.1.4 Alternative 4

Alternative 4 was calculated by estimating annual consumptive quantities of existing crops and associated irrigation practices from Ecology Guidance Document 1210 and Policy 1120. Assuming total irrigated area within COIC is close to the 419 acres of potential irrigation shown in the analysis, up to 733 acre-feet of consumptive use is occurring at COIC. Additional research will be required to assess actual consumptive use, including a 0.01-acre resolution assessment of crop, lawn, or landscaping types, type of water application systems used in each parcel, and more refined data on actual transpiration using precise measurements from tensiometers and associated technology.

Implementation of water use efficiency measures, included as Alternative 4, would include replacement of higher-use landscaping with low water use landscaping, improved irrigation efficiency, or voluntary timing of irrigation. A low water use landscaping program at COIC would free up additional consumptive use water by documenting changes in parcel-scale water use through replanting of lower water use plants such as fescue, buffalo grass, or native landscaping. This water could then be used for additional consumptive use within COIC or be sold to higher-demand end users downstream.
<table>
<thead>
<tr>
<th>Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description of Alternative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Replace existing diversion with pump station on Wenatchee River near Icicle Road</td>
<td>• Replace existing diversion with pump station on Wenatchee River near Icicle Road</td>
<td>• Replace existing diversion with pump station on Wenatchee River near Icicle Road</td>
</tr>
<tr>
<td>• Install pressurized delivery system</td>
<td>• Install pressurized delivery system</td>
<td>• Install pressurized delivery system</td>
</tr>
<tr>
<td>• Install capacity to deliver up to 4 cfs for irrigation</td>
<td></td>
<td>• Install capacity to deliver up to 8 cfs for irrigation</td>
</tr>
<tr>
<td>Total Pumping Power Required</td>
<td>120</td>
<td>190</td>
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<tr>
<td>Recommended Pipe</td>
<td>6-inch to 15-inch, 80-psi Rated PVC</td>
<td>6-inch to 15-inch, 80-psi Rated PVC</td>
</tr>
<tr>
<td><strong>Alternative Costs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Total Opinion of Probable Construction Costs</td>
<td>$1,681,000 to $1,901,000</td>
<td>$1,967,000 to $2,223,000</td>
</tr>
<tr>
<td>• Total Opinion of Probable Project Costs</td>
<td>$2,067,000 to $2,331,000</td>
<td>$2,410,000 to $2,718,000</td>
</tr>
<tr>
<td>• Total Opinion of Annual O&amp;M/Administration Costs</td>
<td>$62,000</td>
<td>$63,000</td>
</tr>
<tr>
<td>• Total Opinion of Annual Pumping Power Cost</td>
<td>$5,114</td>
<td>$8,046</td>
</tr>
<tr>
<td>• Total Opinion of Annual Operating Costs</td>
<td>$67,114</td>
<td>$71,046</td>
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<tr>
<td>Item</td>
<td>Alternative 1</td>
<td>Alternative 2</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
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<tr>
<td>Total Project Cost per Icicle Flow Benefit</td>
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<td>$172,000 to $194,000</td>
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<td></td>
<td>$203,000 to $228,000</td>
<td>$203,000 to $228,000</td>
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<tr>
<td></td>
<td>$231,000 to $261,000</td>
<td>$231,000 to $261,000</td>
</tr>
<tr>
<td></td>
<td>$172,000 to $194,000</td>
<td>$172,000 to $194,000</td>
</tr>
<tr>
<td></td>
<td>$1 to $1</td>
<td>$1 to $1</td>
</tr>
<tr>
<td>Other Key Benefits</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• Eliminates need to participate with LNFH in future upgrades to existing diversion</td>
<td>• Eliminates need to participate with LNFH in future upgrades to existing diversion</td>
</tr>
<tr>
<td></td>
<td>• Improved delivery system reliability</td>
<td>• Improved delivery system reliability</td>
</tr>
<tr>
<td></td>
<td>• Pressurized deliveries to water users</td>
<td>• Pressurized deliveries to water users</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key Challenges</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Property acquisition required for pump station</td>
<td>• Property acquisition required for pump station</td>
</tr>
<tr>
<td></td>
<td>• Permitting pump station construction within Wenatchee River Channel</td>
<td>• Permitting pump station construction within Wenatchee River Channel</td>
</tr>
<tr>
<td></td>
<td>• Pump station construction on steep river bank with bedrock</td>
<td>• Pump station construction on steep river bank with bedrock</td>
</tr>
<tr>
<td></td>
<td>• Long-term O&amp;M of pumping facilities</td>
<td>• Long-term O&amp;M of pumping facilities</td>
</tr>
<tr>
<td></td>
<td>• Impacts to Icicle Road and other local streets</td>
<td>• Impacts to Icicle Road and other local streets</td>
</tr>
<tr>
<td></td>
<td>• Water right transfer</td>
<td>• Water right transfer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2 Recommendations for Additional Work

The intent of this study has been to evaluate alternatives in enough detail to provide a basis for COIC to determine whether the alternatives presented here match the long-term interests and goals of COIC water users. The study is also intended to be used as a tool in the decision-making process as COIC works with WWT and other stakeholders toward identifying opportunities for funding improvements to the system. It is recommended that the following be considered as the process moves forward toward selection of a preferred improvement alternative and implementation of that alternative:

- Refine the on-property analysis of crop/landscape type, consumptive demand, and watering practices at the 0.01 acre or smaller scale using tensiometers and associated technologies to more precisely define the irrigable acreage with COIC.

- Use the refined analysis to determine a design capacity that will provide flexibility for future water supply needs while making sure the system is properly sized to qualify for funding.

- Review the potential for adding capacity to serve LNFH and/or other needs, such as fire protection, with stakeholders and the IWG. Further evaluate opportunities to expand the pump station and delivery system to re-water wells at LNFH or replace surface water diversions, comparing the costs of expanding the COIC project to include LNFH water to other options currently being considered by LNFH to improve supply to the hatchery.

- Develop opinions of cost for a “no action” alternative that would forecast the costs of continuing to operate and maintain the existing system as is, without implementation of one of these alternatives considered in this study. Include the cost of the likely need to participate in upgrade of the diversion facilities shared with LNFH.

- Meet with COIC, as needed, to select and refine the concept for a preferred alternative.

- Coordinate with landowners to evaluate the feasibility of the layout and configuration of delivery system facilities.

- Perform additional field investigations to determine feasibility, including topographic survey and geotechnical field investigations.

- Refine the design analysis and sizing of pumping and delivery facilities based on the additional field work and identify and quantify major materials and components.
• Refine the cost analysis to reflect changes to the system configuration and sizing.
• Coordinate with Chelan County PUD to complete a more detailed assessment of power requirements and refine opinions of cost for extending power to selected pumping sites.
• Complete an environmental review and permitting fatal-flaw analysis to identify any regulatory issues that could impact implementation of the improvement project.
• Hold shareholder meetings to get input from COIC water users.
• Work with WWT and the IWG to identify potential funding sources for the project.
• Incorporate the additional steps into a more detailed feasibility study of improvements to the COIC system and develop preliminary design drawings.
7 REFERENCES

APPENDIX A
PHOTOGRAPHS
Appendix A – Photographs

Photograph 1 – Existing COIC/LNFH Shared Diversion Facilities on Icicle Creek

Photograph 2 – Debris Rack at Inlet to Diversion Pipeline under Control House
Photograph 3 – Inside Control House with Control Gate Operator

Photograph 4 – Bifurcation, Valve Enclosure
Appendix A – Photographs

Photograph 5 – Inside Valve Enclosure

Photograph 6 – Bifurcation with Fish Bypass Pipe and Fish Screen
Appendix A – Photographs

Photograph 7 – Fish Screen and Paddle Wheel

Photograph 8 – Weir, Pipe Inlet, Debris Rack
Appendix A – Photographs

Photograph 9 – Pipe through RV Campground on Icicle Road

Photograph 10 – Open Ditch Downstream of Pipe Outlet at Sleeping Lady
Appendix A – Photographs

Photograph 11 – Open Ditch West of Icicle Road

Photograph 12 – Open Ditch West of Icicle Road
Photograph 13 – Culvert Crossing at Icicle Road

Photograph 14 – Culvert Crossing at Shore Street
Appendix A – Photographs

Photograph 15 – Typical Turnout Structure West of Icicle Road

Photograph 16 – Typical Pumped Turnout West of Icicle Road
Appendix A - Photographs

Photograph 17 - Lateral Intake Structure West of Icicle Road

Photograph 18 - Lateral Intake Structure West of Icicle Road
Appendix A – Photographs

Photograph 19 – Inlet to Tailwater Pipeline at Downstream End of System

Photograph 20 – Tailwater Location and Potential Pump Station Location on Wenatchee River
Photograph 21 – Tailwater Location and Potential Pump Station Location on Wenatchee River

Photograph 22 – Potential Pump Station Location on Icicle Creek Near Shore Street
APPENDIX B
OPINION OF PROBABLE IMPLEMENTATION COSTS
## Cascade Orchards - Alternatives Analysis

### Opinion of Probable Costs

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>UNIT COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. miscellaneous site work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>division of care of water</td>
<td>LS Varies</td>
<td>1 $30,000</td>
</tr>
<tr>
<td>temporary and permanent access</td>
<td>LS Varies</td>
<td>1 $15,000</td>
</tr>
<tr>
<td>temporary erosion and sediment control</td>
<td>LS Varies</td>
<td>1 $30,000</td>
</tr>
<tr>
<td>construction surveying</td>
<td>LS Varies</td>
<td>1 $15,000</td>
</tr>
<tr>
<td>cleaning and grubbing</td>
<td>AC</td>
<td>4 $24,000</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal - miscellaneous site work</strong></td>
<td><strong>$109,000</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal - pressurized distribution system</strong></td>
<td><strong>$697,000</strong></td>
</tr>
<tr>
<td>pipe unit costs include trenching; furnishing and installing pipe, fittings, and appurtenances including turnout connections for water users; backfilling; compaction of backfill; and surface repair</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Notes:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1) Pipe unit costs include trenching; furnishing and installing pipe, fittings, and appurtenances including turnout connections for water users; backfilling; compaction of backfill; and surface repair</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Subtotals and totals are rounded to the nearest $1,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Costs are in 2015 dollars</td>
<td></td>
</tr>
<tr>
<td>ITEM</td>
<td>UNIT</td>
<td>UNIT COST</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>Annual Operations and Maintenance Cost</td>
<td>$62,000</td>
<td>$63,000</td>
</tr>
<tr>
<td>Annual Replacement Fund Cost</td>
<td>$26,410</td>
<td>$33,659</td>
</tr>
<tr>
<td>Pumping Power Costs</td>
<td>Monthly Basic Charge (3-Phase Power)</td>
<td>/EA/MO</td>
</tr>
<tr>
<td>Seasonal Energy Charge</td>
<td>APR</td>
<td>/AWh</td>
</tr>
<tr>
<td></td>
<td>MAY</td>
<td>/AWh</td>
</tr>
<tr>
<td></td>
<td>JUN</td>
<td>/AWh</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>AUG</td>
<td>/AWh</td>
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<tr>
<td></td>
<td>SEP</td>
<td>/AWh</td>
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<tr>
<td>Monthly Demand Charge</td>
<td>/HP/MO</td>
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<tr>
<td>Total Annual Pumping Costs</td>
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</tr>
<tr>
<td>Total Annual Operating Costs</td>
<td>$93,500</td>
<td>$104,700</td>
</tr>
</tbody>
</table>

Notes:
1) See life cycle cost analysis, in 2015 dollars.
2) Pumping power costs are based on 2015 Chelan PUD Electrical Rate Schedule 5 (Irrigation Service).
3) The total operating costs are rounded to nearest $100, and include O&M, Replacement Fund, and Power Costs.
<table>
<thead>
<tr>
<th>Component</th>
<th>Problem or Replacement Fund</th>
<th>Life Cycle Cost</th>
<th>Percent of Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Replacement</td>
<td></td>
<td>$940,000</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total Life Cycle Cost</strong></td>
<td></td>
<td><strong>$940,000</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**Annual Depreciation**: (Annual Depreciation = (Cost - Salvage Value) / Life Cycle Cost)

**Notes**:
1. Total Construction Cost is from the Contractor's Opinion of Probable Costs, which includes construction costs and contingencies.
2. Current Cost is equal to the Contractor's opinion of the available initial funds for the project at beginning of project life.
3. Future cost is valued at each cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
## Summary of Replacement Costs

<table>
<thead>
<tr>
<th>Replacement</th>
<th>Rep.</th>
<th>Future</th>
<th>Current</th>
<th>Current*</th>
<th>Future*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime</td>
<td>58 Years</td>
<td>58 Years</td>
<td>58 Years</td>
<td>58 Years</td>
<td>58 Years</td>
</tr>
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<td>Lesser of</td>
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<td>$1,878,456</td>
<td>$1,878,456</td>
<td>$1,878,456</td>
<td>$1,878,456</td>
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<tr>
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## Lifecycle Costs

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial Cost | $1,238,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 |
| Replacement Expenses | $1,238,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 |
| Operating Expenses | $1,238,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 | $1,878,456 |

## Notes

1. Total Construction Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2. Current Cost is reported to the Engineer's Opinion of Probable Cost basis for the purpose of 1st or 2nd replacement cost.
3. Future cost is net of all life cycle of the facility, or the current cost inflated by the rate of change through the life cycle of the facility.
### Cascade Dwell - Apprenticeship

**Life Cycle Cost Analysis**

**Alternative 3 - Pre-fabricated Systems with Excess Capacity, 1275 Pump Stages**

<table>
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<th>Item</th>
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<th>Revised Cost</th>
<th>Savings</th>
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#### 2. Project Management Costs

#### 3. Preparation of Project

#### 4. Replacements

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<td>5. Annual Replace Schedule</td>
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#### 5. Replacement Fund Summary

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<td>6. Total Replacement Fund</td>
<td>$5,653,800</td>
<td>$5,473,800</td>
<td>$180,000</td>
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</table>

#### 6. Life Cycle Costs

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Cost | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 | $4,000,000 |

### Notes:

1. Total Construction Cost is the Engineer's Opinion of Probable Costs, which includes construction costs and contingencies.
2. The final cost is equal to the Engineer's Estimate of the probable final cost at the time of completion of the project.

### AMHERD-GLA, LLC

CICD Alternatives Analysis: Opinion of Probable Cost - DRAFT.xlsx
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### Image Description:

#### Table Data:

**Cashbriar Orchards - Approval Study**  
**Life Cycle Cost Analysis**  
**Additional Info:** Full Living of Open Ditch, Aboretum System

| Table Title | columns  | rows
|-------------|----------|-----|
| **Replacement Funds (inception)** | 4 | 4
| **Replacement Funds (future)** | 4 | 4
| **Replacement Funds (project)** | 4 | 4

#### Table Details:

**Replacement Funds (inception):**
- **Years:** 0 to 30
- **Replacement Funds in inception:**
  - **Flyash:** $1,970
  - **Flyash:** $1,970
  - **Flyash:** $1,970
  - **Flyash:** $1,970

**Replacement Funds (future):**
- **Years:** 0 to 30
- **Replacement Funds in future:**
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  - **Flyash:** $1,970

**Replacement Funds (project):**
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- **Replacement Funds in project:**
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  - **Flyash:** $1,970
  - **Flyash:** $1,970

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**Note:** The table above represents the replacement funds for different phases of the project, with columns for years 0 to 30, and rows for each year indicating the replacement funds required. The amounts are not presented in this description for brevity.
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Note: The table above represents the net present value (NPV) savings and investment costs for a project over 25 years. The NPV savings are calculated based on the avoided operation and maintenance (O&M) costs, while the investment costs include both the initial capital cost and the estimated present value of future changes in O&M costs. The total investment cost is the sum of the initial capital cost and the net present value of future changes in O&M costs. The O&M avoided costs represent the savings achieved through the implementation of the project. The O&M avoided NPV represents the net present value of these savings. The total NPV is the sum of the NPV savings and the O&M avoided costs, adjusted for the time value of money.