WASHINGTON WATER PROJECT

Lower Wenatchee Instream Flow Enhancement Project

Final Narrative Report

July 31, 2013

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EXECUTIVE SUMMARY

Trout Unlimited – Washington Water Project's (TU-WWP) Lower Wenatchee Instream Flow Enhancement Project (Project) is a successfully implemented salmonid habitat enhancement and irrigator assistance project on the Lower Wenatchee River, in proximity to the City of Wenatchee, Washington. TU-WWP implemented comprehensive irrigation efficiency upgrades and point of diversion changes to attain the Project goal of a win-win solution to the problems posed to both Endangered Species Act (ESA) listed fish of the Wenatchee River and irrigators of the Pioneer Water User Association (PWUA), due to the aging infrastructure and inefficient water use through the 100-year Gun Ditch irrigation canal. The Project provided the PWUA with a more efficient, state-of-the art pressurized pump irrigation system, thereby restoring 38.27 cubic feet per second (cfs) to the lower Wenatchee River for the benefit of Steelhead, Bull trout, Sockeye and Chinook salmon. With strong support from multiple Project partners, TU-WWP completed the Project in April of 2013.

OVERVIEW

Started in 2008, TU-WWP staff took the Project from conception to completion in under five years. This Project is a noteworthy example of the beneficial results of cross-sector partnerships as it involved over 15 different government, utility, non-profit and tribal entities and multiple private sector contractors. This Project has achieved its' goal of improving instream flow in the lower Wenatchee River to improve passage and decrease critical temperature barriers at the confluence with the Columbia and Wenatchee Rivers.

Project Location

The Project took place in Columbia Cascade Water Resource Inventory Area (WRIA) 45, Hydrologic Unit Code (HUC) 1702001105, along the lower seven miles of the Wenatchee River and its' confluence with the Columbia River.

Metrics

Instream Flow

- 38.27 cfs / 7,823.50 acre feet per year (afy), conserved for instream flow in the Wenatchee River, in perpetuity.

Irrigation Delivery

- To: 385 acres, 7.7 cfs, 107 shareholders

Jobs Created/Retained:

- TU-WWP
  - *TU-WWP Subcontractors:*
    - Cascadia Law Group (Legal review)
    - Cascadia Conservation District (Cultural resources)
    - Historical Research Associates, Inc. (Cultural resources)
    - Greenleaf Earthwork and Maintenance, Inc. (domestic water connections within the City of Wenatchee)
    - Public Utility District No. 1 of Chelan County (Power)
    - Forsgren Associates, Inc. (Forsgren) (Project Engineer Contractor)
      - *Forsgren Associates, Inc. Subcontractors:*
        - Grette and Associates (Biological consultation)
        - Z Engineers (Electrical Consultation)
        - Tumwater Drilling (Well Driller)
        - Nelson GeoTech (Geo-Tech Analysis)
    - Pipe of Washington (POW) (Construction Contractor) **Appendix A.**
      - *POW Subcontractors:*
        - Safe Set (Traffic control)
        - Brian Bell Enterprise LLC (Tree and brush removal)
        - Top Tree Service (Tree removal and tree chipping)
        - Irrigation Technology & Control INC (Pump, motor and VFD installation)
        - RM Shearer INC (Consulting)
        - Landmark Landscaping (Landscaping & drip irrigation)
        - A – Core (Hydro-seeding)

Primary Species

The lower Wenatchee River is a critical migration corridor for salmonids, including Sockeye salmon, spring and summer Chinook, Steelhead, Rainbow, and both migratory and resident Bull trout. This sub-watershed provides spawning and rearing habitat for summer Chinook and Steelhead, serves as an important passage corridor for anadromous species, and is therefore critical to the health of anadromous fish in the entire Wenatchee Watershed (p.67, Wenatchee Watershed Plan).

Salmon Recovery Plans/Limiting Factors

The Wenatchee River experiences low flows during the late summer, often less than 300 cfs during salmon spawning times and is on the 303(d) list for the limiting factors of water temperatures, dissolved oxygen and phosphorus. The addition of 38.27 cfs provided through this Project will increase habitat during low flows and help to prevent temperature isolation for fish migrating to the Wenatchee River in the fall. Fall is a critical migration period for Steelhead in the Upper Columbia River system and this Project provides a margin of protection for them and other species. This Project will also improve conditions for migrating and rearing Chinook and Bull trout.

The Project addresses the limiting factor of water quantity listed in the Northwest Power and Conservation Council's Wenatchee Sub-basin Plan (2004) and the Upper Columbia Salmon Recovery Plan (2007).

Funding Partnerships

- National Fish and Wildlife Foundation – Columbia Basin Water Transactions Program (NFWF-CBWTP)
- Bonneville Power Administration - Fish and Wildlife Program (BPA)
- US Bureau of Reclamation (Reclamation)
- US Fish and Wildlife Service (USFWS)
- Washington State Department of Ecology (Ecology) and Office of the Columbia River Program (CRP)
- Washington State Recreation and Conservation Office (RCO) - Washington State Salmon Recovery Funding Board (SRFB)
- Washington State Department of Fish and Wildlife (WDFW)
- Washington State Conservation Commission – Irrigation Efficiencies Program (Commission)
- Upper Columbia Salmon Recovery Board (UCSRB)
- Public Utility District No. 1 of Chelan County – Rock Island Habitat Conservation Plan Tributary Committee (Tributary)
- Public Utility District No. 2 of Grant County – Priest Rapids Coordinating Committee Hatchery Sub-Committee (PRCC)
- Confederated Tribes and Bands of the Yakama Nation (Yakama)
- Cascadia Conservation District (CCD)
- Chelan County Department of Natural Resources - Watershed Planning
- Pioneer Water User Association (PWUA)

Due Diligence

As part of the Project, TU-WWP and PWUA had to complete a change in the entire PWUA water right, which included moving the old point of diversion downstream to the new diversion(s). This effort was conducted by PWUA attorney Mark Peterson with assistance from TU-WWP's Project Manager Aaron Penvose and TU-WWP's water rights attorney Mary McCrea. Through the process, TU-WWP demonstrated on a large scale that Public and Private entities can corroborate with regulatory agencies to create successful outcomes. Please see

Appendix B for the letter of approval from The Department of Ecology (Ecology) for the final Record of Examination summary.

Permitting

TU-WWP secured all necessary local, state and federal permits for this Project, including:

- Chelan County
  - Shoreline Exemption *(allowable under WA state law due to the integral agriculture relationship to the Project),*
  - Building Permit *(pump building and site retaining walls),*
  - Conditional Use Permit *(locating utility infrastructure within residential zoning),*
  - Wetland Variances *(work within wetlands and wetland buffers)*
  - Right-of Way Permit (s)
- City of Wenatchee
  - Right-of Way Permit(s)
- Washington State
  - Department of Natural Resources lease *(locating the fish screen and intake on lands owned by the state),*
  - Fish & Wildlife Hydraulic Project Approval *(work adjacent to and/or with surface waters of the state),*
  - Department of Transportation General Permit *(work within state right-of-way),*
  - Ecology Construction Stormwater *(NPDES Stormwater General Permit requirements).*
- Federal
  - USACE Section 404 permit *(work within wetlands and /or surface waters of the state),*
  - United States Fish and Wildlife Service Consultation *(Endangered Species Act-Bull trout)*
  - National Marine Fisheries Service Consultation *(Endangered Species Act-Spring Chinook and Steelhead)*
  - FERC *(work within the Columbia River Hydropower Project boundary)*
- PUD no. 1 of Chelan County permit *(Work within its Rock Island Dam permit boundary.)*

Design and Engineering

TU-WWP contracted local engineering firm Forsgren and Associates, Inc. to conduct early alternatives analysis on the system in 2008. By 2009, Forsgren was already developing 30% and by 2010 the 75 % design for a pump station near the Columbia-Wenatchee Confluence. An important consideration was location and as part of the development, the team evaluated a preferred location at Confluece State Park and investigated a well field alternative just downstream from the river crossing into Wenatchee, but ultimately ended up at a PWUA owned parcel just upstream from the bridge on river left. This site, though steep, was logistically desirable and the location was still significantly influenced by the Columbia System back-water, providing assurance and stability.

A portion of the design analysis is described below:

The PWUA used to provide irrigation water to 107 users having a total of 527 shares. These users are located on the north and south side of the Wenatchee River. Based on survey information, the total estimated acreage served by PWUA north of the Wenatchee River is 385 acres with 81 users. The acreage is defined as the total parcel acreage and is not limited to irrigation acreage. Crop-water requirement estimates indicate an average annual flow requirement to serve the northern users of approximately 3.7 cubic feet per second (cfs) or 1,700 gallons per minute (gpm). The peak flow required to serve these users during summer months is estimated at approximately 7.7 cfs or 3,400 gpm. It is estimated that the flow require to serve the southern PWUA users is approximately 2.0 cfs or approximately 900 gpm.

The old system primarily consisted of the following major elements:

1. Approximately 25,500 feet of unlined open canal
2. Approximately 10,000 feet of piped section
3. Two siphon highway crossings
4. An inverted siphon river crossing
5. A fish screen and diversion structure
6. Flow measurement flume

In July 2010, a 30% plan and engineering report for a pressurized pump and pipeline delivery system replacing the existing canal was prepared by Forsgren. After review of this 30% document, it was determined that two additional alternatives needed to be considered at the 30% level. These options included:

1. Upgrading the existing diversion site to provide adequate fish screening, relocate the diversion point to a stable section of the main river channel, and convert the existing canal to a pipeline maintaining a gravity flow delivery system;
2. Relocating the diversion to just downstream of the Monitor Bridge, provide a pumped diversion with adequate fish screening, and convert the existing canal to a pipeline utilizing partial gravity flow to offset pumping costs.

These two additional alternatives assumed the same flow requirements estimated in the July 2010 30% engineering report. Analysis of these two alternatives was presented in a second report prepared by Forsgren in December 2010. Following the review of the December 2010 report, the PWUA decided to implement the pressurized pump and pipeline delivery system described in the July 2010 documents.

The third report documents and summarizes efforts on design of the pressurized pump and pipeline delivery system to the 75% level. The 75% level of effort was determined based on available funding at the time. The flow requirements developed in the July 2010 report continued to be the basis for design and are shown in Table 1.

Figure 1 - Estimated Flow Requirements:

	Net Irrigation Requirement (in)	Diversion Flow 1 (gpm)	Diversion Flow (cfs)
Jan	0.00	0	0.00
Feb	0.00	0	0.00
Mar	0.00	0	0.00
Apr	0.24	84	0.19
May	4.14	1,430	3.19
Jun	7.77	2,687	5.99
Jul	10.03	3,469	7.73
Aug	7.14	2,467	5.50
Sep	4.74	1,637	3.65
Oct	0.43	148	0.33
Nov	0.00	0	0.00
Dec	0.00	0	0.00
Totals	**34.49**		

Notes: [1]Assumes 385 acres with irrigation efficiency of 70%.

PRESSURIZED PIPELINE WITH COLUMBIA RIVER DIVERSION

Under this preferred alternative, the existing gravity diversion dam was abandoned and the existing canal was to be replaced with a pressurized pipeline. A pump station and diversion were to be constructed just upstream from the highway crossing as it enters Wenatchee. The major elements of the alternative are summarized below:

1. Abandonment of the existing diversion dam and fish screen at Monitor,
2. Development of a new irrigation water source diversion near the Columbia River,
3. Construction of an irrigation pump station and fish screening structure,

4. Conversion of approximately 21,500 linear feet of unlined and open canal to pressurized pipeline
5. Construction of approximately 4,000 linear feet of transmission pipeline,
6. Connection to or modification of existing highway road crossings and siphons,
7. Installation of service connections at existing irrigation delivery points,
8. Installation of required water control and flow measurement devices.
9. Instillation of well and delivery system on the south side

The pump station layout on the Columbia River is provided in the As-Built Plans in **Appendix C**.

Fish screening was a self-cleaning cone-type fish screen. This type of screen has been accepted by WDFW and will provide a durable low maintenance screening structure, meeting NMFS criteria.

The pump station will consist of five vertical turbine pumps configured in parallel. The pump station will include a variable frequency drive control system to ensure optimum energy efficiency. The pumps and controls will be enclosed in a secure concrete masonry and sheet metal building to control noise and provide weather and vandal protection.

A hydraulic model was prepared as part of the 75% design effort. The model was used to simulate irrigation demands along the length of the pipeline in order to optimize the sizing of the pipe.

PROJECTED POWER REQUIREMENTS

The power requirements assume a residual pressure will be maintained along the irrigation transmission pipeline. The pump station will lift water from the station into the new pipeline and provide a residual pressure to a minimum of 40 psi.

The pumping conditions previously described will require approximately 300 horse power. The horse-power calculations are provided in the **Appendix D**. Table 4 summarizes the conservatively projected power requirements and indicates an annual power cost of approximately $20,690.

Figure 2 - Estimated Power Requirements:

	Net Irrigation	Diversion	Diversion	Horsepower	Pumping	
Jan	0.00	0	0.00	0	0	$ -
Feb	0.00	0	0.00	0	0	$ -
Mar	0.00	0	0.00	0	0	$ -
Apr	0.24	84	0.19	7	3,65	$ 146
May	4.14	1,430	3.19	116	62,05	$ 2,482
Jun	7.77	2,687	5.99	217	116,58	$ 4,663

Jul	10.03	3,469	7.73	280	150,47	$ 6,019
Aug	7.14	2,467	5.50	199	107,01	$ 4,281
Sep	4.74	1,637	3.65	132	71,02	$ 2,841
Oct	0.43	148	0.33	12	6,41	$ 257
Nov	0.00	0	0.00	0	0	$ -
Dec	0.00	0	0.00	0	0	$ -
Totals	**34.49**					**$ 20,689**

O&M/EQUIPMENT REPLACEMENT COST OPINION

Operations and Maintenance (O&M) costs for the pressurized pipeline were evaluated to estimate potential user fees. This effort included estimates of equipment replacement costs over a 40-year life cycle for the Project, though the life cycle is likely much longer. The life cycle cost analyses are provided in **Appendix E**. The analyses estimate annual installment requirements for equipment replacement of $32,300 per year. Added to this cost is the estimated annual power cost of approximately $20,690 per year. The total annual estimated O & M cost is $52,990 per year.

Assuming 385 shares, this translates to an annual user fee of $137.63 per share. This estimated user fee does not consider other administrative and personnel cost associated with operation of the system. These user fees also assumed that PWUA would not be responsible for construction of the diversion upgrades and canal to pipeline conversion. Please see **Appendix F** for Cost Opinion detail.

Construction

Major Construction Elements

Some of the major Project components are given a brief synopsis below and then in an effort to tell the whole story the construction description and accompanying photos demonstrate the construction activities as they played out during construction in Fall of 2012 to Spring of 2013.

Excavation:

Excavation, totaling up to 10,000 cubic yards, was conducted in order to developed the necessary access to the Wenatchee River for the construction of the fish screen cone structure intake and pipe and the pipe pump house structure and pipe. The construction of the fish screen cone structure intake and pipe, the pipe pump house structure and pipe, and the pipe utility lines from the pump house were development approved under Shoreline Exemption 2012-003.

Coffer Dam:

Following excavation of the pump building foundation pad but prior to any work in the water a temporary pre-cured concrete coffer dam was built surrounding and enclosing the entire area of work proposed in the water. A truck delivered the coffer dam components and they were placed

by a crane and excavator per plan and detail constructing a coffer dam around the water work area. Water from within the dam was pumped out with electric pumps to prepare for the installation of the water intake.

Fish Screen Cone Structure Intake and Pipe (In-water work):

An excavator dug an 8' L x 8' W x 3' D hole within the riverbed about 50 ft offshore of the north bank. The excavated material was carefully placed on the riverbed adjacent to the hole. Two (2) 2' L x 4' W x 2' D ecology blocks were placed in the hole. One (1) 6' L x 6' W x 3/16" D epoxy coated steel plate with an attached 24" 90 degree steel pipe elbow (bottom of plate) was then attached to the ecology blocks. All required fastener attachments were completed by hand.

A 50' L x 9'-31' W x 3'-14' D flat trench within the river bed was excavated. The excavated material was carefully placed on the riverbed adjacent to the trench. At the location of each pipe joint a walking backhoe excavated a 8' L x 6' W x 2' D hole within the trench. The excavated material was carefully placed on the riverbed adjacent to the hole. A 4' L x 2' W x 2' D ecology block was placed in each hole. 50 ft of 24" pipe was then be placed in the trench. Each pipe joint was connected to an ecology block. All excavated material was then carefully placed back into the excavated trench and holes.

New Pump Station Diversion:

A cone fish screen structure was placed in the Wenatchee River 50 ft offshore of the north bank adjacent (west of) to the SR 285 Wenatchee River bridge. The screen was attached to the top of a steel plate. A pipe elbow was attached to the bottom of the steel plate. The screen/plate/elbow was attached to two (2) ecology blocks established on the riverbed. A pipe was connected to the elbow. This pipe was placed in a flat trench below the riverbed surface for about 50 ft north to the river bank. The pipe continues north landward about 25 ft; west landward (upstream) about 175 ft; ending beneath the pump building foundation pad.

Following installation of the new pressure pipe, the 12 ft long area of disturbance where the pipe enters the river was stabilized by the construction of a bioengineered revetment. The toe of the bank was excavated approximately 2 ft deep to allow the installation of Geotextile filter fabric which was secured over the shoreline and embedded in the excavated toe of the slope. Large, angular rock was placed parallel to the shoreline and native cobble, boulders and soil were backfilled over the geotextile. Existing materials onsite were used for the majority of the Project, however new angular rock was placed over the disturbed area and up the bank to the Ordinary High Water Mark (OHWM). The newly placed angular rock follows the existing slope of the shoreline at the angle of the undisturbed shoreline on each side.

The entire restored bank and the area disturbed by the installation of the pressure pipe in the upland was planted with native trees, shrubs and grasses. The proposed and approved vegetation species list was developed based on existing vegetation in the immediate vicinity. Re-vegetation

is complete and includes 3 cottonwood (Populus trichocarpa), 16 mountian alder (Alnus incana), 15 willow (salix spp.) and 61 red-osier dogwood (Cornus stolonifera). The area also has been seeded with native grasses. The planting areas will be monitored by a count for a five-year period to determine percent survival. 100% survival would be required after year 1, and 80% survival for years 2-5.

Pump House Structure and Pipe:

A track-hoe excavated landward a 200' L x 4' W x 14'-22' D trench to continue placement of the 24" pipe described in the last section to the pump building foundation pad. The building is a 14' x 16' NEMA rated enclosure on a concrete foundation with electrical controls, HVAC and wet well pumps located within 200 feet of the Wenatchee River and above the 100 year flood plain. All material excavated for the pump building foundation pad, wet well and associated improvements was transported to awaiting trucks via loader and hauled offsite. The site excavation was completed by bulldozer, backhoe and loader; cement concrete was delivered via pump truck for the foundation pad; enclosure construction was completed by standard building techniques with power equipment per the Chelan County building codes.

Retaining Walls:

Five retaining walls were constructed in conjunction with the development of the access driveway to the pump building and the ditch right-of-way. The retaining walls were essential for the developed access driveways due to the steepness of the existing grade. Two retaining walls (8 ft x 59 ft and 4 ft x 115 ft) were constructed along the driveway that connects to the existing ditch right-of-way. The remaining three retaining walls (4 ft x 65 ft, 4 ft x 32 ft, and 4 ft x 24 ft) were constructed along the driveway that accesses the pump building. These walls were not foreseen as necessary or needed during the original design of the proposal, however as development unfolded, their need became essential to the development of safe access. Each wall was constructed using an excavator to move 3-4 man rock that was stacked to construct the retaining walls, and prior excavated soil was backfilled on the uphill side to create flat, safe driveways for access.

Existing Fish Wheel

This structure is located just south (downstream) of the Monitor Main Street bridge. Since water will no longer be flowing through the canal it will be abandoned. WDFW was able to salvage the structure and will use it in another location and application.

Construction Detail

Within the larger Project there were two separate projects, The North River and the Walla Walla Satellite projects:

North: The North River pump station is now a pressurized pump-back system diverting from the confluence of the Columbia and Wenatchee Rivers, serving 56 users.

South: The Walla Walla pump station now diverts from a well and serves 29 users.

*All of the remaining users were residential and were hooked up to Regional Water Supply or the City of Wenatchee.

NORTH RIVER PUMP STATION

Pipe of Washington Contracting (POW) of Pasco, Washington was awarded the contract for construction in October of 2012. Ground breaking on the Project was November 8th, 2012. POW had seven sub-contractors working on the Project (listed in Metrics / **Appendix A**).

POW decided the first order of business on the Project was to prepare the pump station site and the mass excavation; with at least 7,500 cubic yards of dirt and rocks to move, POW kept four to five dump trucks moving through November. Often, the material was relayed with three excavators, moving the dirt and rock up the hill to be loaded into the trucks.

To keep the dust down, POW would use water trucks to spray over the work area. Every one worked very hard at keeping the surrounding neighbors happy and that included keeping the dust down and the mud off the roads. The material at the top of the mass excavation was sandy loam dirt, left from the last glaciation. As POW moved towards the bottom of the site and closer to the river they started to encounter larger cobbles and sand. At the bottom of the site they encountered some larger boulders and sandstone. The sandstone could have created a problem, but we were lucky and POW was able to work around it and get to the proper elevations and depth. The mass excavation came along very nicely and by December 14th, 2012 POW had an access road down to the river.

During construction, the team (TU-WWP, POW, Forsgren and PWUA) would meet every Tuesday morning to go over the previous weeks work and to preview the upcoming work schedule. This proved to be very helpful to keep the team on track and informed on the progress of the Project. We also set up a communication protocol to keep all parties informed and to aid in decision-making; this proved to be a critical piece of the Project and was extremely beneficial for all parties. The weekly meetings were also a good time for the team to review any change orders, field changes, coordination issues and weekly challenges. Above this, the team would give weekly updates to PWUA board of directors and participate in their monthly board meetings to inform them on the Project as a whole. This in its self was one of the reason this Project went so smoothly and is certainly a part of the success.

Concurrent with the mass excavation, POW had a crew working on grading and backfilling the existing earthen cannel along the entire six miles of ditch on the North River. This included removing some concrete sections of the ditch and a few sections of pipe.

POW graded the ditch first to create room to work. This work included being able to stage HDPE pipe and the extra room was valuable for running the HDPE welder and other equipment on PWUA right of way.

POW chose to use some of the dirt they were removing from the pump station site to fill in portions of the old ditch and to flatten the slope. This solved two issues: it was a way to get rid of some excess material that was been excavated from the pump site and where the ditch ran next to homes it was easier to bring dirt in and fill in the ditch than to do unnecessary excavation. POW was able to get through the ditch grading in short order and the ditch transgress cleaned up nicely.

At the same time as the prep work was being done to the existing ditch, POW had two sub-contractors removing all of the trees and brush along the right of way. A total of 1,050 trees were removed during this process, most of which were cottonwood, alder, and elm. One of POW subcontractors used an excavator with a brush blade. They used this implement like an enormous weed whacker and it was capable of clearing small brush and small trees, with a maximum DBH of 2". Another sub-contractor was strictly a tree removal crew; they took care of all the larger trees and also chipped and mulched all of the trees. The larger trees that could not be chipped were hauled off site.

HDPE pipe was the preferred product for this application and was used on the entire Project. With the ditch graded and the trees removed, POW was able to start welding the HDPE pipe. The first 2,500 feet of pipe would be pulled through the existing 3-foot by 4-foot concrete box culvert. The box culvert was utilized on the first section of the new mainline because of issues with bank stability and steepness of the adjacent slope. The recommendation was made by the hydrogeological consultant on the Project, who ultimately determined that disturbing the slope would cause unnecessary harm. This made more sense when the pipe could be sleeved through the culvert instead. In preparation, POW had a crew go through the entire length of box culvert and clean out all rocks, debris and any other sharp objects. This was a precautionary measure to insure that while sleeving, the pipe there would not be damage; HDPE is heavy-duty stuff but it was better to be certain no damage would occur during the long sleeving run.

After this was complete, the crew would push 700 feet of pipe through the culvert at a time, using an excavator with a large strap around the pipe. Incrementally, they would push the pipe 15 feet at a time then readjust the strap and push again until they were completely through.

The five miles of pipe beyond the box culvert was installed in a similar fashion; the crew welded 700 feet at a time and then, moved and dragged the pipe into place with a track-hoe. The bulk of the welding started in January and with this amount of pipe to weld together POW had two welding machines going at the same time. The pipe sizes ranged from 24 inch at the pump station and scaled down to 8 inches toward the end of the system, near Monitor. After it was all complete and welded together it was one continuous piece of pipe from start to finish.

On the left- 3 foot steel pipe from the old gravity canal system, on the right is the new 14 inch HDPE pipe being installed.

With the mass excavation done and the temporary road down to the river, it was time to start the construction of the coffer dam. The coffer dam was needed to install the fish screen, the suction line and suction header.

Initially, POW was going to use a product called Porta Dam. Porta Dam uses plastic sheeting and steel bracing to construct coffer dams. For multiple reasons, POW decided to go with ecology blocks to build the coffer dam. To accomplish this they brought in a 30-ton crane to set the ecology blocks, 275 of them in all. After the ecology blocks were set, they used landscape fabric as the inner shell to protect the 12 millimeter plastic sheeting that was placed as the outer shell. This proved to be effective in keeping "most" of the water out of the work area.

During the construction of the coffer dam, the crew took great care to protect the existing vegetation along the river bank; the Project plan included making as small of a foot print as possible along the river. POW took great care while working in the river bed during the placement of the fish screen, too.

Before dewatering could commence, biological consultants Gretty and Associates were hired to de-fish the coffer dam area. After construction of the temporary coffer dam was completed, fish removal efforts were conducted on January 16, 2013. When the water was low enough to work,

the contractor used a long seine net to move the fish out of the coffer dam, which as imagined, took multiple tries.

As you can see in the above photo, the crew was working in some pretty challenging conditions; the temperature was in the low to mid 20's. Three biologists were onsite and conducted the fish removal with assistance from divers working on the coffer dam. Fish capture gear onsite included beach seines, various sized fish nets (long handled and small mesh minnow nets), and buckets.

Prior to beginning fish removal, 2-3 inches of ice was removed from the surface of the water within the dam and floated out of the opening connecting the dam to the river. Following ice removal, the beach seine was deployed along the landward side of the dam, drug adjacent to the downstream end of the dam and up the waterward side of the dam to form a "U" shape in the net. The net was pulled upstream and through the opening in the dam to herd fish in the direction of the opening.

The seining procedure was completed three times through the opening in the dam. The first effort resulted in approximately 50-70 mountain whitefish (*Prosopium williamsoni*) captured in the net and released through the opening in the dam into the river. The second effort resulted in approximately 125-150 mountain whitefish released through the opening in the dam. The third effort resulted in approximately 30-40 mountain whitefish released through the opening in the dam. During all seining efforts, the cod-end of the net was temporarily held in place near the outlet of the dam while biologists inspected the fish for species, size and quantity.

Due to the large number of fish and freezing temperatures, no fish were captured for sampling during this effort and all were immediately released. The average size of the whitefish was estimated to be 6-10 inches.

Following the third seining of the area, the net was used as a temporary barrier at the outlet of the dam to prevent any fish from entering from the river. While the net was in place, the coffer dam was completed isolating fish access to the work area.

The beach seine was again deployed along the landward side of the dam and drug adjacent to the downstream end of the dam and up the water-ward side of the dam to form a "U" shape in the net. The net was pulled upstream and both ends were pulled onto the beach leaving the cod-end in the river for inspection to determine if any fish remained in the net. During this fourth seining effort there were no fish caught in the net. No additional removal efforts were conducted.

During the entire sampling effort, only mountain whitefish were observed within the fish removal area.

With the fish removal done the dewatering of the coffer dam could take place, for this POW used eight submersible pumps to accomplish the dewatering. POW chose to go with temporary power from the local PUD instead of diesel generators for two reason; the cost of diesel and the noise that the generators would make. It was challenging getting the pumps in the right location and POW took sometime to evaluate locations of the incoming wate; in the end it was a success.

The isolated area required 8 pumps to keep the work area dry and to insure a manageable work environment. Each pump was capable of pumping 1500 GPM, totaling approximately 12,000 GPM. The pumps ran 24 hours a day for about 12 days; POW would check the system twice in the middle of each night to insure there were not any problems.

After the dewatering was complete, it was time to set the fish screen, suction line and suction header. This proved to be a very time consuming process, due to the depth of the suction line and the rock that POW was encountering during the excavation of the fish screen and suction line trench. POW, Forsgren and TU-WWP worked well into the night to set the fish screen. The team accomplished the task at 1:30 am Saturday morning January 19th, 2013. We were working against fluctuating water levels of the Wenatchee/Columbia Rivers due to Chelan Co. PUD dams water use/power demand during winter months and the work had to be conducted after 5 pm. This is when folks head home and crank up the heat, which begins the release of water for power each day/night.

The fish screen is a low profile cone screen manufacture by Intake Screens, Inc. of California; a hydraulic driven motor is used to turn three rushes to keep the screen clean. The cleaning cycle is set on a timer you adjust to whatever is necessary to keep the screen clean (see **Appendix G**).

With the fish screen in place, next came the suction line and suction header. PWUA chose to go with 24-inch ductile iron for the suction and the suction header was 24-inch steel. This work was tedious and progress was very slow because precise elevation of the suction line was needed. Generally, it took the crew about eight hours to go 20-feet, during excavation and placement.

During all in-water work, Forsgren took water samples every 20 minutes for turbidity levels. POW did a very good job of staying within the range of our permits. The team also kept a close eye on other issue like debris/silt fencing, use of waddles where needed and fish friendly hydraulic oil in all machinery that worked below high water line.

Near the beginning of March, with the fish screen and suction line installed, the pump house was next on the agenda. The construction of this went quickly, in no time POW had the footings and floor poured and the framing done.

At the same time the construction of the pump house was being done, the heart of the system was also being installed; this consisted of all the electrical, including five VFD aqua drives (one for each motor, four 75 hp and one 25 hp); along with five vertical industrial turbine type Gould pumps. The 25 hp was installed to take care of low water use times when demand is under 250 gpm. Once the demand exceeds 250 gpm, a 75 hp will come on-line and the 25 hp shuts off.

POW also kept a crew busy installing pipe along PWUA right of way. When close to 20,000 feet were installed, POW started a crew installing service connections right behind the pipe installation. In order for the system to work correctly, each service connection had to have a restrictor pipe installed. The restrictor pipe size was determined by the number of shares the property owner had; this was a way PWUA could control the amount of water each shareholder could use. This was a pretty straight forward process and POW crew worked through it in no time.

By the middle of March the pump house building was nearing completion, all the HDPE pipe was installed, and the services connections were close to completion.

With the April 1st completion date just around the corner, POW had a few more things to accomplish. The road crossings for some service connections were one of the last pieces of the Project to complete and they created some challenges. Locating existing water lines was time consuming along the county road right-of-way but in the end the necessary four main road crossings were completed.

One of the last phases to be completed on north river side was the landscaping. Landmark was the sub-contractor for this work, which included hyrdro-seeding installing drip irrigation at the pump station. 230 trees and shrubs of 12 different varieties were planted at the pump station site. Along with the landscaping, a drip irrigation system was installed to keep everything watered. The crew then hydro-seeded the entire north river system from the pump house to Monitor; any ground that was touched by the construction of the new system was hydro-seeded.

Startup of the north river pump station was on April 4th 2013. All five of the pumps were brought on-line one at a time and up to operating pressure. The one main issue we had to deal with on the pumps was adding air relief valves on the discharge side of the units. We did this to get rid of the air that was in the suction header when the pumps come on-line. With this issue taken care of, the pumps ran nicely and continue to today. During the second start-up, the crew would move the water from one isolation valve to the next until the entire system was charged; this procedure was done to isolate any leaks that may have shown up. The only issue the crew encountered this time was a bad air relief valve on the mainline, which was quickly changed out. The next few days were spent adjusting the pumps on how and when they would come on and off-line during the irrigation season. This was mostly a programming procedure, but required some tinkering with the equipment, too.

The new pressurize system continues to run smoothly, with 90 lbs. pressure at the pump house and 65 lbs. at the last shareholder services valve, near Monitor. The team was very happy with the smooth start-up and is proud of the work accomplished.

WALLA WALLA SYSTEM

The Walla Walla satellite system was designed to take care of PWUA shareholders on the south side of the Wenatchee River, along Walla Walla Avenue. There are 29 shareholders on this system, which consists of an 84 foot well with a 25 horse power submersible pump. Alongside the well is a 11' x 5 ' concrete vault where the electrical panels, the VFD, aqua drive and the Siemens flow meter, with a total of 3,713 feet of 4-inch main-line.

PWUA chose to upgrade to HDPE pipe for the main line on the Walla Walla project. This was a good move, considering much of the main line is under asphalt. Along all the main line, we installed a trace-wire to help locate the main-line after instillation and for future maintenance.

For the most part, the main-line was installed right behind the sidewalk at a depth of 18-inches. POW used a mini excavator to do all the work installing the main line, and hand shovels in the tight fit places. There was a lot of landscape, light poles and other objects to work around.

One of the challenging issues the crew faced on the Walla Walla project were the 10 road crossing. They were time consuming, particularly with consideration of the traffic on Walla Walla Avenue. POW would do half of the road at a time and then move the traffic to the opposite side while working. Once one side was completed, they moved over to the other side and changed the traffic lane. This proved to be an effective way to accomplish this part of the project. Every road crossing had a carrier pipe installed, which the mainline was placed through; this will help if PWUA ever needs to replace the pipe under the road.

The Walla Walla HDPE was welded the same way as the North River project, except on a smaller scale. Basically, the crew welded the pipe in place, then put it in the trench and back filled. This worked out very well and the crew made good progress.

All service connections were installed in an irrigation box with a 2-inch gate valve with a restrictor pipe at each property owners' parcel. Like the North River project, the sizes of the restrictor pipe were based on shares, which correlates to irrigated acres.

TU-WWP was asked by the owners of the property where the pump vault is located to keep everything, including all the electrical panels, below ground in the vault. This meant the team had to install a larger vault to fit everything in, in which it was still a tight fit, but did effectively contain all the pieces.

The Walla Walla Satellite System is now operational and working fantastically. Like on the North River, POW and the team did great work to insure all affected by the project were happy in the end. Seriously, good work.

Dam Removal Completion Scheduled for mid -August 2013:

The dam is located on a side channel, adjacent to SR 2/97, east of the river mainstem. The dam is proposed to be removed "in the dry" by blocking the flow into the side channel. The channel

entrance is narrow and shallow and can easily be temporarily blocked via large sand bags. Water seepage below and through the bags will be pumped back into the river.

Gravel bags will be delivered by trucks to the channel entrance by the existing road providing access to the river located north east of the proposed diversion. The bags would be unloaded and placed by an excavator. After construction of the temporary coffer dam was complete, the standing water above the dam would be seined to capture and fish that may remain. If any fish are found, they would be removed and returned to the river following procedures for fish removal and handling

The water behind the dam will then be lowered by a controlled breach. This will be accomplished by removing a portion of the east or west edge of the dam at intervals. The river bed will then be allowed to dry out. After it is dry, a track-hoe will be used to break up the concrete and load trucks that will haul the material offsite, using the existing PWUA access road.

The accumulated material behind the dam will be used to re-grade the riverbed at the dam removal location. Excess material will be loaded into trucks and hauled offsite using the existing PWUA access road. The temporary dam will then be removed.

COMPLETION

There were a few bugs to work out of both of the systems in the first two or three weeks, but after that the systems have been running very nicely. Currently, PWUA is using about 1/3 of the water that they are accustomed to using from the Wenatchee River, thanks to the on-demand pressurized system. This is the type of system that should be installed for water conservation and could be practical in most situations.

PWUA shareholders are very happy with the new system and are thankful to TU-WWP for helping them upgrade their irrigation system and for being the leader in this Project.

TU-WWP's Pioneer Project is a good example of public/private/government cooperation to insure agriculture in conjunction with measureable ecological benefits, which improves future water supply and insures environmental preservation for future generations.

THANK YOU!

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