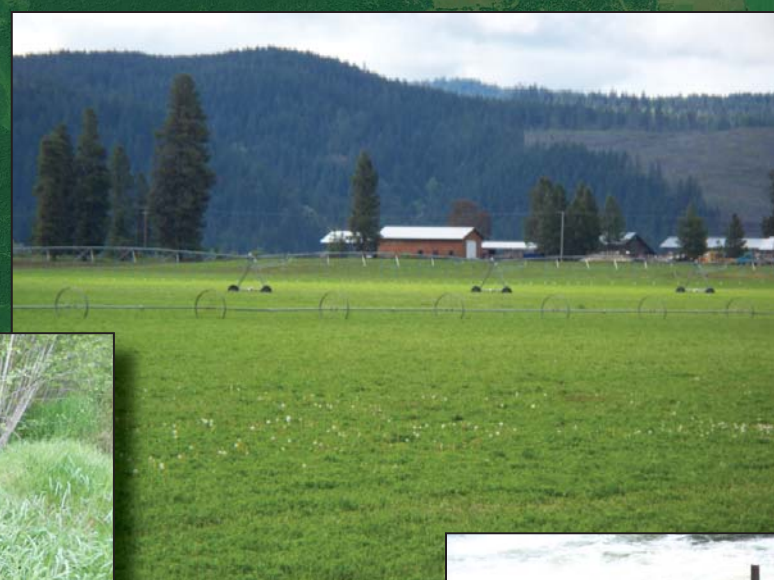
Underwood Conservation District

Trout Lake Reconnaissance Study

June 2012



anderson perry & associates, inc.

engineering · surveying · natural resources

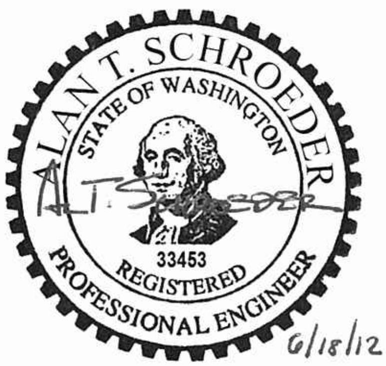
Walla Walla, WA La Grande, OR

TROUT LAKE RECONNAISSANCE STUDY

FOR

UNDERWOOD CONSERVATION DISTRICT

June 2012



This Document is for community consideration and should not be used for conclusive actions.
A more complete Feasibility Study is warranted.

FUNDED BY: KLICKITAT COUNTY ECONOMIC DEVELOPMENT AUTHORITY

ANDERSON PERRY & ASSOCIATES, INC.

Civil Engineers

Walla Walla, Washington
La Grande, Oregon

 Job No. 6006-36

Table of Contents

Table of Contents continued

FIGURES

TABLES

APPENDIX

Section 1.0 Introduction

1.1 Background

Agriculture and working farmlands are highly valued in the Trout Lake Valley, and irrigation water is an essential component of maintaining the viability of that picture. Currently, the Trout Lake Valley is irrigated by 8 separate ditches, all lacking fish screens at the intakes/outtakes and beset with other problems in functionality. There are 264 land parcels in the valley tied to water "shares". The Trout Lake community utilizes irrigation water for a variety of small and large-scale agricultural uses. Many in the Trout Lake Valley believe that the irrigation systems must be improved to maintain viable agriculture and open space in the valley.

The Trout Lake Irrigators Group (TLIG) is an ad hoc group of irrigators and representatives of irrigation ditches/companies. TLIG has been meeting regularly for several years to consider the future of agricultural irrigation in the Trout Lake Valley. Meetings have been open to the public. Each ditch has had a member attend at least two meetings. The first meeting took place June 19, 2008. The group is consensus-based at this time, and no major decisions affecting ditch operations have been made without the solicited involvement of all ditch company Boards and shareholders.

Underwood Conservation District (UCD) is serving as the administrative/fiscal sponsor of the TLIG, organizing meetings and informational presentations. UCD assistance was funded first through a state Coordinated Resource Management grant, and then through direct contributions and assessments from several ditch companies. The mission of Underwood Conservation District is to enhance natural resources and stewardship in Skamania County and western Klickitat County. UCD serves to support and facilitate the community's efforts to protect and enhance natural resources.

There are several concerns that have motivated TLIG to pursue this initial irrigation water delivery Reconnaissance Study, including:

- High likelihood of increased scrutiny of instream flows, water rights, lack of fish screens, and water quality due to increasing demands on water and the reintroduction of anadromous fish, including salmon and Pacific Lamprey in the lower White Salmon River watershed.

- Lack of capacity for individual ditch companies to accomplish tasks independently.

- Need for reliable, pressurized, and more efficient delivery of water for agricultural irrigation and possibly fire protection.

- Increased energy prices from outside sources.

Direct project partners include: members of the Coate ditch, JC Hoke ditch, Little Mountain ditch, Pearson-Olsen ditch, Pearson-Peterson-Stadleman ditch, Trout Creek Water Co., Trout Lake Water Co., and Guler ditch; the Trout Lake Community Council; and private landowners.

The TLIG sees what is occurring within irrigated agriculture elsewhere. Societal and regulatory pressures regarding fish screening and fish passage, water conservation, water rights, and natural resource protection are growing. Irrigation water delivery systems are being upgraded to address these pressures, and to improve water delivery operations. The TLIG senses that in time the eight Trout Lake ditches will face similar scrutiny. The TLIG hopes to learn facts, evaluate options, assess cost impacts, and make decisions regarding Trout Lake Valley agriculture before external pressures drive future outcomes for the Valley.

The TLIG wants to look at the feasibility of developing a piped and pressurized irrigation water delivery system serving several thousand acres of farmland. They know that a full feasibility study to accomplish planning goals could cost upwards of 10 times what Klickitat County EDA has committed for this initial study. But EDA funds are a welcome start, and the TLIG hopes to take full advantage of this initial reconnaissance opportunity.

Pre-study estimates for a robust irrigation water delivery system and accessories range between $20 million and $40 million. The TLIG knows that price tag is too high for landowners and farmers. Some other financing sources have to contribute a larger portion to the project. The two most hopeful concepts include a hydropower element for energy generation, and agency grant funding support.

Hydropower might take advantage of the available head, or elevation change, in the project area to generate electricity revenues beyond irrigation water assessments. Anticipated electricity revenues could fund some construction bond or loan capacity. Some Irrigators believe that a hydropower element is critical to make the whole concept work.

Grant funding is also a potential, but the TLIG knows there have to be sound reasons for public or tribal finance participation. Grant support might be gained through reducing the number of irrigation diversions in the Valley, fish screening, water efficiency gains, water trust fund involvement, etc. But each of these mechanisms also concern the TLIG. Natural resource enhancements are in everyone's interests, but the bottom line is that the TLIG needs to have enough water at the right time and at the right price to operate farms. Trout Lake Valley does not have enough land in high valued crops to facilitate modernization of water delivery through user assessments alone.

Besides capital cost concerns, the TLIG also wonders about future operations. Do the Irrigators have enough common goals to formalize individual ditch companies into an irrigation district for assessment and management purposes? Some public organizational structure will certainly be necessary if the TLIG intends to pursue additional water rights (e.g. Condit Dam) for hydropower. Is there enough of a user base to support ongoing operations, or are land use pressures and development taking too much from the base of agriculture needed to support a pressurized deliver system? While not financially prepared to move ahead, the TLIG is highly informed regarding complex water issues. That is a great asset for beginning more focused evaluation and planning functions.

UCD has championed the TLIG cause so far, as irrigator goals and those of UCD strongly overlap. Both entities, or TLIG/UCD combined, support natural resource stewardship in agriculture and protection of agricultural values. UCD's continued participation, as a sponsor and perhaps later as a project supporter, is very important. UCD's involvement shows cooperation in the Valley, a must for project development.

The Washington State Department of Ecology (ECY) has not yet played a strong regulatory role in White Salmon River or Trout Lake Creek water rights. ECY's priorities are targeted more in over-appropriated or low flow watersheds. ECY, aided by the Klickitat County Water Conservancy Board, will need to participate in water rights resolutions, and in possibilities for consolidating ditch intakes. Part of the TLIG/UCD long-term effort will be to secure ECY's support in project merits.

State and federal fisheries agencies and the Yakama Nation have also yet to show strong interest in Trout Lake ditch operations or screening. That may begin to change with the removal of Condit Dam in 2011 and with increased study of Pacific Lamprey. Water diversions in the upper watershed above Big Brother Falls may gain more spotlight now that the Condit Dam removal is generating new interest in the White Salmon River watershed fisheries potential.

Klickitat County and the Trout Lake Community Council are also important long term partners. Support from Klickitat County Commissioners will be needed in future funding pursuits, and in the formation of any irrigation district. Klickitat County will also be a critical partner in determining the final disposition or use of the Condit Dam hydroelectric water rights.
Condit Dam water rights may be available for basin uses following removal of Condit Dam.

Project Goals

This initial Reconnaissance Study and future efforts are aimed at:

- Retention and protection of water rights and historic water usage in the valley.
- Increased agricultural viability for both large and small operations and protection of working farmlands.
- Provision of secure, consolidated delivery of pressurized irrigation water.
- Availability of reliable, pressurized water flow for community fire protection.
- Family-wage jobs associated with project construction, as well as long-term operations and maintenance.
- Fish-screening to protect fisheries resources.
- Water conservation and fish habitat enhancement.
- Maintenance of valley aesthetics.

- Mapping and measuring of water use for better planning and regulatory compliance.
- Potential power generation through community-based low-impact production.
- Compliance with fish/water laws.

1.2 Work Description and Scope

This Reconnaissance Study focuses on some of the first issues needing consideration in a potential development project. Results from this Reconnaissance Study will allow ditch shareholders to make preliminary decisions about the future potential of co-managing or consolidating the system. The Reconnaissance Study is intended to present a few conceptual design options, incorporating community input and water modeling.

The Study is also intended to help identify and quantify the potential community and environmental benefits of the project. Beneficial natural resource outcomes for this project will not only help with furthering community support, but also greatly assist in procuring funding support from other sources for a comprehensive Feasibility Study. Benefit examples which could possibly be quantified include: the amount of irrigation water conserved, fish populations affected, energy and dollars saved, acres of farmland remaining viable or being added, number of homes and acres of forest being protected from wildfire, etc.

A wide variety of funding sources could be approached for funding the Feasibility Study and/or project construction. There are funding sources which are designed to address instream water quantity and water quality issues, agricultural irrigation efficiency improvements, clean energy and sustainable communities, rural development, fire protection, as well as fish habitat improvements. The variety of benefits this project could produce increases the potential for acquiring financial support.

Tasks or Study Products

Reconnaissance Study products envisioned at the beginning of this study are listed below. As the study progressed the TLIG focused on some products more than others. Task completion continues to evolve and will carry forward to a full Feasibility Study.

A. Water Rights Summary

Review, mapping, and quantitative analysis of publicly-available surface water rights information upstream of BZ Corner, WA.

B. Hydraulic Model

Develop a skeleton hydraulic model for main pipeline routes and sizing of pipelines.

C. Water Budget

Analysis of paper water rights and water use to develop a potential basin-wide budget for water savings.

D. Development of Design Options

Discuss at least three potential design options and provide a concept level design.

E. Summary of Quantifiable Project Benefits

Describe the amount of irrigation water conserved, fish populations affected, energy and dollars saved, acres of farmland remaining viable or being added, number of homes and acres of forest being protected from wildfire, improved crop value, decreased operating costs, etc.

F. Engineers' Opinions of Probable Cost

Develop rough order of magnitude costs based on potential design options.

G. Development of Funding Options

Summarize potential funding sources.

H. Summary of Capital and Operating Costs (life cycle)

Summarize capital and operating costs. On-farm savings due to a pressurized source would be presented on a per acre basis.

I. Permit Identification and Key Regulatory Elements

Identify key permits and regulatory involvement. Primarily identify who may need to review the project and what their involvement might be.

J. Identification of Project Pitfalls and Barriers

Identify issues such as water rights, fish passage and screening, power purchasing, etc. that may impede project development.

K. Project Timeline

Prepare a very high level estimate of a project timeline, showing permitting, funding, design, and construction.

L. Public Involvement

Continue public involvement in the process through public meetings and disseminating information and study results throughout the study period, as well as at the conclusion of the study.

Section 2.0 Water Rights Summary

2.1 Irrigation Summary

Irrigation water in the Trout Lake Valley is available to about 264 parcels. Parcels range in size from less than an acre to several hundred acres. Irrigation methods include flood, fixed head, hand line, wheel line, and center pivot irrigation. Irrigation water is provided to active farms and residential lots. Each conveyance ditch organization has a method for assigning irrigation "shares" to landowners.

An irrigation user database was created in this initial study. The database includes ditch and parcel information, share assignments, ownership, and estimates for irrigable acreage. A brief snapshot of this database is included in Table 1. All information in the database is not shown for privacy reasons. As the TLIG moves ahead, the database will serve as a functional planning tool.

Through this study TLIG has assembled a comprehensive file including available ditch user lists and associated water rights documentation. User lists and water rights information will be needed as a Feasibility Study continues.

TLIG has opted to initially focus on irrigation potential in the valley instead of historical water use. An effort to perfect water rights will be long and involved and may expose some dormant or underutilized parcels. TLIG is not at a point where discussing water rights and actual usage is widely supported in the group. That time would come once a majority of participants voice support for a potential project and water rights assessment is needed to move ahead.

Figure 1 shows existing conveyance ditch routes. None of the ditches are fitted with flow measuring devices. UCD measured ditch intake flows on five occasions between July 27 and October 11, 2011. Ditch flows are summarized in Appendix I. The peak measured flow for the total diversion system was 160 cfs.

2.2 Existing Rights and Claims

Historically, eight ditch companies have served the irrigation needs of the valley. Although some older ditches may have served portions of the historically irrigated acreage, eight separate ditch names survive, either through the process of maintaining an active shareholder association, or by the required re-filing of claims with ECY in 1973, or by both. Seven of those named or associated ditches maintain active diversions and usage by shareholders. Much of the acreage associated with the one ditch that is inactive has been absorbed into the irrigated acreage of adjoining ditches. Priority dates for each ditches' underlying claims range from 1886 to 1910. Thus each ditch was developed and had appropriated water for beneficial use prior to Condit Dam's construction in 1913. Each ditch's priority date also predates the adoption of the first statewide surface water code in 1917.

Claims for instantaneous quantities (Qi) vary from about 10 cfs to over 50 cfs, with five ditches claiming 25 cfs each. Periods of use also vary among the ditches with the majority claiming use during irrigation season, typically March through October. Several ditches claim continuous use, including the ditch with the largest Qi claim, the Trout Lake Water Company.

The quality of the 1973 re-filing of claims with ECY varies in quality, with one ditch's re-filing papers in almost perfect order under contemporary standards, with one ditch failing to re-file altogether, and with varying levels of errors and inaccuracies in the re-filings of the remaining ditches. The most typical error is the inaccurate description of irrigated lands.

Historically, there have been no calls by seniors against juniors, meaning that the more senior claims holders have never had to exercise their prior rights by shutting off the juniors. ECY has never assigned a water master to the valley, nor issued cease and desist orders to any ditch companies. Over the years there has been very little presence, and thus little guidance, from ECY.

As agriculture changed from many small dairies to a few larger ones and as a row-cropping company developed in the valley in the 1970s and 1980s, farms began the switch from flood to pressurized irrigation. In many cases it was simpler to establish a single pump station to irrigate fields that had historically been irrigated from multiple ditches. This process led to fields, or parts of fields, receiving their water from the "wrong" ditch. Often this was done with the agreement of the parties and the ditches, but without filing a change in point of diversion application with ECY.

As is natural with ditches and flood irrigation throughout the west, ditch and water politics have played a prominent role in the community. But with plenty of water relative to acres irrigated, and without the modulating role of a water master, many in the community came to assume that ownership of ditch shares was equivalent to a perfected water right.

As irrigation and farming have become more capital intensive, and land ownership has transitioned from farm to rural residential, some historically irrigated acreage has seen irrigation lapses in excess of twenty years. With twenty years of non-use representing the outside limits of even the most liberal interpretations of the statue, it is fair to say that these lands have lost their senior priority dates, and may have lost their water rights altogether. Some landowners continue to believe that their payment of ditch company assessments constitutes a water right independent of the statutory requirements for beneficial use. This presents an education challenge for individual ditch companies and within the larger community and will present a significant barrier to public understanding of any new system or project.

2.3 Irrigable Potential

The project database includes estimates for parcel size based on County Assessor maps. With parcel information summarized, the total acreage potentially served by each ditch was calculated. Field visits and aerial imagery were then used to estimate the amount of irrigable land for each ditch and for the total system. The total system includes approximately 6,700 acres of land with 5,300 acres deemed irrigable. Similar estimates for each ditch are available through the project database.

The estimate for and distribution of irrigable acres is used in this study to lay out design options, and to estimate per acreage costs. Future project refinements will need to consider actual usage in addition to the irrigation potential.

2.4 History of Interest in the Condit Dam Hydro Right

Interest in the Condit Dam water right was sparked in earnest during the Water Resource Inventory Area (WRIA) 29 Watershed Planning Process. During the period the stakeholder group deliberated on the statutory watershed planning process and its mandatory elements; Condit Dam's removal by PacifiCorp was not yet certain. A significant portion of the stakeholder group and some local governments strongly opposed both dam removal and the watershed planning process itself.

The Trout Lake Valley was well represented in the WRIA stakeholder group with active representation from irrigators, ditch companies, and the community.

Trout Lake Valley representatives were the first to realize that the water right itself had not been addressed in the 1997 settlement agreement in which PacifiCorp agreed to remove Condit Dam.

Trout Lake Valley representatives also realized that the hydropower right was actually consumptive for the reach of the river between the dam and the powerhouse (approximately 1.25 miles) and that the right could be proportionally transferable under Washington law.

That argument was initially vetted with a representative of ECY (Fred Rajala) at a conservancy board training workshop. This may have been the only time (to date) in which the idea of transferring the Condit hydropower right was presented to representatives of ECY.

The politically fraught WRIA 29 watershed planning process ultimately led one of the representatives from the Trout Lake Valley to resign. But before he did, he advised his county commissioner to give up on preventing dam removal and to instead focus on preserving the dam's water right.

Subsequently, and after its own independent analysis, the Klickitat County Commissioners pursued that strategy and ultimately reached a settlement agreement with PacifiCorp containing a provision for the quit claim of all Condit Dam water rights to Klickitat County - tied to certain benchmarks in dam removal and river restoration. At this writing that transfer was expected to take place before the end of 2012.

The WRIA 29 watershed planning process effectively ended in stalemate and Klickitat County reached its settlement agreement with PacifiCorp in 2011.

Midway through the intervening nine years TLIG began meeting to discuss environmental and conservation issues proactively, given the increased probability of dam removal.

Section 3.0 Hydraulic Model

A hydraulic model was developed for the Reconnaissance Study to determine pipeline sizes, flow rates within pipelines, and subsequent pressures developed throughout the study area. Hydraulic models are an effective way to estimate these parameters when the model is calibrated correctly and the ground surface data used is fairly accurate. Another advantage of hydraulic modeling is the ability to look at several different alternatives to have options that best fit the situation. Important parameters for the hydraulic model are the pipeline routes, and the flow and elevation design criteria to be used for the model. It is important for these parameters to be defined properly for the model to be meaningful. Another important parameter is the end goal; i.e. what are you looking to accomplish? The end goal for hydraulic modeling is to develop a pressurized irrigation system model to serve irrigation users within the study area while also incorporating the feasibility of hydropower generation using the pressurized irrigation system. The hydraulic model is able to iterate across these two purposes.

3.1 Route Selection

Route selection is a very important part of defining the hydraulic model. If route selection does not appropriately represent what is ultimately the path of the pressurized irrigation system, pipeline sizes, pipeline lengths, and associated pipeline pressures, the estimated construction cost will not be very accurate. Final TLIG pipeline routes would be selected after several design iterations. This report narrows down to a route combination that appears prudent.

There are many important features of a pipeline route to consider. Some of these important features include:

- Where are the existing routes for irrigation water transport and how effectively can these routes be used?
- Where are the existing turnouts for existing users and how would changing irrigation conveyance routes affect service ability?
- What is the route accessibility for construction?
- What is the route accessibility for long term maintenance?

- Where is the existing public right-of-way and can it be used effectively?

- Where will be an effective place to locate a hydropower generation facility?

- What topographic features, land uses, land features, and/or demographics are present that need to be considered?

These features are not all inclusive but are some of the main issues to consider when selecting routes for the pressurized pipeline system.

To determine routes for the pressurized system, a good understanding of the existing system is needed. That understanding begins with an on-the-ground review of the existing system and development of an overall existing irrigation system map. Each of the seven active main line conveyance ditches was walked and main canal turnouts were identified. This information was placed on an aerial map to develop routes for the existing ditches (Refer to Figure 1). Additionally, property owner data, tax lot data, property boundaries, road rights-of-way, key road names, and other features were retrieved from the Klickitat County Assessor databases.

During the field reconnaissance, representatives from the irrigation companies accompanied the field reviewer where possible. User input provided valuable insight to the existing system that would help in selecting effective pipeline routes.

Water for irrigation purposes originates from two sources, the White Salmon River and Trout Lake Creek. The Guler ditch, Coate ditch, Hoke ditch, Little Mountain ditch, and Trout Lake Water Company, Inc. obtain water from the White Salmon River. Trout Creek Water Company, Inc. and Pearson/Peterson/Stadleman ditch obtain water from Trout Lake Creek.

A. Intake Selection

One of the first decisions to make concerning the pipeline route is to select the number and location of intake diversions from the water sources. To provide pressurized water throughout the study area and to minimize the number of intakes, three water intakes were initially selected. Referring to Figure 2, an upper intake from the White Salmon River, and two intakes from Trout Lake Creek are proposed for the selected pipeline route. This diversion strategy will eliminate four active intakes from the White Salmon

River. If these four intakes were included, less pressurized water would be available to end users and the energy (elevation) available for hydropower would be affected dramatically. The two Trout Lake Creek intakes are included at this time to keep flexibility for future study. It may be possible in the future to combine the two Trout Lake Creek intakes into one diversion.

B. Pipeline Route Selection

From the three intakes, conceptual pipeline routes follow existing roadways and existing canal routes for the most part. Referring to Figure 2, the pipeline route from the White Salmon River would follow the existing canal until it reached an existing roadway. From there the pipeline would follow the roadway south to the existing alignment for the Pearson/Peterson/Stadleman line. The route would then split following the Pearson/Peterson/Stadleman routes that are traversing easterly and southeasterly. These routes would continue following the existing routes of the Coate ditch, Hoke ditch, Little Mountain ditch, and the Trout Lake Water Company, Inc. ditch. By following these existing alignments, existing right-of-ways or easements will be used and locations of existing user turnouts will be more efficiently connected to the pressurized system. In addition to following canal routes, the conceptual pipeline route would follow roadways where possible. The bottom end of the Trout Lake Water Company, Inc. canal alignment forms the route for the penstock for a proposed hydropower generation facility as shown on Figure 2. To provide water for the Guler ditch, the lower portion of the existing Guler ditch alignment would be used.

From the Trout Lake Creek intake, the pipeline route would follow the Trout Creek canal. The existing canal route is used instead of following adjacent roadways because of the minimal amount of grade available from the intake to several thousand feet downgradient. To use existing roadways, the pipeline would have to be buried deep to maintain the gradient and would cost more for construction. Once the route reaches SR 141, there is sufficient head so that the route can follow roadways where possible. As shown on Figure 2, the Trout Creek route connects to the White Salmon route on Warner Road so that both sources can be used for hydropower generation.

3.2 Design Criteria

The hydraulic model requires certain design criteria inputs that are utilized for determining pipe sizes and subsequent pressure conditions in the pipelines. These design criteria inputs include:

- Internal Pipe Roughness
- Ground Elevation Data
- Pipe Velocity Requirements
- Available Pressure for Users
- Location of Flow Demands
- Flow Demand per Acre
- Flow Rate for Hydropower

A. Internal Pipe Roughness

An internal pipe roughness value of 125 was used to simulate long term use. Internal pipe roughness of new pipe can be as high as 150, but that value does not take into account minor sediment buildup, internal wall buildup such as slime or scale, or minor losses due to bends, valves, and connections.

B. Ground Elevation Data

Ground elevation data from Google was used for the model and is sufficient for the level of the current study. For future progression of the feasibility analysis, more accurate data will be needed. Elevation at the intake locations will be especially important in future refinements.

C. Pipe Velocity Requirements

An approximate pipe velocity of 5 feet per second is the target velocity for pipe sizing. This value was chosen to both maintain cost effective pipe sizing and to manage the potential for water hammer. As the velocity increases, the pipe size required for a given flow rate decreases, but the amount of water hammer potential increases. The use of 5 feet per second is a common value used in the industry to meet both objectives.

D. Available Pressure for Users

The pressure required for irrigation purposes varies with the type of irrigation system used to irrigate crops. Some systems need only about 30 psi while others can use up to 60 psi. For most uses, 50 psi is an acceptable pressure to efficiently irrigate a crop. Though all points in the system cannot be accommodated with 50 psi pressure for irrigation due to topographic constraints, 50 psi will be the target design pressure for the system.

E. Location of Flow Demands

To model the water demand in the system, flow demand points must be located along the pipeline routes that simulate the outtake of water by individual users. The hydraulic model terminology for these flow demand points refer to "junction nodes". A common practice for hydraulic model development is to group several flow demands at a single junction node. By grouping the flow demands, less junction nodes are needed. As long as the junction nodes are not overly minimized, the effect on the hydraulic model is not significant. Table 1 shows the junction nodes associated with each individual user.

F. Flow Demand per Acre

The flow demand per acre is the maximum estimated use of irrigation water required by users on a per acre basis. Though the amount of use during a season varies, the maximum use is identified so that pipelines are properly sized. The irrigation demand per acre varies with crop type, soil type, and climate. For the study, two values will be used to compare the resultant pipe sizing. A rate of 14 gpm/acre and a rate of 6 gpm/acre will be used.

G. Flow Rate for Hydropower

To select a flow rate to be used for the hydropower models, a generalized hydropower generation evaluation was performed using available flow data from the White Salmon River and Trout Lake Creek. Table 2 and Table 3 show historic flows for the White Salmon River and Trout Lake Creek, respectively. As shown on the tables, flow rates for July, August, September, and October are the low flow months. Since irrigation needs are met in July through September, and October flow totals are low, available flows for hydropower will be for the months of November through June. Except for November, the maximum flow rate for hydropower for each month will be 200 cfs. A maximum flow rate of 100 cfs will be assumed for November. This maximum flow rate is a conservative approach at this time, since flows for hydropower generation will most likely originate from both the White Salmon River and Trout Lake Creek. Besides the maximum flow rate for hydropower, several other flow rates were used in the evaluation to determine the time period for payback and therefore the effectiveness of the particular flow rate.

The effectiveness of flow rates for hydropower generation were evaluated based on a general elevation head condition, estimated cost of a penstock and hydro facility infrastructure, and an estimated power wholesale rate. Referring to Table 4, the following parameters were used for the initial evaluation.

- A nominal pipe diameter was used to keep the pipe velocity about 5 fps.
- The months of November through June were used for the operation period, with all months at the given flow rate except for November. A maximum of 100 cfs was used for November.
- A static head of 650 feet was used for the evaluation. This was the approximate difference in elevation of the Trout Lake Creek diversion and the elevation at the Hydropower Facility site. The dynamic head was the static head minus pipe friction loss.
- A turbine efficiency of 85 percent was used.
- A power rate of $0.04 per kW-h was used. In the past, power rates have been much higher, but they have dropped off recently. This makes hydropower generation projects more difficult to implement and requires significant grant funds to obtain a reasonable payback time period.
- A 2 percent loan rate with various grant portions was used to evaluate the payback period.

Referring to the loan portion of Table 4, a flow rate of about 200 cfs appears to be necessary based upon the payback time period for the hydropower element only. It should be understood that the payback time period for all facilities will be longer once all infrastructure improvements have been considered.

The flow rate that will be used in the study will be 200 cfs for a combined system and 150 cfs for a White Salmon River system.

3.3 Transmission Line Modeling

An irrigation transmission line is required to feed water to all major areas of the system. Transmission lines are also called main lines. Other types of lines are connected to the transmission lines to feed water to local areas that have just a few users on them. These lines are called distribution lines or sub-mains. The hydraulic model in this report models only the transmission lines. The transmission line models show the pipe sizing required to meet the design criteria. Several transmission line models are included in the study and are described in Section 4. Model results are included electronically on CD (Appendix A through F).

3.4 Hydropower Modeling

Hydropower modeling is used to determine an estimate of the available dynamic head at the location of the hydropower generation facility. This available dynamic head is in turn used to calculate the available power that can be generated. For modeling purposes, the transmission line model was used and updated to meet design criteria requirements. By using the transmission line model as the base model, an efficient piping system can be determined which takes advantage of all pipeline routes to carry water to the hydropower facility. Several hydropower models are included in the study and are described in Section 4.

Section 4.0 Development of Design Options

Having determined a route for the pipelines to serve both the White Salmon River users and Trout Lake Creek users, several options were developed to meet the goal of pressurized irrigation water and hydropower generation. Six design options were developed. The results of each of these options provide information that is valuable to consider during future phases of project development.

4.1 Combined Irrigation System at 14 gpm/acre

The combined irrigation system at 14 gpm/acre option is a transmission line option that does not include hydropower. The flow rate developed, based upon irrigable acreages, is the high end option for irrigation use only. This option provides a comparison to the design option that uses 6 gpm/acre. This option also combines both Trout Lake Creek users with White Salmon River users. Figure 3 shows the pipe sizes resulting from the hydraulic modeling of this option and Appendix A shows the model results. The White Salmon River diversion provides approximately 128 cfs to the system and the Trout Lake Creek diversions deliver approximately 38 cfs to meet the demands. This option will also be the basis for developing a hydropower option.

4.2 Combined Irrigation System at 6 gpm/acre

The combined irrigation system at 6 gpm/acre option is a transmission line option that does not include hydropower. The flow rates developed, based upon irrigable acreages, is the low end option for irrigation use only. This option provides a comparison to the design option that uses 14 gpm/acre. This option also combines both Trout Lake Creek users with the White Salmon River users. Figure 4 shows the pipe sizes resulting from the hydraulic modeling of this option and Appendix B shows the model results. The White Salmon River diversion provides approximately 55 cfs to the system and the Trout Lake Creek intakes deliver approximately 16 cfs to meet the demands.

4.3 Hydropower for Combined Irrigation System

A. Pipeline System

The Hydropower Combined Irrigation System option uses the combined irrigation at 14 gpm/acre option as the basis of design and increases pipe sizes to meet the design criteria. The flow rate used for this hydropower option is 200 cfs. Figure 5 shows the pipe sizes resulting from the hydraulic modeling and Appendix C shows the model results. The available dynamic head generated at the location of the hydropower generation facility is 610 ft. This head is based upon the elevation at the Trout Lake Creek diversion which is estimated at 1,933 msl, and not the elevation at the White Salmon diversion which is estimated at 1,997 msl. Based upon historical flow data for the fall, winter, and spring months, both White Salmon River water and Trout Lake Creek water will be needed to obtain the 200 cfs flow rate. To use both sources, the lower elevation source controls the available elevation at the intake. Future stages of the project will determine how much water will come from the White Salmon River and Trout Creek to achieve the 200 cfs flow rate. Currently the model shows 150 cfs from the White Salmon River and 50 cfs from Trout Creek.

B. Hydropower Generation

The conceptual stage annual power generation for the combined irrigation system option would be approximately 47,000 MW-h, and the annual revenue would be approximately $1.88 million, based upon the head generated, a turbine efficiency of 85 percent, and a power rate of $0.04/kW-h. The estimated peak power would be 8.8 MW. These are conceptual numbers which will need to be reevaluated based upon actual available flow rates during the course of a season and power rates at the time.

4.4 White Salmon Irrigation System at 14 gpm/acre

This transmission line option shows the irrigation system requirements for the White Salmon River users at a demand of 14 gpm/acre. Trout Lake Creek users are not considered in this option. Figure 6 shows the pipe sizes resulting from the hydraulic modeling and Appendix D shows the model results. For this option, the White Salmon River diversion provides approximately 128 cfs. This option will also be the basis for developing a hydropower option for White Salmon River users.

4.5 Hydropower for White Salmon Irrigation System

A. Pipeline System

The "Hydropower for the White Salmon Irrigation System" option uses the White Salmon irrigation system at 14 gpm/acre option as the basis of design and increases pipe sizes to meet the design criteria. The flow rate used for this hydropower option is 150 cfs. This is approximately the flow rate required for irrigation at 14 gpm/acre. Figure 7 shows the pipe sizes resulting from the hydraulic modeling and Appendix E shows the model results. The available dynamic head generated at the location of the hydropower generation facility is 670 feet. This head is based upon the elevation of the White Salmon River diversion which is estimated at 1997 msl.

B. Hydropower Generation

The conceptual stage annual power generation for the White Salmon irrigation system option would be approximately 40,000 MW-h, and the annual revenue would be approximately $1.6 million, based upon the head generated, a turbine efficiency of 85 percent, and a power rate of $0.04/kW-h. The estimated peak power would be 7.2 MW. These are conceptual numbers that will need to be reevaluated based upon actual available flow rates during the course of a season and power rates at the time.

4.6 Trout Lake Creek Irrigation System at 14 gpm/acre

This transmission line option shows the irrigation system requirements for the Trout Lake Creek users at a demand of 14 gpm/acre. White Salmon River users and hydropower generation are not considered in this option. Figure 8 shows the pipe sizes resulting from the hydraulic modeling and Appendix F shows the model results. For this option, the Trout Lake Creek diversions provide approximately 38 cfs.

Section 5.0 Summary of Quantifiable Project Benefits

Several direct project benefits can be specifically identified at this level of study. Further identification of project benefits and quantification of those benefits requires further study.

5.1 Pressurized Water Delivery

Under the development options identified, the vast majority of parcels served would receive irrigation water at 50 psi or greater pressure. Available pressures would eliminate the need for on-farm pumping for all but a few parcels.

5.2 Ditch Leakage (Water Conservation)

No specific study has been made of seepage and other water losses in the Trout Lake ditch system. Literature indicates seepage can vary widely with soil type, ditch siltation, and other factors. Seepage losses of 10 percent to 40 percent are found widely in literature. Seepage tends to be highest early in the irrigation season as earthen ditches are filled and begin operating.

It is reasonable to estimate that at least 10 percent of the total Trout Lake diversion is lost to seepage. Evidence of seepage includes robust plant life in ditch corridors and reported moist or saturated soils. Diversion rates measured in July through October 2011 ranged between 60 and 160 cfs. If seepage losses were reduced by closing the delivery system in pipe, between 6 and 16 cfs (10 percent of total diversion) or more could remain in the White Salmon River system. Some portion of that conservation would presumably benefit downstream flows and/or water users.

5.3 Fire Protection

Pressurized water for fire protection would be available at any of the main line routes during periods of pipeline usage, including the summer period when fire danger is highest. Water pressure (50 psi or greater) and flow would greatly exceed the supply (1,000 gpm) practically deliverable by rural fire district equipment.

5.4 Fisheries

Through initial discussions with Yakama Nation Fisheries Program staff, resident Rainbow Trout and Pacific Lamprey were identified as important species that could benefit or be impacted. Benefits are not quantifiable at this time but consensus on at least two important species allows proactive planning in the future to target specific benefits.

5.5 Reduced Diversions

Conceptual options for pipeline routing reduce the total number of diversion intakes from eight to two or three. Eliminating five or six diversion locations would reduce man-made instream obstructions and diversion hazards. Diversions are subject to bed loading and siltation. Mechanical instream maintenance can be eliminated at five or six sites. Outtakes, or return flow channels, could also be reduced to one or two locations.

5.6 Screening

A pressurization project would add fish screening at all continued diversion locations and eliminate most returns, or outtakes. Screening costs for two or three diversions would conservatively be $1.0 million to $2.0 million less than full screening of existing diversions. Screen maintenance would also be less costly with two or three diversions instead of eight.

5.7 Condit Dam Water Right Preservation

A Trout Lake project has the possibility of preserving the hydroelectric right from Condit Dam for future economic and community benefits. Approximately 150 to 200 cfs could be utilized. If no other uses arise in the basin, the right may be lost in time. The hydroelectric potential represents between $1.5 million and $3.0 million (2012 dollars) in annual economic activity. This does not include the potentially larger economic benefit of increased crop values and jobs creation.

Section 6.0 Engineer's Opinions of Probable Cost

6.1 Cost Elements

There are several cost elements associated with developing a pressurized irrigation system and a hydropower generation facility. Both the pressurized irrigation system and hydropower generation facility have their own specific components to consider as cost implications. The following separately describes the cost elements for developing a pressurized irrigation system and a hydropower generation facility.

Pressurized irrigation System

A pressurized irrigation system will have the following required components to construct the system:

- **Mobilization/Demobilization** A construction project requires certain bonds to be secured for the project. Additionally, equipment and facilities for constructing the project must be mobilized to the project and demobilized from the project. Transporting equipment and establishing facilities at the jobsite are also costs that occur with mobilization and demobilization.

- **Temporary Protection and Direction of Traffic/Project Safety** Project safety for construction is the responsibility of the contractor including traffic control, signing, coordination, etc. This cost element occurs during the course of the work.

- **Pipeline** The pipeline cost element is the construction cost for providing and installing the transmission lines.

- **Sub-main Line** The sub-main lines are the irrigation lines that connect to the transmission line to distribute irrigation water to individual users. Most of the time a user's service is not directly connected to main lines. By having sub-main lines, isolation of groups of users is possible without affecting the transmission line flow rate and subsequently other users. Sub-main lines can be just a few hundred feet in length or several thousand feet in length, depending upon the location of services. The sub-main line cost element is the cost to connect to the transmission line and to construct the sub-main line.

- **Main Line Valve** Main line valves are isolation valves on the transmission line to isolate the main line at different sections. Usually there are very few main line valves because of the cost and their infrequent use. Main line valves are usually located at places where the main line splits so that each section can be isolated. The cost of main line valves includes providing and installing the valve on the transmission line.

- **Sub-main Valve** Sub-main valves are valves located at the connections to the transmission lines to isolate the sub-main lines. The cost of sub-main valves includes providing and installing the valve at the connection of the transmission line and sub-main line.

- **Air/Vac Valve** Combination air release/ air vacuum valves are used on both transmission lines and sub-main lines to expel air when filling the irrigation lines and to introduce air when draining the lines. These valves are located at high points in the system, at dead end lines that are high points, and downstream of isolation valves. The air/vac valves also provide a means for reducing the impact of water hammer. The cost of air/vac valves include providing and installing the valve and enclosure, and connecting the valve to the irrigation line.

- **Blowoff Assembly** Blowoff assemblies are drain systems used on both transmission lines and sub-main lines to drain the lines and to expel sediment buildup in the smaller irrigation lines. The valves are located at the low points in the irrigation system and at dead end lines that are low points. The cost of the blowoff assemblies include providing and installing the assembly, and connecting the assembly to the irrigation line.

- **Pressure Reducing/Flow Control** Pressure reducing /flow control stations are usually located on sub-main lines to reduce the pressure of the transmission line to a pressure suitable for users on the sub-main line. The flow control feature of the station prevents the overuse of water on the sub-main. The cost of the pressure reducing/flow control station includes providing and installing the valve, piping, enclosure, and making connections to the irrigation lines.

- **Services** The services for the pressurized irrigation system are the individual turnout points for users. These services are connected to the sub-main lines to obtain irrigation water. The services include isolation, individual flow control, and in some instances additional pressure reducing, piping, and the enclosure. The service is connected to the sub-main and the user is responsible for making a connection to the service.

- **Cathodic Protection** Several pipe material options may be used for the transmission line work. Where steel or cement mortar lined and coated steel is used, a cathodic protection system will be required to maintain the integrity of the steel.

- **Culvert Replacement** During the course of work in rural areas, culverts can be damaged or need replacement at roadside ditches. An estimate of the linear feet of culvert replacement is included for this purpose. The cost includes removing the old culvert and replacing it with a new culvert.

- **Rock Excavation** Based upon the soils maps that are available, rock will be encountered about 2.5 feet below ground surface in some areas. Rock may be encountered approximately 1,000 feet south and southwest of the White Salmon River. This would mean that the Trout Lake Creek line, a portion of the Guler line, and the lower portion of the Trout Lake line may be constructed in rock. Rock excavation is a cost element identified separately from normal excavation in soils because of the amount of effort required to excavate rock.

- **Repair of Unmarked Utilities and Irrigation** Prior to constructing irrigation improvements, an extensive mark out of existing underground utilities and irrigation lines is conducted. Unfortunately, not all locations are marked out properly by locate services and by irrigation line owners. When utilities or irrigation lines are damaged during construction, these lines must be repaired by the contractor or the utility or irrigation line owner. The cost of these repairs can be a cost to the project in some instances, and in other instances are a cost to the utility or irrigation line owner. An estimate of the cost to the project is included to cover those instances where the utility conflicts exist.

- **Surface Restoration** During the construction of irrigation improvements, the ground surface and ground surface materials will be disturbed and will require restoration. Typical types of restoration include pastures, fields, yards, roads, etc. Hydroseed surface restoration is included to account for pasture, field, and yard restoration cost. Gravel and asphalt restoration is included as a restoration cost for roadways. Other types of restoration cost that may be included in the future based on more detail study will be sod restoration, specific types of field restoration, and ditch restoration alongside roadways.

- **Potholing** Prior to the start of construction, the contractor will locate existing underground utilities and irrigation lines based upon locate mark outs. This is normally done by excavating carefully until the utility or irrigation line is located. The elevation and location of the line is identified and coordinated with the improvements in the area. The cost of performing the excavation, locate, backfill, and general restoration is included in the cost.

- **Diversion Improvements** Diversion improvements for the White Salmon River and Trout Lake Creek are included as cost elements because of the required flow rates that will need to be taken from these sources. In the study concept, several diversions will be eliminated from the White Salmon River and one upstream diversion used at the location of the upper diversion. Both of the Trout Lake Creek diversions will be used at this time although in future evaluations, one diversion may be eliminated. With the elimination of diversions, the existing diversions to be used will need to be improved to handle the additional capacity.

- **Fish Screen Improvement** To protect fish and fish passage on the White Salmon River and Trout Lake Creek, horizontal flat plate fish screens are anticipated for each of the diversions. These screens will allow water for irrigation or hydropower generation to be diverted without harming fish within these two water sources. Also, in the future, these screens may be approved for use when considering Pacific Lamprey migration.

- **ROW** To build the transmission lines and other infrastructure, rights-of-way or easements for construction and maintenance of improvements will be required. Most of the anticipated improvements will be in existing rights-of-way, but not all areas have existing rights-of-way. For areas that do not have existing rights-of-way, both temporary and permanent rights-of-way will be required.

- **Indirect Cost** Indirect costs include design engineering, construction engineering, environmental work, and permitting work.

Hydropower Generation Facility

A hydropower generation facility will have the following required components to construct the facility:

- **Penstock** The penstock is the piping system that conveys the water from the diversion (forebay) to the hydropower generation facility. For the purpose of the study, all of the main line piping system for each option is included in the penstock cost. All of the cost is included so that all irrigation system infrastructure costs are included in the payback analysis.

- **Site** The site cost includes all work at the hydropower generation facility site including site grading, site drainage, site surfacing, site piping, site fencing, and other site improvements.

- **Buildings** The building cost includes the physical building to house the turbine and switchgear. The cost also includes trolleys and rail systems for hoisting equipment and walkway systems within the building.

- **Turbine** The turbine cost includes the turbine, adjacent piping, and valves. It also includes the switchgear required to generate power.

- **Tailrace** The tailrace is the outlet for the water that passes through the turbine which connects to an adjacent waterway. The cost of the tailrace includes the outlet infrastructure, the conveyance system to the waterway, and the improvements required at the waterway to accept the hydropower facility water.

- **Transmission and Substation** A power transmission line and a power substation are facilities that may be required to transmit the power generated at the hydropower generation facility to the utility power grid. Existing powerlines adjacent to the hydropower plant may not have sufficient capacity to handle the power load from the plant, requiring a new powerline to be constructed. The project may also require the construction of a substation.

- **ROW** To build the penstock, hydropower generation facility, and the tailrace, rights-of-way or land purchases for construction and maintenance of improvements will be required. Most of these improvements will be in existing rights-of-way, but not all areas of improvements have existing rights-of-way. For areas that do not have existing rights-of-way, both temporary and permanent rights-of-way are needed.

- **Indirect Cost** The indirect costs include design engineering, construction engineering, environmental work, and permitting work.

6.2 Pressurized Irrigation System with Hydropower

Within the study, two options were developed for a pressurized system with hydropower generation. A combined system with hydropower was developed and the White Salmon River system with hydropower was developed. The combined system included both the White Salmon River and Trout Lake Creek as water sources. The White Salmon River system only used the White Salmon River as a source of water. Referring to Table 5, the estimated cost of constructing the combined system is $132.1 million. Table 6 shows the estimated cost of the White Salmon River system to be $102.6 million. The cost for both options includes all infrastructure cost associated with a pressurized irrigation system and the hydropower generation component.

6.3 Pressurized Irrigation System without Hydropower

The study includes four options for pressurized irrigation without hydropower generation. The options are a combined pressurized irrigation system with two different flow rate scenarios; a White Salmon River user pressurized irrigation system and a Trout Lake Creek user pressurized irrigation system. The combined pressurized irrigation system combines the White Salmon River and Trout Lake Creek users into one system. Tables 7 and 8 show the estimated cost for the combined pressurized irrigation system for 14 gpm/acre and 6 gpm/acre, respectively, with a total estimated cost of $59.6 million and $43.3 million. The White Salmon River pressurized irrigation system estimated cost is $49.1 million as shown on Table 9. The Trout Creek pressurized irrigation system estimated cost is $12.8 million as shown on Table 10.

Section 7.0 Development of Funding Options

TLIG is not yet in a position to seek construction financing. Further feasibility assessment is needed, as well as consensus and organization within TLIG to move a project forward. The current focus on funding should be to secure $200,000 to $400,000 for a more advanced Feasibility Study. The scope and cost of that work will partially depend on the preferred construction project scope.

TLIG should consider narrowing the area served by an initial project. Maximizing the overlap between irrigation water delivery pipelines and hydropower penstock pipelines will increase feasibility by optimizing material costs. Accordingly, TLIG may need to delay some improvements (e.g. Guler) to later phases while focusing initially on the project core.

In this section, several funding agencies and funding programs are identified. A TLIG construction project will probably require participation by a handful of agencies. Finance leveraging is common in public projects, especially large ones. State and federal participation at a high level is hard to predict at this time. Federal and state budgets are in flux and operating year to year with less programmatic planning. TLIG should learn about programs that might be involved in construction, but focus now more on additional planning dollars for a full feasibility assessment.

We suggest that TLIG representatives meet with three agencies to start a new round of finance development. These agencies include the US Bureau of Reclamation, the Department of Ecology Office of Columbia River, and USDA Rural Development. AP will join with TLIG at each meeting. Discussions with these three entities may lead to opportunities the agencies offer, or opportunities they may suggest elsewhere.

TLIG may also consider joining the Washington State Water Resources Association (WSWRA). WSWRA has regular meetings at the Sunnyside Valley Irrigation District office in Sunnyside. Rubbing elbows with other irrigation districts at WSWRA functions is one way to learn about current happenings in irrigation system operation and financing. Business member rates are reasonable and available to non-districts.

7.1 TLIG

To secure outside funds, a local match is often required or preferred. Generating a local match shows interest and support. When TLIG is unified in moving ahead, the group should consider generating a local match for continued pre-construction activities. The match may need to be on the order of $50,000 to $100,000. That represents a per acre one-time charge of $10-20 over 5,000 acres. Generating a local match would internally build confidence that the larger group is unified.

7.2 Yakama Nation Fisheries Program

A partnership with the Yakama Nation for the study of and mitigation for Pacific Lamprey may fit into the project scope. The Yakama Nation should be consulted regularly on various fronts to see if there is project interest, and possibly support.

7.3 USDA Rural Development – Rural Energy for America Program (REAP)

REAP offers loans and grants for energy efficiency improvements and renewable energy systems. Funding is available for feasibility studies and other project phases. Eligibility is limited to small businesses and agricultural producers. USDA's Yakima Office can be consulted for REAP program details.

7.4 Washington State Department of Ecology – Office of Columbia River (OCR)

OCR focuses on delivering permittable water to the Columbia River or one of its tributaries. Grants can fund studies through construction. The funding source is legislatively authorized. Water conservation through piping will leave water in the White Salmon River. A discussion with OCR staff is advisable.

7.5 Natural Resources Conservation Service (NRCS) - Agricultural Water Enhancement Program (AWEP)

AWEP is a voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land to conserve surface and groundwater and improve water quality. AWEP is not a grant program. Eligible partners enter into multi-year agreements with NRCS to promote ground and surface water conservation, or improve water quality on eligible agricultural lands. AWEP is intended to leverage investment in natural resources conservation along with services and non-Federal resources of other eligible partners.

7.6 US Bureau of Reclamation – WaterSMART

The Bureau of Reclamation joins with states, Indian tribes, irrigation districts, water districts and other organizations with water or power delivery authority to partner with Reclamation on projects that increase water conservation or result in other improvements that address water supply sustainability in the West. Focused on improving water conservation and helping water and resource managers make wise decisions about water use, Reclamation's portion of the WaterSMART program is achieved through administration of grants, scientific studies, technical assistance, and scientific expertise. Pressurization projects have been funded with WaterSMART dollars.

7.7 Washington State Community Economic Revitalization Board (CERB)

CERB is Washington's strategic economic development resource, focused on creating and retaining jobs in partnership with local government. CERB provides limited funding for studies which evaluate high-priority economic development projects. Projects should target job growth and long-term economic prosperity and can include: site-specific plans, studies, and analyses that address environmental impacts, capital facilities, land use, permitting, feasibility, marketing, project engineering, design, site planning and project debt and revenue impacts. When considering planning applications, the Board will give priority to those projects that could ultimately result in a type of project eligible for CERB construction funds.

Section 8.0 Summary of Capital and Operating Costs (life cycle)

8.1 Pressurized System with Hydropower

Within the other sections of the study, two options were developed for pressurized irrigation with a hydropower generation facility component. Additionally, estimated costs of improvements to develop the two options were provided. The two options were a combined irrigation system option and a White Salmon irrigation system option. To evaluate the feasibility of the two options, a life cycle cost analysis is needed. For this study, the time required to pay back project development loans and the estimated on-farm annual cost of the project will be used for the life cycle analysis. It is also assumed that revenue from hydropower generation will be used to pay for project development costs and hydropower generation operation and maintenance. Annual operation and maintenance for the irrigation system will be assumed to constitute the on farm cost. The following tables show the required annual revenue for a given grant dollar amount and time period to pay back project development loans. Two loan time periods are used for the analysis, a 50-year time period and a 60-year time period.

Combined Pressurized Irrigation with Hydropower

Annual Revenue from Power Generation	$1.88 million
Annual Estimated Operation and Maintenance	$0.3 million
Annual Net Revenue	$1.58 million
Estimated Project Cost	$132.1 million
Loan Rate	2 Percent

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	2.67	2.29	1.53	
50	2.96	2.54	1.69	1.27

White Salmon Pressurized Irrigation with Hydropower

Annual Revenue from Power Generation	$1.6 million
Annual Estimate Operation and Maintenance	$0.25 million
Annual Net Revenue	$1.35 million
Estimated Project Cost	$102.6 million
Loan Rate	2 Percent

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent
60	2.08	1.78	1.19
50	2.30	1.97	1.31

The annual operation and maintenance for the irrigation system for the two options include personnel, materials, and equipment. For this size of system the operation and maintenance will be between $400,000 and $500,000 annually. Given the estimated irrigable acres for the combined system is 5,300 acres, the annual on-farm cost would be approximately $75 to $95 per acre. The estimated irrigable acres for the White Salmon irrigation system is 4,100 acres. The annual on-farm cost for operation and maintenance for the White Salmon System would be approximately $75 to $100 per acre based upon an annual operation and maintenance cost between $300,000 and $400,000.

8.2 Pressurized System without Hydropower

Within other sections of this study, four options were developed for pressurized irrigation without a hydropower generation facility component. Additionally, estimated costs of improvements to develop the four options were provided. The four options were two combined irrigation system options (14 gpm/acre and 6 gpm/acre), a White Salmon irrigation system option, and a Trout Lake Creek option. The life cycle analysis for these options is the time period for pay back of loans for project development, on-farm cost for loan repayment, and on-farm cost for operation and maintenance of the irrigation system. The following tables show the results of the analysis:

Combined Irrigation at 14 gpm/acre

Project Development Cost	$59.6 million
Estimated Annual Operation and Maintenance Cost	$0.4 to $0.5 million
Loan Rate	2 percent
Estimated Irrigable Acres	5,300

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	1.21	1.03	0.69	0.52
50	1.34	1.14	0.76	0.57

On-Farm Cost per Acre for Annual Payment ($)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	227	195	130	97
50	252	216	144	108

Total On-Farm Cost for Annual Payment and Operation and Maintenance ($)

Grant (%)	60-Year Period Annual Payment	Total Cost w/ Operation and Maintenance at $75 per Acre	Total Cost w/ Operation and Maintenance at $95 per Acre
30	227	302	322
40	195	270	290
60	130	205	225
70	97	172	192

Combined Irrigation System at 6 gpm/acre

Project Development Cost	$43.3 million
Estimated Annual Operation and Maintenance Cost	$0.4 to $0.5 million
Loan Rate	2 Percent
Estimated Irrigable Acres	5,300

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	0.88	0.75	0.50	0.38
50	0.97	0.83	0.55	0.42

On-Farm Cost per Acre for Annual Payment ($)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	165	142	94	71
50	183	157	105	78

Total on-Farm Cost for Annual Payment and Operation and Maintenance ($)

Grant (%)	60-Year Period Annual Payment	Total Cost w/ Operation and Maintenance at $75 per Acre	Total Cost w/ Operation and Maintenance at $95 per Acre
30	165	240	260
40	142	217	237
60	94	169	189
70	71	146	166

White Salmon Irrigation System

Project Development Cost	$49.1 million
Estimated Annual Operation and Maintenance Cost	$0.3 to $0.4 million
Loan Rate	2 Percent
Estimated Irrigable Acres	4,100

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	0.99	0.85	0.57	0.43
50	1.10	0.94	0.63	0.47

On-Farm Cost per Acre for Annual Payment ($)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	242	208	138	104
50	268	230	153	115

Total On-Farm Cost for Annual Payment and Operation and Maintenance ($)

Grant (%)	60 Year Period Annual Payment	Total Cost w/ Operation and Maintenance at $75 per Acre	Total Cost w/ Operation and Maintenance at $100 per Acre
30	242	317	342
40	208	283	308
60	138	213	238
70	104	179	204

Trout Creek Irrigation System

Project Development Cost	$12.8 million
Estimated Annual Operation and Maintenance Cost	$0.1 to $0.2 million
Loan Rate	2 Percent
Estimated Irrigable Acres	1,200

Annual Payment Considering Percentage Grant ($ Million)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	0.26	0.22	0.15	0.11
50	0.29	0.25	0.16	0.12

On-Farm Cost per Acre for Annual Payment ($)

Period (yr)	30 Percent	40 Percent	60 Percent	70 Percent
60	216	185	123	92
50	239	205	137	102

Total On-Farm Cost for Annual Payment and Operation and Maintenance ($)

Grant (%)	60 Year Period Annual Payment	Total Cost w/ Operation and Maintenance at $85 per Acre	Total Cost w/ Operation and Maintenance at $170 per Acre
30	216	301	386
40	185	270	355
60	123	208	293
70	92	177	262

Section 9.0 Permit Identification and Key Regulatory Elements

Anticipated major permitting and regulatory elements are identified in this section for a combination pressurization and hydropower project. Additional major permitting requirements may be revealed as a full Feasibility Study is completed.

9.1 FERC Licensing

Licensing or a Conduit Exemption through the Federal Energy Regulatory Commission (FERC) would be needed to construct and operate a hydropower facility, and requires significant consultation and review with natural resource agencies. FERC hydropower licensing processes are described at www.ferc.gov.

9.2 Water Rights Confirmation

To obtain ECY approval of a new pressurized water delivery system, all water rights and claims attributable to the system will need to go through regulatory review. It is clear that some water rights/claims in the Trout Lake Valley will not be proven. Usage has been short of claims. The process of proving water rights and claims will be significant and some relinquishment should be anticipated. Water rights "trimming" for water conservation can also be anticipated in the current regulatory negotiation process.

9.3 Diversion Screening and Consolidation

Diversion screen installation and diversion consolidation will require permitting and regulatory review through the Washington State Department of Fish and Wildlife and ECY. Parallel federal agency consultation is anticipated, but is not anticipated at a high level at this time due to the lack of known threatened or endangered species in the study area.

9.4 Irrigation District Formation

Formation of a lead entity would be needed for permitting and licensing functions. The lead entity is anticipated as an irrigation district or other public entity.

9.5 NEPA and SEPA Review

Environmental assessment under the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA) will be necessary. NEPA review is anticipated as a prerequisite to project financing through at least one federal agency. General environmental assessment, specific biological assessments, and cultural resource investigations are anticipated. It is too early to determine if a full Environmental Impact Statement would be necessary.

9.6 Hydroelectric Right Transfer

Klickitat County will go through a process to select possible recipients for water rights associated with Condit Dam. That County process is just beginning. The scope and breadth of the water right transfer process by Klickitat County is unknown at this time.

9.7 Pipeline Route Land Rights

Once a preferred network of transmission and sub-main pipeline routes is identified, legal access to those routes must be secured. Many routes are likely to follow existing ditch easements or rights-of-way. Other routes may fall within other public rights-of-way, such as for county or state roads. Some access may need to be created over private lands. Various road cut and crossing permits are anticipated.

9.8 Site Specific Permits

A number of site specific permits are anticipated. These include fill and removal permits, in-water work permits, Klickitat County land use permits, and others tied to specific development sites. The list of site specific permits will be revealed as route selection and project development advances to the feasibility level.

Section 10.0 Identification of Project Pitfalls and Barriers

10.1 Water Rights

Existing water rights or claims for irrigation will need to be proven for transfer or consolidation. Varied agricultural usage in the Trout Lake Valley leaves some uncertainty for continued water rights access at a level supporting a major capital construction project. TLIG will need to decide if the level of risk is worth the potential project betterment. Water rights analysis at a higher level should be a priority in full feasibility assessment.

10.2 Condit Rights

Final disposition of water rights associated with Condit Dam is a critical uncertainty. Obtaining some portion of the hydroelectric right for Condit Dam is viewed as more likely than obtaining a new right for off-season power production. Continued preservation of the Condit right should be a top priority for TLIG and the entire County.

Transferring and putting the 1913 Condit Dam hydropower right to beneficial use will require a multi-faceted political, legal, and regulatory effort over a significant amount of time. The greatest challenge may be maintaining momentum and focused interest and through election cycles, incumbency, and administrative staffing changes at community, county and state levels over the course of years or even decades. Combining hydropower with pressurized irrigation requires significant time and effort even in those cases where irrigation districts are already in place and the economic, legal and regulatory requirements already align. Without a legally formed irrigation district and within an economic climate of electrical energy surpluses, the process becomes even more complex.

These challenges also present a unique opportunity to structure, design and implement integrated irrigation and hydropower systems providing economic and environmental benefit to the public for generations. The Condit Dam water right is unique and irreplaceable and every reasonable effort should be made to ensure that it is transferred and used beneficially.

10.3 Power Sales

At present, natural gas prices are low. Natural gas futures prices are one third the levels seen several years ago. Inexpensive natural gas is suppressing wholesale prices for all types of power. Hydropower contracts have been affected in recent years, with lower payment rates at the wholesale level. Until natural gas prices rise to more attractive levels, the sale of hydropower will be similarly constrained. That means the debt recovery on a hydropower production facility for TLIG will not be attractive until pricing circumstances change. Economic literature anticipates natural gas price recovery, but not in the near term future.

10.4 Yakama Tribe Interests

A pressurization and hydropower project for TLIG will be of interest to the Yakama Nation. The Yakamas are likely to be interested in fisheries, and water quality and water rights aspects that may be influenced or improved by a TLIG project. It is also possible that the Yakamas could choose to participate in project funding if TLIG develops project benefits important to the Yakama Nation.

In November 2011 AP and UCD personnel met with tribal natural resource staff to discuss the possible project. A summary memo from that meeting is included as Appendix G. Yakama representatives have also been invited to and attended past TLIG meetings. The November 2011 staff meeting was intended to establish a link with the Yakama Nation. That link will need to be strengthened and maintained in future project development efforts.

Because of natural passage barriers in the White Salmon River downstream of Trout Lake, anadromous salmonids may not be of concern in the project. However, Pacific Lamprey and stream-resident fish will necessitate appropriate screening at diversions and returns. The Yakamas will also be interested in water rights issues, wintertime hydropower generation effects on the river flow regime, and water quality.

TLIG should request Yakama Nation participation in the full Feasibility Study so tribal interests are recognized and supported.

10.5 Fisheries

Condit Dam was breached in the fall of 2011. Dam breaching opens up portions of the White Salmon River and its tributaries to anadromous fish passage, spawning, and rearing. Natural falls near BZ Corner are believed to prevent anadromous salmonid passage upstream to the Trout Lake Valley. Anadromous fish passage can possibly be excluded from the full feasibility study scope. Confirmation of the future study scope with state, federal, and tribal fisheries agencies should be obtained.

10.6 Capital Financing

Project capital financing in the general range of $40 million to $130 million will require participation by multiple state and federal agencies. Under current financing possibilities, 50 percent or more of the project cost will need to be supported by grants. Development of grant opportunities is critical to project feasibility and is assumed in previously developed cost scenarios.

10.7 Spatial Distribution

Some conceptualized pipeline routes through the Trout Lake Valley combine advantages for elevation (power potential), water delivery, and farm production. In central areas the viability of a pressurized system for water delivery and power production is notable. Other areas in the valley do not contribute to multi-facetted development. A full Feasibility Study should focus on areas advantageous to higher volume water delivery and power production. Marginal zones may be dropped or placed in later project development phases to improve initial cost-benefit scenarios. A White Salmon River only system or some refined "Eastside" system may emerge as the best candidate for initial development.

10.8 District Formation

TLIG members understand that securing hydropower rights and attracting project financing will require a lead entity. That lead entity almost certainly must be a public entity as major private investment is unlikely. An irrigation district including all participating lands is anticipated to move the project forward.

TLIG should continue to work through district formation concepts. A formal vote of interest by valley landowners should be considered. Prior to a Klickitat County decision on Condit rights, TLIG should at a minimum express their intentions for district formation to the County Commissioners. The County is unlikely to offer or reserve water rights without some certainty that a legal public entity will be the recipient.

10.9 Project Momentum

This Reconnaissance Study is just the beginning for project development. Time on the order of one or two decades will be needed to complete further studies, secure water rights and legal positions, and develop a financially sound project. Full project development is likely to be further out still. Sustaining project momentum will be important. TLIG should consider revisiting the project development status on a defined basis (semi-annual, annual) until the project gains its legs or passes by. Public discussion must be maintained throughout.

10.10 Project Schedule

The Reconnaissance Study has revealed, though not surprisingly, that a project schedule will cover decades. Feasibility Study funding and completion will likely take 5 to 10 years. Condit Dam water rights assignments may take 5 to 20 years in a competitive environment. Project permitting and licensing will take 5 to 10 years. Project capital financing is dependent on power market conditions and on the availability of public agency investments. Finance development will take time. Project construction is currently anticipated as possible in 10 to 20 years. This generalized schedule is common to major projects. Further investigation is needed to detail a full project schedule beyond speculation.

TABLES

TABLE 1
Existing Irrigation System Users

Water Co	g	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
?		FROM MAP						1.43	1.00	1.00	1.43	20	H		1.5"
Coate Ditch		FROM MAP						54.34	1.00	1.00	54.34	761	C		8"
Coate Ditch								3.96	1.00	1.00	3.96	55	C		2.5"
Coate Ditch								21.01	0.80	1.00	21.01	294	H		6"
Coate Ditch		FROM MAP						0.76	1.00	1.00	0.76	11	H		1"
Coate Ditch								4.08	1.00	1.00	4.08	57	H		2.5"
Coate Ditch								12.00	0.15	0.15	1.80	25	C		1.5"
Coate Ditch								247.75	0.52	0.52	128.83	1804	C		12"
Coate Ditch								20.57	0.50	0.80	16.46	230	C		6"
Coate Ditch								20.00	0.85	0.85	17.00	238	C		6"
Coate Ditch								20.00	0.80	0.80	16.00	224	C		6"
Coate Ditch								33.94	1.00	1.00	33.94	475	C		6"
Coate Ditch								74.76	0.80	0.80	59.81	837	C		8"
Coate Ditch		FROM MAP						1.00	1.00	1.00	1.00	14	H		1.5"
Coate Ditch								21.00	1.00	1.00	21.00	294	H		6"
Coate Ditch								21.00	1.00	1.00	21.00	294	H		6"
Coate Ditch								21.00	1.00	1.00	21.00	294	H		6"
Coate Ditch								45.51	1.00	1.00	45.51	637	H		8"
Coate Ditch								114.24	0.50	0.50	57.12	800	H		8"
Coate Ditch								10.60	1.00	1.00	10.60	148	C		4"
Coate Ditch								40.00	0.10	0.10	4.00	56	C		2.5"
Coate Ditch								20.00	1.00	1.00	20.00	280	C		6"
Coate Ditch								25.83	1.00	1.00	25.83	362	H		6"
Coate Ditch								48.40	0.90	0.90	43.56	610	H		8"
Coate Ditch		FROM MAP						20.00	0.20	0.50	10.00	140	H		4"
Coate Ditch								60.00	0.85	0.85	51.00	714	C		8"
Guler	West							2.35	0.80	1.00	2.35	33	G		2.5"
Guler	West							2.27	0.30	1.00	2.27	32	G		2"
Guler	East							2.13	0.20	0.95	2.02	28	P		2"
Guler	East							21.62	1.00	1.00	21.62	303	H		6"
Guler	East							21.23	1.00	1.00	21.23	297	H		6"
Guler	East							10.54	0.95	1.00	10.54	148	I		4"
Guler	West							5.15	0.40	1.00	5.15	72	G		2.5"
Guler	East							2.00	0.30	1.00	2.00	28	P		2"
Guler	West							2.46	0.70	1.00	2.46	34	G		2.5"
Guler	W	FROM MAP						2.00	1.00	1.00	2.00	28	G		2"
Guler	West							5.22	1.00	1.00	5.22	73	G		3"
Guler	West							2.02	1.00	1.00	2.02	28	G		2"
Guler	West							2.02	1.00	1.00	2.02	28	G		2"
Guler	East							6.00	0.20	0.90	5.40	76	P		3"
Guler	East							2.00	0.20	0.95	1.90	27	P		1.5"
Guler	East							15.50	0.75	1.00	15.50	217	I		6"
Guler	East							21.31	1.00	1.00	21.31	298	H		6"

Names, Parcel Numbers, and Stations were deleted for privacy.

TABLE 1
Existing Irrigation System Users

Water Co	gr	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
Guler	West							56.20	0.50	0.90	50.58	708	G		8"
Guler	West							1.85	0.50	1.00	1.85	26	G		1.5"
Guler	West							1.43	0.80	1.00	1.43	20	G		1.5"
Guler	West							1.43	0.60	1.00	1.43	20	G		1.5"
Guler	East							10.00	0.90	1.00	10.00	140	I		4"
Guler	East							11.60	0.90	1.00	11.60	162	I		4"
Guler	West							20.00	0.90	0.95	19.00	266	G		6"
Guler	West							20.00	0.80	1.00	20.00	280	G		6"
Guler	West							0.35	1.00	1.00	0.35	5	G		1"
Guler	West							5.15	0.40	1.00	5.15	72	G		2.5"
Guler	East							1.77	1.00	1.00	1.77	25	H		1.5"
Guler	East							18.31	0.75	0.95	17.39	244	P		6"
Guler	West							2.14	0.80	1.00	2.14	30	G		2"
Guler	East							199.03	0.95	0.95	189.08	2647	G		14"
Guler	East?							12.22	1.00	1.00	12.22	171	P		4"
Guler	West							2.14	0.50	1.00	2.14	30	G		2"
Guler	West							2.07	0.60	1.00	2.07	29	G		2"
Guler	East							25.16	1.00	1.00	25.16	352	P		6"
Guler	West							2.58	0.70	1.00	2.58	36	G		2.5"
Guler	West							5.15	0.40	1.00	5.15	72	G		2.5"
Guler	East							4.88	1.00	1.00	4.88	68	P		2.5"
Guler	East							2.00	0.70	0.95	1.90	27	P		1.5"
Guler	E	FROM MAP						8.20	0.90	1.00	8.20	115	H		3"
Guler	West							2.57	0.60	1.00	2.57	36	G		2.5"
Guler	West							2.16	1.00	1.00	2.16	30	G		2"
Guler	West							1.21	1.00	1.00	1.21	17	G		1.5"
Guler	E	FROM MAP						27.80	1.00	1.00	27.80	389	P		6"
Guler	East							2.60	1.00	1.00	2.60	36	P		2.5"
Guler	West							4.24	0.80	1.00	4.24	59	G		2.5"
Guler	West							2.00	0.40	1.00	2.00	28	G		2"
Guler	E	FROM MAP						9.00	1.00	1.00	9.00	126	P		4"
Guler	East							2.00	0.90	0.95	1.90	27	P		1.5"
Guler	West							2.43	0.50	1.00	2.43	34	G		2.5"
Guler	East							7.26	0.10	0.80	5.81	81	P		3"
Guler	East							6.88	0.60	0.90	6.19	87	P		3"
Guler	West							2.04	0.60	1.00	2.04	29	G		2"
Guler	East							2.55	0.80	1.00	2.55	36	H		2.5"
Guler	West							2.00	0.50	1.00	2.00	28	G		2"
Guler	East							89.32	0.05	0.05	4.47	63	I		2.5"
Guler	West							2.00	0.30	1.00	2.00	28	G		2"
Guler	West							21.00	0.80	0.90	18.90	265	G		6"
Guler	West							21.15	0.70	0.70	14.81	207	G		6"
Guler	East							2.54	1.00	1.00	2.54	36	H		2.5"

TABLE 1
Existing Irrigation System Users

Water Co	g	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
Guler	West							20.00	0.30	0.90	18.00	252	G		6"
Guler	West							1.06	0.50	1.00	1.06	15	G		1.5"
Guler	East							20.00	1.00	1.00	20.00	280	P		6"
Guler	East							20.00	1.00	1.00	20.00	280	P		6"
Guler	West							2.58	0.80	1.00	2.58	36	G		2.5"
Guler	East							2.00	0.30	0.95	1.90	27	P		1.5"
Guler	East							4.91	0.90	0.90	4.42	62	P		2.5"
Guler	East							3.97	0.50	0.9	3.57	50	P		2.5"
Guler	West							2.01	0.90	1.00	2.01	28	G		2"
Guler	West							2.60	0.40	1.00	2.60	36	G		2.5"
Guler	East							18.19	1.00	1.00	18.19	255	P		6"
Guler	West							1.03	1.00	1.00	1.03	14	G		1.5"
Guler	West							2.64	0.70	1.00	2.64	37	G		2.5"
Guler	West							2.12	0.60	1.00	2.12	30	G		2"
Guler	East							2.54	1.00	1.00	2.54	36	H		2.5"
Guler	East							3.01	0.50	1.00	3.01	42	P		2.5"
Guler	East							36.07	0.80	1.00	36.07	505	P		8"
Guler	East							40.00	0.01	0.05	2.00	28	I		2"
Guler	West							30.00	0.40	1.00	30.00	420	G		6"
Guler	West							2.65	0.40	1.00	2.65	37	G		2.5"
Hoke		sep name,share list						35.00	1.00	1.00	35.00	490	H		8"
Hoke		added	12-29-11					62.00	0.95	0.95	58.90	825	H		8"
Hoke		sep name,share list						39.40	1.00	1.00	39.40	552	H		8"
Hoke		sep name,share list						39.60	0.90	0.90	35.64	499	H		8"
Hoke		sep name,share list						35.00	0.60	0.60	21.00	294	H		6"
Hoke		sep name,share list						40.00	0.90	0.90	36.00	504	H		8"
Hoke		FROM MAP						1.15	1.00	1.00	1.15	16	H		1.5"
Hoke		sep name,share list						33.00	1.00	1.00	33.00	462	H		6"
Hoke		sep name,share list						28.16	0.90	1.00	28.16	394	H		6"
Hoke		sep name,share list						9.34	0.20	0.20	1.87	26	H		1.5"
Hoke		sep name,share list						13.50	0.40	0.40	5.40	76	H		3"
Hoke		sep name,share list						12.32	0.90	0.90	11.09	155	H		4"
Hoke		sep name,share list						5.00	1.00	1.00	5.00	70	H		2.5"
Hoke		sep name,share list						3.50	1.00	1.00	3.50	49	H		2.5"
Hoke		sep name,share list						5.60	1.00	1.00	5.60	78	H		3"
Hoke		FROM MAP						22.12	0.70	0.80	17.70	248	H		6"
Hoke		sep name,share list						22.00	1.00	1.00	22.00	308	H		6"
Hoke		FROM MAP						1.34	1.00	1.00	1.34	19	H		1.5"
Hoke		sep name,share list						22.80	1.00	1.00	22.80	319	H		6"
Hoke		sep name,share list						20.62	1.00	1.00	20.62	289	H		6"
Hoke		sep name,share list						20.14	0.85	0.85	17.12	240	H		6"
Hoke								20.13	0.75	0.90	18.12	254	H		6"
Hoke								20.13	0.75	0.90	18.12	254	H		6"

TABLE 1
Existing Irrigation System Users

Water Co	gr	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
Hoke								20.10	0.70	0.70	14.07	197	H		4"
Hoke								20.00	0.30	0.90	18.00	252	H		6"
Hoke		sep name,share list						119.24	0.90	0.90	107.32	1502	H		12"
Hoke								49.75	1.00	1.00	49.75	697	H		8"
Hoke								29.43	1.00	1.00	29.43	412	H		6"
Hoke		FROM MAP						0.75	1.00	1.00	0.75	11	H		1"
Hoke								20.47	1.00	1.00	20.47	287	H		6"
Hoke		added	12-29-11					80.00	0.60	0.60	48.00	672	H		8"
Hoke		MAP						11.00	1.00	1.00	11.00	154	P		4"
Hoke		FROM MAP						1.99	1.00	1.00	1.99	28	H		2"
Hoke		sep name,share list						10.00	1.00	1.00	10.00	140	H		4"
Hoke		sep name,share list						28.54	0.20	0.20	5.71	80	H		3"
Little Mtn Ditch								20.00	0.20	0.80	16.00	224	P		6"
Little Mtn Ditch								20.22	0.90	0.90	18.20	255	P		6"
Little Mtn Ditch								19.67	0.80	0.95	18.69	262	P		6"
Little Mtn Ditch								135.74	1.00	1.00	135.74	1900	P		12"
Little Mtn Ditch								88.80	1.00	1.00	88.80	1243	P		10"
Little Mtn Ditch								59.70	0.75	0.80	47.76	669	P		8"
Little Mtn Ditch								2.75	1.00	1.00	2.75	39	P		2.5"
Little Mtn Ditch								17.78	0.95	0.95	16.89	236	P		6"
P/P/S Ditch								1.50	1.00	1.00	1.50	21	P		1.5"
P/P/S Ditch								6.53	1.00	1.00	6.53	91	P		3"
P/P/S Ditch								35.41	0.90	0.90	31.87	446	P		6"
P/P/S Ditch								23.52	1.00	1.00	23.52	329	P		6"
P/P/S Ditch								1.59	1.00	1.00	1.59	22	P		1.5"
P/P/S Ditch								22.07	1.00	1.00	22.07	309	H		6"
P/P/S Ditch								0.96	1.00	1.00	0.96	13	P		1.5"
P/P/S Ditch								6.00	1.00	1.00	6.00	84	P		3"
P/P/S Ditch								69.94	0.80	0.95	66.44	930	H		10"
P/P/S Ditch								20.00	1.00	1.00	20.00	280	H		6"
P/P/S Ditch								83.81	0.90	0.95	79.62	1115	H		10"
P/P/S Ditch		MAP SPLIT						56.82	1.00	1.00	56.82	795	P		8"
P/P/S Ditch								35.44	1.00	1.00	35.44	496	P		8"
P/P/S Ditch								7.06	1.00	1.00	7.06	99	P		3"
P/P/S Ditch								12.96	1.00	1.00	12.96	181	P		4"
P/P/S Ditch								20.00	0.80	1.00	20.00	280	P		6"
P/P/S Ditch								40.00	0.60	1.00	40.00	560	P		8"
P/P/S Ditch								80.00	0.90	1.00	80.00	1120	P		10"
P/P/S Ditch								75.50	1.00	1.00	75.50	1057	P		10"
P/P/S Ditch								1.11	1.00	1.00	1.11	16	P		1.5"
P/P/S Ditch								11.06	0.90	0.90	9.95	139	H		4"
P/P/S Ditch								0.62	1.00	1.00	0.62	9	P		1"
P/P/S Ditch								16.27	0.75	0.95	15.46	216	H		6"

TABLE 1
Existing Irrigation System Users

Water Co	g	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
P/P/S Ditch								7.00	1.00	1.00	7.00	98	P		3"
P/P/S Ditch								7.50	1.00	1.00	7.50	105	P		3"
Trout Creek		sep name,share list						20.14	1.00	1.00	20.14	282	N		6"
Trout Creek		sep name,share list						25.62	1.00	1.00	25.62	359	N		6"
Trout Creek		added	12-29-11					13.33	1.00	1.00	13.33	187	N		4"
Trout Creek		sep name,share list						20.01	0.10	1.00	20.01	280	N		6"
Trout Creek								26.52	0.10	0.10	2.65	37	N		2.5"
Trout Creek								21.28	0.50	0.50	10.64	149	N		4"
Trout Creek		sep name,share list						20.21	1.00	1.00	20.21	283	N		6"
Trout Creek		sep name,share list						1.00	1.00	1.00	1.00	14	N		1.5"
Trout Creek		sep name,share list						5.00	0.20	1.00	5.00	70	N		2.5"
Trout Creek		sep name,share list						4.45	0.10	1.00	4.45	62	N		2.5"
Trout Creek		sep name,share list						120.00	0.25	0.50	60.00	840	N		8"
Trout Creek								80	0.40	1.00	80.00	1120	N		10"
Trout Creek		sep name,share list						20.00	0.50	1.00	20.00	280	N		6"
Trout Creek		sep name,share list						52.89	0.70	1.00	52.89	740	N		8"
Trout Creek		sep name,share list						40.00	1.00	1.00	40.00	560	N		8"
Trout Creek		sep name,share list						1.37	1.00	1.00	1.37	19	N		1.5"
Trout Creek		sep name,share list						22.56	1.00	1.00	22.56	316	N		6"
Trout Creek		sep name,share list						20.01	0.50	1.00	20.01	280	N		6"
Trout Creek								20.01	0.60	1.00	20.01	280	N		6"
Trout Creek								22.52	0.70	1.00	22.52	315	N		6"
Trout Creek		sep name,share list						13.21	1.00	1.00	13.21	185	N		4"
Trout Creek								6.8	1.00	1.00	6.80	95	N		3"
Trout Creek		sep name,share list						13.33	1.00	1.00	13.33	187	N		4"
Trout Creek								13.33	1.00	1.00	13.33	187	N		4"
Trout Creek								7.00	1.00	1.00	7.00	98	N		3"
Trout Creek		sep name,share list						13.00	1.00	1.00	13.00	182	N		4"
Trout Creek		sep name,share list						5.00	0.20	1.00	5.00	70	N		2.5"
Trout Creek		sep name,share list						39.57	1.00	1.00	39.57	554	N		8"
Trout Lake								21.00	0.20	1.00	21.00	294	E		6"
Trout Lake								28.21	1.00	1.00	28.21	395	E		6"
Trout Lake								20.00	0.90	0.90	18.00	252	E		6"
Trout Lake								20.30	0.80	0.90	18.27	256	E		6"
Trout Lake								23.65	1.00	1.00	23.65	331	E		6"
Trout Lake								59.46	0.90	1.00	59.46	832	N		8"
Trout Lake								7.38	0.50	1.00	7.38	103	E		3"
Trout Lake								7.00	0.20	1.00	7.00	98	E		3"
Trout Lake								21.44	0.20	1.00	21.44	300	E		6"
Trout Lake								37.63	0.50	0.95	35.75	500	E		8"
Trout Lake								37.82	1.00	1.00	37.82	529	E		8"
Trout Lake								20.65	0.20	1.00	20.65	289	E		6"
Trout Lake		FROM MAP						5.00	0.50	1.00	5.00	70	E		2.5"

TABLE 1

Existing Irrigation System Users

Water Co	g	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
Trout Lake								155.34	0.50	0.80	124.27	1740	E		12"
Trout Lake		FROM MAP						0.38	1.00	1.00	0.38	5	E		1"
Trout Lake								8.14	0.50	1.00	8.14	114	E		3"
Trout Lake								34.20	0.90	1.00	34.20	479	E		8"
Trout Lake								96.88	0.70	0.70	67.82	949	E		10"
Trout Lake								3.45	1.00	1.00	3.45	48	E		2.5"
Trout Lake								20.39	0.50	1.00	20.39	285	E		6"
Trout Lake								24.62	0.80	1.00	24.62	345	E		6"
Trout Lake								40.26	0.75	0.95	38.25	535	E		8"
Trout Lake								17.00	1.00	1.00	17.00	238	H		6"
Trout Lake								8.24	0.50	1.00	8.24	115	E		3"
Trout Lake								23.70	1.00	1.00	23.70	332	H		6"
Trout Lake								20.94	1.00	1.00	20.94	293	E		6"
Trout Lake								21.12	1.00	1.00	21.12	296	E		6"
Trout Lake								21.52	1.00	1.00	21.52	301	E		6"
Trout Lake								10.00	0.20	1.00	10.00	140	E		4"
Trout Lake								12.00	0.10	1.00	12.00	168	E		4"
Trout Lake								11.86	0.80	1.00	11.86	166	E		4"
Trout Lake		FROM MAP						20.22	1.00	1.00	20.22	283	E		6"
Trout Lake								52.96	0.80	1.00	52.96	741	E		8"
Trout Lake								22.90	1.00	1.00	22.90	321	E		6"
Trout Lake								30.09	0.01	0.50	15.05	211	E		6"
Trout Lake								21.00	0.90	1.00	21.00	294	H		6"
Trout Lake								21.00	0.20	1.00	21.00	294	E		6"
Trout Lake								20.00	0.80	1.00	20.00	280	E		6"
Trout Lake								20.06	0.75	1.00	20.06	281	E		6"
Trout Lake								17.70	0.30	0.80	14.16	198	H		4"
Trout Lake								20.00	1.00	1.00	20.00	280	E		6"
Trout Lake								20.00	0.90	1.00	20.00	280	E		6"
Trout Lake								20.00	0.80	0.80	16.00	224	E		6"
Trout Lake								20.00	0.10	1.00	20.00	280	E		6"
Trout Lake								2.00	0.80	1.00	2.00	28	E		2"
Trout Lake								21.00	0.50	1.00	21.00	294	E		6"
Trout Lake								632.60	0.15	0.15	94.89	1328	E		10"
Trout Lake								20.00	0.90	0.90	18.00	252	E		6"
Trout Lake								20.00	1.00	1.00	20.00	280	E		6"
Trout Lake								9.04	0.60	1.00	9.04	127	E		4"
Trout Lake								21.02	0.65	1.00	21.02	294	E		6"
Trout Lake								20.00	0.60	1.00	20.00	280	E		6"
Trout Lake								20.00	0.60	0.60	12.00	168	E		4"
Trout Lake								20.00	0.90	0.90	18.00	252	E		6"
Trout Lake								32.76	0.95	0.95	31.12	436	E		6"
Trout Lake								21.00	0.70	0.90	18.90	265	E		6"

TABLE 1

Existing Irrigation System Users

Water Co	gr	source	Certificate	Surname	Name	Notes/multiple lots	Parcel No.	Acres	Curr % irr	rmv trees % irr	Full Irr acre	Water Alloca (gpm)	pipe	Station	Serv Size
Trout Lake								20.00	0.20	0.80	16.00	224	E		6"
Trout Lake								44.00	0.90	1.00	44.00	616	E		8"
Trout Lake								11.20	0.80	0.80	8.96	125	E		4"
Trout Lake		FROM MAP						8.84	1.00	1.00	8.84	124	E		4"
Trout Lake								20.00	1.00	1.00	20.00	280	E		6"
		FROM MAP						19.98	1.00	1.00	19.98	280	H		6"
		FROM MAP						20.00	1.00	1.00	20.00	280	H		6"
							Check sum	6640.35			5307.34	74,303			
											gpm/acre	14			

Serv size	range low	rng hi	Serv size	Count
1"	0	12.74	1"	5
1.5"	12.8	27.5	1.5"	23
2"	27.5	32.5	2"	19
2.5"	32.5	72.5	2.5"	34
3"	72.5	122.5	3"	19
4"	122.5	204	4"	27
6"	205	475	6"	95
8"	476	840	8"	30
10"	841	1350	10"	8
12"	1351	2000	12"	4
14"	2001	2700	14"	1

Table 2
White Salmon River Historical Flow Rates
Above Trout Lake Creek

	October	November	December	January	February	March	April	May	June	July	August	September
Max Day	471	785	879	527	860	475	587	718	539	359	290	297
Avg Day	176.1	206.9	220.1	212.4	253.6	210.2	277.2	346.5	340.8	248.6	203.2	174.7
Min Day	132	132	122	120	115	110	163	179	212	182	155	138

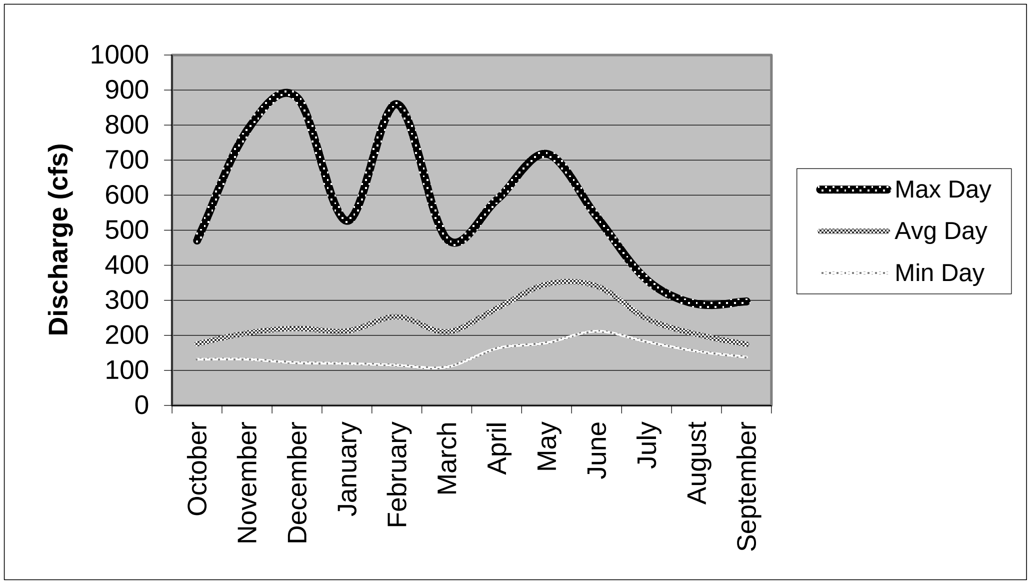


Table 3
Trout Lake Creek Historical Flow Rates (cfs)

	1909	1910	1911	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
January		650	242		320	887	725	401	850	1280	248	1230	450	1370
February		737	157		820	1340	304	1350	417	890	114	692	1970	150
March		1060	321		739	678	232	325	191	316	415	340	631	343
April		737	463		810	688	986	624	314	1540	855	198	390	623
May		650	768		860	785	674	515	807	674	1210	901	510	1220
June		438	707		796	735	453	261	841	472	614	598	800	815
July		115	181	138	199	146	148	86	266	123	290	222	94	161
August		56	66	50	91	57	70	45	149	64	65	63	146	
September		49	109	218	58	114	140	37	76	51	47	54	138	
October	142	92		590	140	131	446	133	124	62	127	890	386	
November	1540	1130		883	1530	397	1800	447	631	270	452	701	1120	
December	1470	489		585	286	898	674	347	2200	304	1560	503	582	
Avg	1051	516.9	334.9	410.7	554.1	571.3	554.3	380.9	572.2	503.8	499.8	532.7	601.4	668.9
Min	142	49	66	50	58	57	70	37	76	51	47	54	94	150
Max	1540	1130	768	883	1530	1340	1800	1350	2200	1540	1560	1230	1970	1370

Table 4
Trout Lake Irrigators Group c/o Underwood Conservation District
Trout Lake Irrigation Improvement and Hydropower Reconnaissance Study
Conceptual Hydropower Evaluation

Static Head (FT)	650
Penstock Length (mi)	9.9
Turbine Efficiency (%)	85
Power Rate ($)	0.04

Flow CFS	Nominal Penstock Diameter FT	Estimated Peak Power MG-W	Estimated Annual Power Gen MG-W-HR	Estimated Annual Revenue $ mil	O&M $ mil	Estimated Annual Net Rev $ mil	Penstock $ mil	Site $ mil	Bldgs $ mil	Turbine $ mil	Tailrace $ mil	Transmission & Substation $ mil	ROW $ mil	Indirect Cost $ mil	Estimated Total Cost $ mil
50	3.5	1.9	12541	0.502	0.15	0.352	18.0	0.5	0.5	2.5	0.1	1.5	2.0	3.5	28.6
100	5.0	4.1	24041	0.962	0.20	0.762	25.0	0.5	1.0	4.5	0.2	2.5	2.0	5.2	40.9
150	6.0	6.3	35332	1.413	0.25	1.163	32.0	0.5	1.5	6.5	0.3	3.5	2.0	6.7	53.0
200	7.0	8.6	47067	1.883	0.30	1.583	40.0	0.5	2.0	9.0	0.4	5.0	2.0	8.3	67.2

Loan @ 2%

	60 Year				50 Year				40 Year				30 Year			
Flow CFS	0% Grant $ mil	20% Grant $ mil	30% Grant $ mil	40% Grant $ mil	0% Grant $ mil	20% Grant $ mil	30% Grant $ mil	40% Grant $ mil	0% Grant $ mil	20% Grant $ mil	30% Grant $ mil	40% Grant $ mil	0% Grant $ mil	20% Grant $ mil	30% Grant $ mil	40% Grant $ mil
50	0.827	0.661	0.579	0.496	0.915	0.732	0.641	0.549	1.050	0.840	0.735	0.630	1.281	1.025	0.897	0.769
100	1.182	0.946	0.827	0.709	1.309	1.047	0.916	0.785	1.501	1.201	1.051	0.901	1.832	1.466	1.283	1.099
150	1.532	1.225	1.072	0.919	1.696	1.357	1.187	1.018	1.945	1.556	1.362	1.167	2.374	1.900	1.662	1.425
200	1.942	1.554	1.359	1.165	2.150	1.720	1.505	1.290	2.466	1.973	1.726	1.480	3.011	2.408	2.107	1.806

See attached notes

Trout Lake Reconnaissance Study
Hydropower for Combined Irrigation System
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
	IRRIGATION SYSTEM				
1	Mobilization/Demobilization	LS	$ 80,000	All Req'd	$ 5,100,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	500	5,000
4	84-inch Pipeline	LF	610	26,700	16,287,000
5	72-inch Pipeline	LF	510	10,200	5,202,000
6	60-inch Pipeline	LF	350	23,500	8,225,000
7	42-inch Pipeline	LF	210	40,000	8,400,000
8	36-inch Pipeline	LF	200	14,200	2,840,000
9	24-inch Pipeline	LF	120	16,800	2,016,000
10	18-inch Pipeline	LF	85	2,000	170,000
11	16-inch Pipeline	LF	70	4,100	287,000
12	14-inch Pipeline	LF	65	3,300	214,500
13	12-inch Pipeline	LF	45	700	31,500
14	10-inch Pipeline	LF	40	300	12,000
15	6-inch Pipeline	LF	30	1,200	36,000
16	Sub-main Pipeline	LF	30	100,000	3,000,000
17	Main Line Valve	EA	45,000	10	450,000
18	Sub-main Valve	EA	1,200	100	120,000
19	Main Line Air/Vac	EA	8,000	30	240,000
20	Sub-main Air/Vac	EA	2,500	150	375,000
21	Blowoff Assemblies	EA	3,500	150	525,000
22	Pressure Reducing/Flow Control	EA	17,000	150	2,550,000
23	1-inch Service	EA	2,000	5	10,000
24	1.5-inch Service	EA	3,500	23	80,500
25	2-inch Service	EA	4,000	19	76,000
26	2.5-inch Service	EA	5,000	34	170,000
27	3-inch Service	EA	7,500	19	142,500
28	4-inch Service	EA	15,000	27	405,000
29	6-inch Service	EA	16,000	95	1,520,000
30	8-inch Service	EA	17,000	30	510,000
31	10-inch Service	EA	19,000	8	152,000
32	12-inch Service	EA	21,000	4	84,000
33	14-inch Service	EA	23,000	1	23,000
34	Cathodic Protection	LS	700,000	All Req'd	700,000
35	Culvert Replacement	LF	42	1,000	42,000
36	Rock Excavation	CY	60	150,000	9,000,000
37	Repair of Unmarked Utilities	EA	600	300	180,000
38	Repair of Unmarked Irrigation	EA	600	300	180,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
39	Hydroseed Surface Restoration	SY	0.50	500,000		250,000
40	Gravel Surface Restoration	SY	5	250,000		1,250,000
41	Asphalt Surface Restoration	SY	60	2,000		120,000
42	Potholing	LS	50,000	All Req'd		50,000
43	Diversion Improvements	EA	200,000	3		600,000
44	Fish Screen Improvements	LS	1,200,000	All Req'd		1,200,000
				IRRIGATION SUBTOTAL	**$**	**72,931,000**
				Sales Tax (7.0%)	**$**	**5,105,200**
				IRRIGATION TOTAL ESTIMATED COST	**$**	**78,036,200**

Contingency	$	11,705,400
Indirect	$	12,563,800
IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY	$	102,305,400

HYDROPOWER GENERATION

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
1	Site	LS	$ 500,000	All Req'd	$	500,000
2	Buildings	LS	2,000,000	All Req'd		2,000,000
3	Turbine	LS	9,000,000	All Req'd		9,000,000
4	Tailrace	LS	400,000	All Req'd		400,000
5	Transmission & Substation	LS	5,000,000	All Req'd		5,000,000
6	ROW	LS	600,000	All Req'd		600,000
				HYDROPOWER SUBTOTAL		17,500,000
				Sales Tax (7.0%)	**$**	**1,225,000**
				HYDROPOWER TOTAL ESTIMATED COST	**$**	**18,725,000**

Contingency	$	2,808,800
Indirect	$	8,300,000
HYDROPOWER TOTAL ESTIMATED COST PLUS CONTINGENCY	$	29,833,800

TOTAL IRRIGATION WITH HYDRO POWER ESTIMATED COST	**$**	**132,139,200**

Trout Lake Reconnaissance Study
Hydropower for White Salmon Irrigation System
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
	IRRIGATION SYSTEM				
1	Mobilization/Demobilization	LS	80,000	All Req'd	$ 4,000,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	500	5,000
4	72-inch Pipeline	LF	510	36,700	18,717,000
5	60-inch Pipeline	LF	350	23,500	8,225,000
6	42-inch Pipeline	LF	210	13,600	2,856,000
7	36-inch Pipeline	LF	200	14,200	2,840,000
8	24-inch Pipeline	LF	120	16,800	2,016,000
9	18-inch Pipeline	LF	85	2,000	170,000
10	16-inch Pipeline	LF	70	4,100	287,000
11	14-inch Pipeline	LF	65	3,300	214,500
12	12-inch Pipeline	LF	45	700	31,500
13	10-inch Pipeline	LF	40	300	12,000
14	6-inch Pipeline	LF	30	1,200	36,000
15	Sub-main Pipeline	LF	30	80,000	2,400,000
16	Main Line Valve	EA	45,000	9	405,000
17	Sub-main Valve	EA	1,200	80	96,000
18	Main Line Air/Vac	EA	8,000	20	160,000
19	Sub-main Air/Vac	EA	2,500	130	325,000
20	Blowoff Assemblies	EA	3,500	130	455,000
21	Pressure Reducing/Flow Control	EA	17,000	130	2,210,000
22	1-inch Service	EA	2,000	4	8,000
23	1.5-inch Service	EA	3,500	17	59,500
24	2-inch Service	EA	4,000	19	76,000
25	2.5-inch Service	EA	5,000	30	150,000
26	3-inch Service	EA	7,500	12	90,000
27	4-inch Service	EA	15,000	19	285,000
28	6-inch Service	EA	16,000	80	1,280,000
29	8-inch Service	EA	17,000	23	391,000
30	10-inch Service	EA	19,000	3	57,000
31	12-inch Service	EA	21,000	4	84,000
32	14-inch Service	EA	23,000	1	23,000
33	Cathodic Protection	LS	600,000	All Req'd	600,000
34	Culvert Replacement	LF	42	700	29,400
35	Rock Excavation	CY	60	100,000	6,000,000
36	Repair of Unmarked Utilities	EA	600	200	120,000
37	Repair of Unmarked Irrigation	EA	600	200	120,000
38	Hydroseed Surface Restoration	SY	0.50	400,000	200,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
39	Gravel Surface Restoration	SY	5	200,000		1,000,000
40	Asphalt Surface Restoration	SY	60	1,000		60,000
41	Potholing	LS	35,000	All Req'd		35,000
42	Diversion Improvements	EA	200,000	1		200,000
43	Fish Screen Improvements	LS	820,000	All Req'd		820,000
				IRRIGATION SUBTOTAL	**$**	**57,248,900**
				Sales Tax (7.0%)	**$**	**4,007,400**
				IRRIGATION TOTAL ESTIMATED COST	**$**	**61,256,300**
			Contingency		$	9,188,400
			Indirect		$	9,862,300
			IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY		$	80,307,000

HYDROPOWER GENERATION

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
1	Site	LS	500,000	All Req'd		500,000
2	Buildings	LS	1,500,000	All Req'd		1,500,000
3	Turbine	LS	6,500,000	All Req'd		6,500,000
4	Tailrace	LS	300,000	All Req'd		300,000
5	Transmission & Substation	LS	3,500,000	All Req'd		3,500,000
6	ROW	LS	400,000	All Req'd		400,000
				HYDROPOWER SUBTOTAL		12,700,000
				Sales Tax (7.0%)	**$**	**889,000**
				HYDROPOWER TOTAL ESTIMATED COST	**$**	**13,589,000**
			Contingency		$	2,038,400
			Indirect		$	6,700,000
			HYDROPOWER TOTAL ESTIMATED COST PLUS CONTINGENCY		$	22,327,400

TOTAL IRRIGATION WITH HYDROPOWER ESTIMATED COST	**$**	**102,634,400**

TABLE 7

Trout Lake Reconnaissance Study
Combined Irrigation System at 14 gpm/acre
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
1	Mobilization/Demobilization	LS	$ 80,000	All Req'd	$ 3,000,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	500	5,000
4	72-inch Pipeline	LF	510	8,400	4,284,000
5	66-iinch Pipeline	LF	475	1,600	760,000
6	54-inch Pipeline	LF	320	3,500	1,120,000
7	48-inch Pipeline	LF	230	18,500	4,255,000
8	42-inch Pipeline	LF	210	6,600	1,386,000
9	36-inch Pipeline	LF	200	7,200	1,440,000
10	30-inch Pipeline	LF	150	8,300	1,245,000
11	24-inch Pipeline	LF	120	22,700	2,724,000
12	20-inch Pipeline	LF	95	14,000	1,330,000
13	18-inch Pipeline	LF	85	4,800	408,000
14	16-inch Pipeline	LF	70	12,100	847,000
15	14-inch Pipeline	LF	65	16,900	1,098,500
16	12-inch Pipeline	LF	45	1,100	49,500
17	10-inch Pipeline	LF	40	9,200	368,000
18	8-inch Pipeline	LF	35	2,700	94,500
19	6-inch Pipeline	LF	30	3,700	111,000
20	4-inch Pipeline	LF	25	1,300	32,500
21	Sub-main Pipeline	LF	30	100,000	3,000,000
22	Main Line Valve	EA	45,000	10	450,000
23	Sub-main Valve	EA	1,200	100	120,000
24	Main Line Air/Vac	EA	8,000	30	240,000
25	Sub-main Air/Vac	EA	2,500	150	375,000
26	Blowoff Assemblies	EA	3,500	150	525,000
27	Pressure Reducing/Flow Control	EA	17,000	150	2,550,000
28	1-inch Service	EA	2,000	5	10,000
29	1.5-inch Service	EA	3,500	23	80,500
30	2-inch Service	EA	4,000	19	76,000
31	2.5-inch Service	EA	5,000	34	170,000
32	3-inch Service	EA	7,500	19	142,500
33	4-inch Service	EA	15,000	27	405,000
34	6-inch Service	EA	16,000	95	1,520,000
35	8-inch Service	EA	17,000	30	510,000
36	10-inch Service	EA	19,000	8	152,000
37	12-inch Service	EA	21,000	4	84,000
39	14-inch Service	EA	23,000	1	23,000
40	Cathodic Protection	LS	500,000	All Req'd	500,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
40	Culvert Replacement	LF	42	1,000		42,000
41	Rock Excavation	CY	60	30,000		1,800,000
42	Repair of Unmarked Utilities	EA	600	300		180,000
43	Repair of Unmarked Irrigation	EA	600	300		180,000
44	Hydroseed Surface Restoration	SY	0.50	500,000		250,000
45	Gravel Surface Restoration	SY	5	250,000		1,250,000
46	Asphalt Surface Restoration	SY	60	2,000		120,000
47	Potholing	LS	50,000	All Req'd		50,000
48	Diversion Improvements	EA	200,000	3		600,000
49	Fish Screen Improvements	LS	1,000,000	All Req'd		1,000,000
				IRRIGATION SUBTOTAL	**$**	**41,063,000**
				Sales Tax (7.0%)	**$**	**2,874,400**
				IRRIGATION TOTAL ESTIMATED COST	**$**	**43,937,400**

Contingency	$	6,590,600
Indirect	$	8,589,800
ROW	$	500,000
IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY	$	59,617,800

Trout Lake Reconnaissance Study
Combined Irrigation System at 6 gpm/acre
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
1	Mobilization/Demobilization	LS	$ 80,000.00	All Req'd	$ 2,000,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	500	5,000
4	48-inch Pipeline	LF	230	8,400	1,932,000
5	42-inch Pipeline	LF	210	1,600	336,000
6	36-inch Pipeline	LF	200	7,800	1,560,000
7	30-inch Pipeline	LF	150	19,300	2,895,000
8	24-inch Pipeline	LF	120	8,600	1,032,000
9	20-inch Pipeline	LF	95	2,200	209,000
10	18-inch Pipeline	LF	85	14,800	1,258,000
11	16-inch Pipeline	LF	70	14,100	987,000
12	14-inch Pipeline	LF	65	16,000	1,040,000
13	12-inch Pipeline	LF	45	8,400	378,000
14	10-inch Pipeline	LF	40	15,000	600,000
15	8-inch Pipeline	LF	35	13,900	486,500
16	6-inch Pipeline	LF	30	6,300	189,000
17	4-inch Pipeline	LF	25	5,400	135,000
18	3-inch Pipeline	LF	20	900	18,000
19	Sub-main Pipeline	LF	30	100,000	3,000,000
20	Main Line Valve	EA	45,000	10	450,000
21	Sub-main Valve	EA	1,200	100	120,000
22	Main Line Air/Vac	EA	8,000	30	240,000
23	Sub-main Air/Vac	EA	2,500	150	375,000
24	Blowoff Assemblies	EA	3,500	150	525,000
25	Pressure Reducing/Flow Control	EA	17,000	150	2,550,000
26	1-inch Service	EA	2,000	43	86,000
27	1.5-inch Service	EA	3,500	30	105,000
28	2-inch Service	EA	4,000	11	44,000
29	2.5-inch Service	EA	5,000	34	170,000
30	3-inch Service	EA	7,500	62	465,000
31	4-inch Service	EA	15,000	42	630,000
32	6-inch Service	EA	16,000	33	528,000
33	8-inch Service	EA	17,000	9	153,000
34	10-inch Service	EA	19,000	1	19,000
35	Cathodic Protection	LS	500,000	All Req'd	500,000
36	Culvert Replacement	LF	42	1,000	42,000
37	Rock Excavation	CY	60	25,000	1,500,000
38	Repair of Unmarked Utilities	EA	600	300	180,000
39	Repair of Unmarked Irrigation	EA	600	300	180,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
40	Hydroseed Surface Restoration	SY	0.50	500,000		250,000
41	Gravel Surface Restoration	SY	5	250,000		1,250,000
42	Asphalt Surface Restoration	SY	60	2,000		120,000
43	Potholing	LS	50,000	All Req'd		50,000
44	Diversion Improvements	EA	200,000	3		600,000
45	Fish Screen Improvements	LS	430,000	All Req'd		430,000
				IRRIGATION SUBTOTAL	**$**	**29,722,500**
				Sales Tax (7.0%)	**$**	**2,080,600**
				IRRIGATION TOTAL ESTIMATED COST	**$**	**31,803,100**

Contingency	$	4,770,500
Indirect	$	6,217,500
ROW	$	500,000
IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY	$	43,291,100

Trout Lake Reconnaissance Study
White Salmon Irrigation System at 14 gpm/acre
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
1	Mobilization/Demobilization	LS	$ 80,000	All Req'd	$ 2,500,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	300	3,000
4	72-inch Pipeline	LF	510	8,400	4,284,000
5	66-iinch Pipeline	LF	475	1,600	760,000
6	54-inch Pipeline	LF	320	3,500	1,120,000
7	48-inch Pipeline	LF	230	18,500	4,255,000
8	42-inch Pipeline	LF	210	1,500	315,000
9	36-inch Pipeline	LF	200	12,200	2,440,000
10	30-inch Pipeline	LF	150	2,900	435,000
11	24-inch Pipeline	LF	120	12,500	1,500,000
12	20-inch Pipeline	LF	95	11,000	1,045,000
13	18-inch Pipeline	LF	85	3,700	314,500
14	16-inch Pipeline	LF	70	10,700	749,000
15	14-inch Pipeline	LF	65	13,300	864,500
16	12-inch Pipeline	LF	45	700	31,500
17	10-inch Pipeline	LF	40	6,500	260,000
18	8-inch Pipeline	LF	35	1,800	63,000
19	6-inch Pipeline	LF	30	4,000	120,000
20	4-inch Pipeline	LF	25	750	18,800
21	Sub-main Pipeline	LF	30	80,000	2,400,000
22	Main Line Valve	EA	45,000	9	405,000
23	Sub-main Valve	EA	1,200	80	96,000
24	Main Line Air/Vac	EA	8,000	20	160,000
25	Sub-main Air/Vac	EA	2,500	130	325,000
25	Blowoff Assemblies	EA	3,500	130	455,000
26	Pressure Reducing/Flow Control	EA	17,000	130	2,210,000
27	1-inch Service	EA	2,000	4	8,000
28	1.5-inch Service	EA	3,500	17	59,500
29	2-inch Service	EA	4,000	19	76,000
30	2.5-inch Service	EA	5,000	30	150,000
31	3-inch Service	EA	7,500	12	90,000
32	4-inch Service	EA	15,000	19	285,000
33	6-inch Service	EA	16,000	80	1,280,000
34	8-inch Service	EA	17,000	23	391,000
35	10-inch Service	EA	19,000	3	57,000
36	12-inch Service	EA	21,000	4	84,000
37	14-inch Service	EA	23,000	1	23,000
38	Cathodic Protection	LS	400,000	All Req'd	400,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
39	Culvert Replacement	LF	42	700	29,400
40	Rock Excavation	CY	60	20,000	1,200,000
41	Repair of Unmarked Utilities	EA	600	200	120,000
42	Repair of Unmarked Irrigation	EA	600	200	120,000
43	Hydroseed Surface Restoration	SY	0.50	400,000	200,000
44	Gravel Surface Restoration	SY	5	200,000	1,000,000
45	Asphalt Surface Restoration	SY	60	1,000	60,000
46	Potholing	LS	35,000	All Req'd	35,000
47	Diversion Improvements	EA	200,000	1	200,000
48	Fish Screen Improvements	LS	820,000	All Req'd	820,000
				IRRIGATION SUBTOTAL	**$ 33,917,200**
				Sales Tax (7.0%)	**$ 2,374,200**
				IRRIGATION TOTAL ESTIMATED COST	**$ 36,291,400**

Contingency	$	5,443,700
Indirect	$	7,095,000
ROW	$	300,000
IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY	$	49,130,100

Trout Lake Reconnaissance Study
Trout Lake Creek Irrigation System at 14 gpm/acre
COST ESTIMATE
March 2012

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
1	Mobilization/Demobilization	LS	$ 80,000	All Req'd	$ 620,000
2	Temporary Protection and Direction of Traffic/Project Safety	LS	10,000	All Req'd	100,000
3	Project Documentation	EA	10	300	3,000
4	36-inch Pipeline	LF	200	500	100,000
5	30-inch Pipeline	LF	150	5,100	765,000
6	24-inch Pipeline	LF	120	6,100	732,000
7	20-inch Pipeline	LF	95	8,800	836,000
8	18-inch Pipeline	LF	85	2,100	178,500
9	16-inch Pipeline	LF	70	7,400	518,000
10	14-inch Pipeline	LF	65	2,700	175,500
11	10-inch Pipeline	LF	40	1,400	56,000
12	8-inch Pipeline	LF	35	6,700	234,500
13	Sub-main Pipeline	LF	30	20,000	600,000
14	Main Line Valve	EA	45,000	2	90,000
15	Sub-main Valve	EA	1,200	20	24,000
16	Main Line Air/Vac	EA	8,000	10	80,000
17	Sub-main Air/Vac	EA	2,500	30	75,000
18	Blowoff Assemblies	EA	3,500	30	105,000
19	Pressure Reducing/Flow Control	EA	17,000	30	510,000
20	1-inch Service	EA	2,000	1	2,000
21	1.5-inch Service	EA	3,500	6	21,000
22	2.5-inch Service	EA	5,000	4	20,000
23	3-inch Service	EA	7,500	7	52,500
24	4-inch Service	EA	15,000	8	120,000
25	6-inch Service	EA	16,000	15	240,000
26	8-inch Service	EA	17,000	7	119,000
27	10-inch Service	EA	19,000	5	95,000
28	Cathodic Protection	LS	200,000	All Req'd	200,000
29	Culvert Replacement	LF	42	300	12,600
30	Rock Excavation	CY	60	10,000	600,000
31	Repair of Unmarked Utilities	EA	600	100	60,000
32	Repair of Unmarked Irrigation	EA	600	100	60,000
33	Hydroseed Surface Restoration	SY	0.50	100,000	50,000
34	Gravel Surface Restoration	SY	5	100,000	500,000
35	Asphalt Surface Restoration	SY	60	1,000	60,000

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT		TOTAL PRICE
36	Potholing	LS	15,000	All Req'd		15,000
37	Diversion Improvements	EA	200,000	2		400,000
38	Fish Screen Improvements	LS	320,000	All Req'd		320,000
				IRRIGATION SUBTOTAL	**$**	**8,749,600**
				Sales Tax (7.0%)	**$**	**612,500**
				IRRIGATION TOTAL ESTIMATED COST	**$**	**9,362,100**

Contingency	$	1,404,300
Indirect	$	1,830,300
ROW	$	200,000
IRRIGATION TOTAL ESTIMATED COST PLUS CONTINGENCY	$	12,796,700

APPENDIX

Appendix A

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-100	722.00	72.0	Ductile Iron	125.0	65,440.00	0.74	1.02	5.16
P-110	693.00	72.0	Ductile Iron	125.0	65,440.00	0.71	1.02	5.16
P-120	944.00	72.0	Ductile Iron	125.0	65,440.00	0.96	1.02	5.16
P-130	618.00	72.0	Ductile Iron	125.0	65,349.00	0.63	1.02	5.15
P-140	1,700.00	72.0	Ductile Iron	125.0	64,682.00	1.69	1.00	5.10
P-300	1,301.00	72.0	Ductile Iron	125.0	64,122.00	1.28	0.98	5.05
P-310	694.00	72.0	Ductile Iron	125.0	63,676.00	0.67	0.97	5.02
P-320	1,710.00	72.0	Ductile Iron	125.0	63,362.00	1.64	0.96	4.99
P-330	424.00	66.0	Ductile Iron	125.0	56,800.00	0.51	1.20	5.33
P-340	1,169.00	66.0	Ductile Iron	125.0	55,683.00	1.35	1.15	5.22
P-350	548.00	54.0	Ductile Iron	125.0	34,375.36	0.69	1.26	4.82
P-360	570.00	54.0	Ductile Iron	125.0	34,375.36	0.72	1.26	4.82
P-370	542.00	54.0	Ductile Iron	125.0	34,375.36	0.68	1.26	4.82
P-380	1,809.00	54.0	Ductile Iron	125.0	34,375.36	2.27	1.26	4.82
P-390	2,026.00	48.0	Ductile Iron	125.0	32,985.36	4.18	2.06	5.85
P-400	2,267.00	48.0	Ductile Iron	125.0	31,224.36	4.23	1.86	5.54
P-410	1,641.00	48.0	Ductile Iron	125.0	29,327.36	2.72	1.66	5.20
P-415	1,671.00	48.0	Ductile Iron	125.0	29,173.35	2.75	1.64	5.17
P-420	3,042.00	48.0	Ductile Iron	125.0	28,398.36	4.76	1.56	5.04
P-430	1,263.00	48.0	Ductile Iron	125.0	28,162.36	1.95	1.54	4.99
P-440	1,357.00	48.0	Ductile Iron	125.0	27,907.36	2.06	1.51	4.95
P-450	1,121.00	48.0	Ductile Iron	125.0	27,421.36	1.64	1.47	4.86
P-460	1,252.00	48.0	Ductile Iron	125.0	25,471.36	1.60	1.28	4.52
P-470	1,231.00	48.0	Ductile Iron	125.0	25,471.36	1.57	1.28	4.52
P-480	1,637.00	48.0	Ductile Iron	125.0	25,471.36	2.09	1.28	4.52
P-490	1,471.00	42.0	Ductile Iron	125.0	23,571.36	3.12	2.12	5.46
P-500	2,001.00	36.0	Ductile Iron	125.0	17,851.00	5.38	2.69	5.63
P-510	2,457.00	36.0	Ductile Iron	125.0	16,914.00	5.98	2.43	5.33
P-520	1,046.00	36.0	Ductile Iron	125.0	13,534.00	1.68	1.61	4.27
P-530	1,366.00	30.0	Ductile Iron	125.0	12,690.00	4.74	3.47	5.76
P-533	838.00	30.0	Ductile Iron	125.0	10,815.00	2.16	2.58	4.91
P-537	657.00	30.0	Ductile Iron	125.0	9,192.00	1.26	1.91	4.17
P-540	1,331.00	24.0	Ductile Iron	125.0	8,022.00	5.86	4.40	5.69
P-545	1,421.00	24.0	Ductile Iron	125.0	6,741.00	4.53	3.19	4.78
P-550	1,289.00	20.0	Ductile Iron	125.0	4,926.00	5.59	4.34	5.03
P-555	1,353.00	20.0	Ductile Iron	125.0	4,637.00	5.25	3.88	4.74
P-560	639.00	18.0	Ductile Iron	125.0	4,357.00	3.69	5.77	5.49
P-563	2,019.00	14.0	Ductile Iron	125.0	2,737.00	16.76	8.30	5.70
P-565	1,095.00	14.0	Ductile Iron	125.0	2,299.00	6.58	6.01	4.79
P-570	2,532.00	14.0	Ductile Iron	125.0	2,070.00	12.53	4.95	4.31
P-580	3,684.00	14.0	Ductile Iron	125.0	2,070.00	18.23	4.95	4.31
P-700	2,027.00	24.0	Ductile Iron	125.0	6,237.00	5.60	2.76	4.42
P-720	729.00	18.0	Ductile Iron	125.0	3,590.00	2.94	4.03	4.53
P-730	1,242.00	18.0	Ductile Iron	125.0	3,590.00	5.01	4.03	4.53
P-750	1,237.00	16.0	Ductile Iron	125.0	2,410.00	4.23	3.42	3.85
P-760	1,619.00	16.0	Ductile Iron	125.0	2,405.00	5.52	3.41	3.84
P-770	1,272.00	16.0	Ductile Iron	125.0	2,293.00	3.97	3.12	3.66
P-780	526.00	14.0	Ductile Iron	125.0	1,974.00	2.38	4.53	4.11
P-785	999.00	14.0	Ductile Iron	125.0	1,841.00	3.98	3.98	3.84
P-790	1,742.00	14.0	Ductile Iron	125.0	1,712.00	6.07	3.48	3.57
P-800	685.00	12.0	Ductile Iron	125.0	1,536.00	4.13	6.03	4.36

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-810	320.00	10.0	Ductile Iron	125.0	835.00	1.52	4.74	3.41
P-820	331.00	6.0	Ductile Iron	125.0	252.00	2.06	6.21	2.86
P-830	896.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-900	2,295.00	42.0	Ductile Iron	125.0	20,802.65	3.87	1.68	4.82
P-910	1,308.00	42.0	Ductile Iron	125.0	19,567.65	1.97	1.50	4.53
P-920	1,551.00	42.0	Ductile Iron	125.0	17,274.65	1.85	1.19	4.00
P-930	1,574.00	36.0	Ductile Iron	125.0	13,699.65	2.59	1.65	4.32
P-940	1,284.00	24.0	Ductile Iron	125.0	7,667.52	5.20	4.05	5.44
P-950	1,007.00	24.0	Ductile Iron	125.0	7,667.52	4.08	4.05	5.44
P-960	1,214.00	24.0	Ductile Iron	125.0	7,667.52	4.92	4.05	5.44
P-970	1,249.00	24.0	Ductile Iron	125.0	6,970.52	4.24	3.40	4.94
P-980	622.00	24.0	Ductile Iron	125.0	6,970.52	2.11	3.40	4.94
P-990	731.00	24.0	Ductile Iron	125.0	6,196.52	2.00	2.73	4.39
P-1000	796.00	24.0	Ductile Iron	125.0	5,896.52	1.98	2.49	4.18
P-1010	830.00	24.0	Ductile Iron	125.0	5,609.52	1.88	2.27	3.98
P-1020	1,535.00	20.0	Ductile Iron	125.0	4,605.52	5.88	3.83	4.70
P-1030	1,340.00	20.0	Ductile Iron	125.0	4,465.52	4.85	3.62	4.56
P-1040	2,284.00	20.0	Ductile Iron	125.0	4,465.52	8.26	3.62	4.56
P-1050	1,305.00	20.0	Ductile Iron	125.0	4,225.52	4.26	3.27	4.32
P-1060	1,384.00	16.0	Ductile Iron	125.0	2,571.65	5.34	3.86	4.10
P-1070	1,426.00	10.0	Ductile Iron	125.0	915.65	8.02	5.63	3.74
P-1075	1,132.00	6.0	Ductile Iron	125.0	369.65	14.29	12.63	4.19
P-1080	607.00	4.0	Ductile Iron	125.0	-207.35	18.93	31.19	5.29
P-1090	733.00	4.0	Ductile Iron	125.0	-207.35	22.86	31.19	5.29
P-1100	355.00	12.0	Ductile Iron	125.0	-1,823.35	2.94	8.29	5.17
P-1110	1,266.00	20.0	Ductile Iron	125.0	-5,087.35	5.83	4.61	5.20
P-1200	609.00	20.0	Ductile Iron	125.0	4,418.12	2.16	3.55	4.51
P-1205	1,038.00	18.0	Ductile Iron	125.0	3,657.12	4.33	4.17	4.61
P-1210	1,128.00	16.0	Ductile Iron	125.0	2,943.12	5.59	4.96	4.70
P-1220	808.00	16.0	Ductile Iron	125.0	2,943.12	4.00	4.96	4.70
P-1230	1,089.00	16.0	Ductile Iron	125.0	2,943.12	5.40	4.96	4.70
P-1240	1,041.00	16.0	Ductile Iron	125.0	2,770.12	4.61	4.43	4.42
P-1250	1,160.00	16.0	Ductile Iron	125.0	2,714.12	4.95	4.27	4.33
P-1260	1,064.00	10.0	Ductile Iron	125.0	910.12	5.92	5.56	3.72
P-1270	978.00	10.0	Ductile Iron	125.0	910.12	5.44	5.56	3.72
P-1280	1,338.00	10.0	Ductile Iron	125.0	910.12	7.44	5.56	3.72
P-1290	1,248.00	8.0	Ductile Iron	125.0	630.12	10.41	8.34	4.02
P-1300	1,319.00	6.0	Ductile Iron	125.0	162.12	3.57	2.71	1.84
P-1310	1,479.00	8.0	Ductile Iron	125.0	-536.88	9.17	6.20	3.43
P-1320	419.00	10.0	Ductile Iron	125.0	-1,373.88	5.00	11.93	5.61
P-1400	141.00	36.0	Ductile Iron	125.0	8,862.00	0.10	0.74	2.79
P-1410	306.00	30.0	Ductile Iron	125.0	8,862.00	0.55	1.79	4.02
P-1420	1,088.00	24.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1430	893.00	24.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1440	533.00	30.0	Ductile Iron	125.0	8,862.00	0.95	1.79	4.02
P-1450	501.00	30.0	Ductile Iron	125.0	8,862.00	0.89	1.79	4.02
P-1460	564.00	30.0	Ductile Iron	125.0	8,862.00	1.01	1.79	4.02
P-1470	1,262.00	30.0	Ductile Iron	125.0	8,708.00	2.18	1.73	3.95
P-1480	1,231.00	30.0	Ductile Iron	125.0	8,708.00	2.13	1.73	3.95
P-1490	1,006.00	30.0	Ductile Iron	125.0	8,708.00	1.74	1.73	3.95
P-1500	1,260.00	24.0	Ductile Iron	125.0	8,092.00	5.64	4.48	5.74

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-1510	567.00	24.0	Ductile Iron	125.0	8,092.00	2.54	4.48	5.74
P-1520	1,407.00	24.0	Ductile Iron	125.0	8,092.00	6.30	4.48	5.74
P-1530	1,239.00	24.0	Ductile Iron	125.0	8,092.00	5.55	4.48	5.74
P-1540	1,613.00	24.0	Ductile Iron	125.0	7,812.00	6.76	4.19	5.54
P-1550	2,157.00	24.0	Ductile Iron	125.0	5,852.00	5.30	2.46	4.15
P-1560	874.00	20.0	Ductile Iron	125.0	5,386.00	4.47	5.12	5.50
P-1570	2,114.00	20.0	Ductile Iron	125.0	4,826.00	8.83	4.18	4.93
P-1580	1,163.00	18.0	Ductile Iron	125.0	3,894.00	5.45	4.69	4.91
P-1590	1,394.00	16.0	Ductile Iron	125.0	3,233.00	8.22	5.90	5.16
P-1600	1,359.00	14.0	Ductile Iron	125.0	2,132.00	7.10	5.23	4.44
P-1610	1,848.00	10.0	Ductile Iron	125.0	1,392.00	22.59	12.22	5.69
P-1620	1,814.00	10.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-110	1,985.00	Zone	Demand	0.00	Fixed	0.00	1,996.26	4.87
J-120	1,990.00	Zone	Demand	0.00	Fixed	0.00	1,995.56	2.40
J-130	1,984.00	Zone	Demand	91.00	Fixed	91.00	1,994.60	4.58
J-140	1,972.00	Zone	Demand	667.00	Fixed	667.00	1,993.97	9.50
J-150	1,950.00	Zone	Demand	560.00	Fixed	560.00	1,992.27	18.29
J-300	1,938.00	Zone	Demand	446.00	Fixed	446.00	1,991.00	22.93
J-310	1,946.00	Zone	Demand	314.00	Fixed	314.00	1,990.33	19.18
J-320	1,935.00	Zone	Demand	325.00	Fixed	325.00	1,988.69	23.23
J-330	1,931.00	Zone	Demand	1,117.00	Fixed	1,117.00	1,988.18	24.74
J-340	1,914.00	Zone	Demand	505.00	Fixed	505.00	1,986.83	31.51
J-350	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,986.14	40.30
J-360	1,887.00	Zone	Demand	0.00	Fixed	0.00	1,985.43	42.58
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,984.74	43.59
J-380	1,869.00	Zone	Demand	1,390.00	Fixed	1,390.00	1,982.47	49.09
J-390	1,852.00	Zone	Demand	1,761.00	Fixed	1,761.00	1,978.29	54.64
J-400	1,833.00	Zone	Demand	1,897.00	Fixed	1,897.00	1,974.06	61.03
J-405	1,800.00	Zone	Demand	154.00	Fixed	154.00	1,971.34	74.13
J-410	1,778.00	Zone	Demand	775.00	Fixed	775.00	1,968.59	82.46
J-420	1,751.00	Zone	Demand	236.00	Fixed	236.00	1,963.83	92.08
J-430	1,747.00	Zone	Demand	255.00	Fixed	255.00	1,961.89	92.97
J-440	1,747.00	Zone	Demand	486.00	Fixed	486.00	1,959.83	92.08
J-450	1,740.00	Zone	Demand	1,950.00	Fixed	1,950.00	1,958.19	94.40
J-460	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,956.59	104.09
J-470	1,705.00	Zone	Demand	0.00	Fixed	0.00	1,955.01	108.17
J-480	1,699.00	Zone	Demand	1,900.00	Fixed	1,900.00	1,952.92	109.86
J-490	1,692.00	Zone	Demand	633.00	Fixed	633.00	1,949.80	111.54
J-500	1,671.00	Zone	Demand	937.00	Fixed	937.00	1,944.42	118.30
J-510	1,626.00	Zone	Demand	3,380.00	Fixed	3,380.00	1,938.44	135.18
J-520	1,618.00	Zone	Demand	844.00	Fixed	844.00	1,936.76	137.91
J-524	1,604.00	Zone	Demand	1,875.00	Fixed	1,875.00	1,932.01	141.92
J-527	1,590.00	Zone	Demand	1,623.00	Fixed	1,623.00	1,929.85	147.04
J-530	1,577.00	Zone	Demand	1,170.00	Fixed	1,170.00	1,928.59	152.12
J-535	1,557.00	Zone	Demand	1,281.00	Fixed	1,281.00	1,922.73	158.23
J-540	1,536.00	Zone	Demand	1,815.00	Fixed	1,815.00	1,918.20	165.36
J-545	1,516.00	Zone	Demand	289.00	Fixed	289.00	1,912.60	171.59
J-550	1,486.00	Zone	Demand	280.00	Fixed	280.00	1,907.36	182.30
J-553	1,474.00	Zone	Demand	1,620.00	Fixed	1,620.00	1,903.67	185.90
J-557	1,448.00	Zone	Demand	438.00	Fixed	438.00	1,886.90	189.89
J-560	1,424.00	Zone	Demand	229.00	Fixed	229.00	1,880.32	197.43
J-570	1,387.00	Zone	Demand	0.00	Fixed	0.00	1,867.79	208.02
J-580	1,359.00	Zone	Demand	2,070.00	Fixed	2,070.00	1,849.56	212.24
J-710	1,948.00	Zone	Demand	2,647.00	Fixed	2,647.00	1,983.08	15.18
J-720	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,980.14	12.18
J-740	1,959.00	Zone	Demand	1,180.00	Fixed	1,180.00	1,975.13	6.98
J-750	1,952.00	Zone	Demand	5.00	Fixed	5.00	1,970.90	8.18
J-760	1,948.00	Zone	Demand	112.00	Fixed	112.00	1,965.38	7.52
J-770	1,953.00	Zone	Demand	319.00	Fixed	319.00	1,961.41	3.64
J-775	1,950.00	Zone	Demand	133.00	Fixed	133.00	1,959.02	3.90
J-780	1,945.00	Zone	Demand	129.00	Fixed	129.00	1,955.05	4.35
J-790	1,935.00	Zone	Demand	176.00	Fixed	176.00	1,948.98	6.05
J-800	1,928.00	Zone	Demand	701.00	Fixed	701.00	1,944.85	7.29
J-810	1,929.00	Zone	Demand	583.00	Fixed	583.00	1,943.33	6.20

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-820	1,933.00	Zone	Demand	252.00	Fixed	252.00	1,941.27	3.58
J-830	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,941.27	6.18
J-900	1,893.00	Zone	Demand	1,235.00	Fixed	1,235.00	1,982.96	38.92
J-910	1,878.00	Zone	Demand	2,293.00	Fixed	2,293.00	1,981.00	44.56
J-920	1,857.00	Zone	Demand	3,575.00	Fixed	3,575.00	1,979.14	52.85
J-930	1,849.00	Zone	Demand	1,614.00	Fixed	1,614.00	1,976.55	55.19
J-940	1,843.00	Zone	Demand	0.00	Fixed	0.00	1,971.35	55.53
J-950	1,838.00	Zone	Demand	0.00	Fixed	0.00	1,967.27	55.93
J-960	1,829.00	Zone	Demand	697.00	Fixed	697.00	1,962.36	57.70
J-970	1,814.00	Zone	Demand	0.00	Fixed	0.00	1,958.11	62.35
J-980	1,810.00	Zone	Demand	774.00	Fixed	774.00	1,956.00	63.17
J-990	1,807.00	Zone	Demand	300.00	Fixed	300.00	1,954.01	63.60
J-1000	1,796.00	Zone	Demand	287.00	Fixed	287.00	1,952.02	67.50
J-1010	1,781.00	Zone	Demand	1,004.00	Fixed	1,004.00	1,950.14	73.18
J-1020	1,763.00	Zone	Demand	140.00	Fixed	140.00	1,944.26	78.42
J-1030	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,939.41	83.68
J-1040	1,730.00	Zone	Demand	240.00	Fixed	240.00	1,931.15	87.03
J-1050	1,731.00	Zone	Demand	280.00	Fixed	280.00	1,926.89	84.75
J-1060	1,722.00	Zone	Demand	1,656.00	Fixed	1,656.00	1,921.55	86.34
J-1065	1,716.00	Zone	Demand	546.00	Fixed	546.00	1,913.52	85.46
J-1070	1,707.00	Zone	Demand	577.00	Fixed	577.00	1,899.23	83.17
J-1080	1,697.00	Zone	Demand	0.00	Fixed	0.00	1,918.16	95.69
J-1090	1,695.00	Zone	Demand	1,616.00	Fixed	1,616.00	1,941.02	106.44
J-1100	1,689.00	Zone	Demand	3,264.00	Fixed	3,264.00	1,943.97	110.31
J-1200	1,842.00	Zone	Demand	761.00	Fixed	761.00	1,974.39	57.28
J-1205	1,833.00	Zone	Demand	714.00	Fixed	714.00	1,970.06	59.30
J-1210	1,827.00	Zone	Demand	0.00	Fixed	0.00	1,964.47	59.48
J-1220	1,830.00	Zone	Demand	0.00	Fixed	0.00	1,960.47	56.45
J-1230	1,829.00	Zone	Demand	173.00	Fixed	173.00	1,955.07	54.54
J-1240	1,816.00	Zone	Demand	56.00	Fixed	56.00	1,950.46	58.17
J-1250	1,795.00	Zone	Demand	1,804.00	Fixed	1,804.00	1,945.51	65.12
J-1260	1,787.00	Zone	Demand	0.00	Fixed	0.00	1,939.59	66.02
J-1270	1,776.00	Zone	Demand	0.00	Fixed	0.00	1,934.15	68.42
J-1280	1,768.00	Zone	Demand	280.00	Fixed	280.00	1,926.71	68.67
J-1290	1,760.00	Zone	Demand	468.00	Fixed	468.00	1,916.30	67.62
J-1300	1,756.00	Zone	Demand	699.00	Fixed	699.00	1,912.72	67.81
J-1310	1,736.00	Zone	Demand	837.00	Fixed	837.00	1,921.89	80.43
J-1410	1,930.00	Zone	Demand	0.00	Fixed	0.00	1,932.90	1.25
J-1420	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,932.35	2.31
J-1430	1,901.00	Zone	Demand	0.00	Fixed	0.00	1,958.55	24.90
J-1440	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,931.40	1.90
J-1450	1,925.00	Zone	Demand	0.00	Fixed	0.00	1,930.50	2.38
J-1460	1,921.00	Zone	Demand	154.00	Fixed	154.00	1,929.50	3.68
J-1470	1,910.00	Zone	Demand	0.00	Fixed	0.00	1,927.31	7.49
J-1480	1,894.00	Zone	Demand	0.00	Fixed	0.00	1,925.19	13.49
J-1490	1,884.00	Zone	Demand	616.00	Fixed	616.00	1,923.45	17.07
J-1500	1,881.00	Zone	Demand	0.00	Fixed	0.00	1,917.81	15.92
J-1510	1,864.00	Zone	Demand	0.00	Fixed	0.00	1,915.27	22.18
J-1520	1,847.00	Zone	Demand	0.00	Fixed	0.00	1,908.97	26.81
J-1530	1,848.00	Zone	Demand	280.00	Fixed	280.00	1,903.43	23.98
J-1540	1,826.00	Zone	Demand	1,960.00	Fixed	1,960.00	1,896.66	30.57
J-1550	1,816.00	Zone	Demand	466.00	Fixed	466.00	1,891.37	32.61

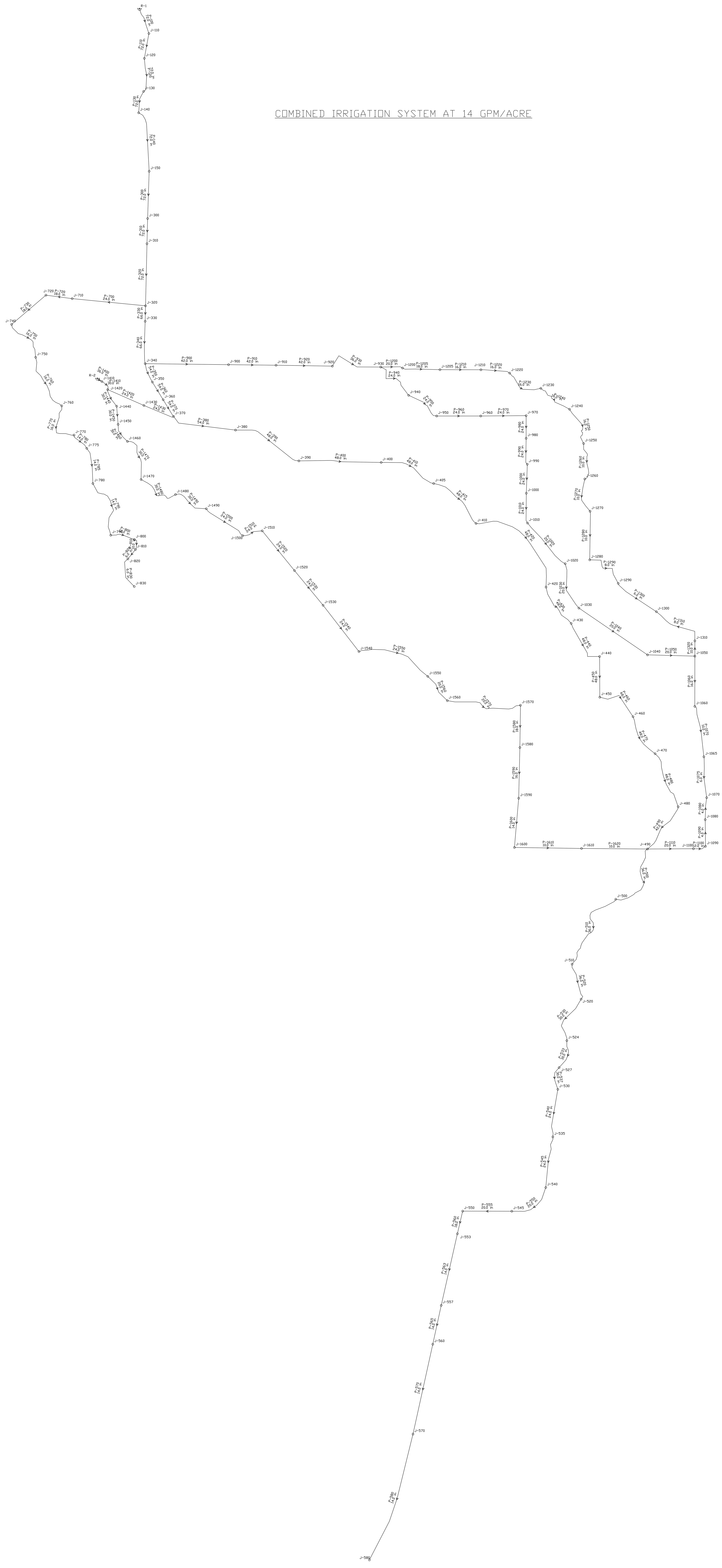
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1560	1,805.00	Zone	Demand	560.00	Fixed	560.00	1,886.89	35.43
J-1570	1,756.00	Zone	Demand	932.00	Fixed	932.00	1,878.06	52.81
J-1580	1,746.00	Zone	Demand	661.00	Fixed	661.00	1,872.61	54.78
J-1590	1,725.00	Zone	Demand	1,101.00	Fixed	1,101.00	1,864.39	60.31
J-1600	1,698.00	Zone	Demand	740.00	Fixed	740.00	1,857.28	68.91
J-1610	1,681.00	Zone	Demand	1,392.00	Fixed	1,392.00	1,834.70	66.50

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,997.00	Zone	-65,440.00	1,997.00
R-2	1,933.00	Zone	-8,862.00	1,933.00

COMBINED IRRIGATION SYSTEM AT 14 GPM/ACRE



Appendix B

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-100	722.00	48.0	Ductile Iron	125.0	28,045.72	1.10	1.53	4.97
P-110	693.00	48.0	Ductile Iron	125.0	28,045.72	1.06	1.53	4.97
P-120	944.00	48.0	Ductile Iron	125.0	28,045.72	1.44	1.53	4.97
P-130	618.00	48.0	Ductile Iron	125.0	28,006.72	0.94	1.52	4.97
P-140	1,700.00	48.0	Ductile Iron	125.0	27,720.86	2.54	1.50	4.91
P-300	1,301.00	48.0	Ductile Iron	125.0	27,480.86	1.92	1.47	4.87
P-310	694.00	48.0	Ductile Iron	125.0	27,289.72	1.01	1.45	4.84
P-320	1,710.00	48.0	Ductile Iron	125.0	27,155.15	2.46	1.44	4.81
P-330	424.00	42.0	Ductile Iron	125.0	24,342.86	0.96	2.25	5.64
P-340	1,169.00	42.0	Ductile Iron	125.0	23,864.15	2.54	2.17	5.53
P-350	548.00	36.0	Ductile Iron	125.0	14,809.32	1.04	1.90	4.67
P-360	570.00	36.0	Ductile Iron	125.0	14,809.32	1.08	1.90	4.67
P-370	542.00	36.0	Ductile Iron	125.0	14,809.32	1.03	1.90	4.67
P-380	1,809.00	36.0	Ductile Iron	125.0	14,809.32	3.44	1.90	4.67
P-390	2,026.00	36.0	Ductile Iron	125.0	14,213.61	3.57	1.76	4.48
P-400	2,267.00	36.0	Ductile Iron	125.0	13,458.89	3.61	1.59	4.24
P-410	1,641.00	30.0	Ductile Iron	125.0	12,645.89	5.66	3.45	5.74
P-415	1,671.00	30.0	Ductile Iron	125.0	12,579.89	5.71	3.42	5.71
P-420	3,042.00	30.0	Ductile Iron	125.0	12,247.75	9.89	3.25	5.56
P-430	1,263.00	30.0	Ductile Iron	125.0	12,146.61	4.04	3.20	5.51
P-440	1,357.00	30.0	Ductile Iron	125.0	12,037.32	4.27	3.15	5.46
P-450	1,121.00	30.0	Ductile Iron	125.0	11,829.04	3.42	3.05	5.37
P-460	1,252.00	30.0	Ductile Iron	125.0	10,993.32	3.33	2.66	4.99
P-470	1,231.00	30.0	Ductile Iron	125.0	10,993.32	3.28	2.66	4.99
P-480	1,637.00	30.0	Ductile Iron	125.0	10,993.32	4.36	2.66	4.99
P-490	1,471.00	30.0	Ductile Iron	125.0	10,179.03	3.40	2.31	4.62
P-500	2,001.00	24.0	Ductile Iron	125.0	7,650.43	8.07	4.03	5.43
P-510	2,457.00	24.0	Ductile Iron	125.0	7,248.86	8.97	3.65	5.14
P-520	1,046.00	24.0	Ductile Iron	125.0	5,800.29	2.53	2.42	4.11
P-530	1,366.00	20.0	Ductile Iron	125.0	5,438.57	7.12	5.21	5.55
P-533	838.00	20.0	Ductile Iron	125.0	4,635.00	3.25	3.88	4.73
P-537	657.00	18.0	Ductile Iron	125.0	3,939.43	3.15	4.79	4.97
P-540	1,331.00	16.0	Ductile Iron	125.0	3,438.00	8.80	6.61	5.49
P-545	1,421.00	16.0	Ductile Iron	125.0	2,889.00	6.80	4.79	4.61
P-550	1,289.00	14.0	Ductile Iron	125.0	2,111.14	6.62	5.13	4.40
P-555	1,353.00	14.0	Ductile Iron	125.0	1,987.29	6.21	4.59	4.14
P-560	639.00	12.0	Ductile Iron	125.0	1,867.29	5.54	8.66	5.30
P-563	2,019.00	10.0	Ductile Iron	125.0	1,173.00	17.97	8.90	4.79
P-565	1,095.00	10.0	Ductile Iron	125.0	985.29	7.06	6.44	4.02
P-570	2,532.00	8.0	Ductile Iron	125.0	887.14	39.84	15.74	5.66
P-580	3,684.00	8.0	Ductile Iron	125.0	887.14	57.97	15.74	5.66
P-700	2,027.00	16.0	Ductile Iron	125.0	2,673.00	8.40	4.15	4.27
P-720	729.00	14.0	Ductile Iron	125.0	1,538.57	2.08	2.86	3.21
P-730	1,242.00	14.0	Ductile Iron	125.0	1,538.57	3.55	2.86	3.21
P-750	1,237.00	12.0	Ductile Iron	125.0	1,032.86	3.58	2.89	2.93
P-760	1,619.00	12.0	Ductile Iron	125.0	1,030.71	4.67	2.88	2.92
P-770	1,272.00	12.0	Ductile Iron	125.0	982.71	3.36	2.64	2.79
P-780	526.00	10.0	Ductile Iron	125.0	846.00	2.56	4.86	3.46
P-785	999.00	10.0	Ductile Iron	125.0	789.00	4.27	4.27	3.22
P-790	1,742.00	10.0	Ductile Iron	125.0	733.71	6.50	3.73	3.00
P-800	685.00	10.0	Ductile Iron	125.0	658.29	2.09	3.05	2.69

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-810	320.00	8.0	Ductile Iron	125.0	357.86	0.94	2.93	2.28
P-820	331.00	4.0	Ductile Iron	125.0	108.00	3.08	9.32	2.76
P-830	896.00	3.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-900	2,295.00	30.0	Ductile Iron	125.0	8,838.40	4.08	1.78	4.01
P-910	1,308.00	30.0	Ductile Iron	125.0	8,309.11	2.07	1.59	3.77
P-920	1,551.00	24.0	Ductile Iron	125.0	7,326.40	5.77	3.72	5.20
P-930	1,574.00	24.0	Ductile Iron	125.0	5,794.25	3.80	2.41	4.11
P-940	1,284.00	18.0	Ductile Iron	125.0	3,348.76	4.55	3.55	4.22
P-950	1,007.00	18.0	Ductile Iron	125.0	3,348.76	3.57	3.55	4.22
P-960	1,214.00	18.0	Ductile Iron	125.0	3,348.76	4.31	3.55	4.22
P-970	1,249.00	18.0	Ductile Iron	125.0	3,050.05	3.73	2.98	3.85
P-980	622.00	18.0	Ductile Iron	125.0	3,050.05	1.86	2.98	3.85
P-990	731.00	16.0	Ductile Iron	125.0	2,718.33	3.13	4.28	4.34
P-1000	796.00	16.0	Ductile Iron	125.0	2,589.76	3.11	3.91	4.13
P-1010	830.00	16.0	Ductile Iron	125.0	2,466.76	2.97	3.57	3.94
P-1020	1,535.00	14.0	Ductile Iron	125.0	2,036.48	7.37	4.80	4.24
P-1030	1,340.00	14.0	Ductile Iron	125.0	1,976.47	6.09	4.54	4.12
P-1040	2,284.00	14.0	Ductile Iron	125.0	1,976.47	10.38	4.54	4.12
P-1050	1,305.00	14.0	Ductile Iron	125.0	1,873.62	5.37	4.11	3.90
P-1060	1,384.00	10.0	Ductile Iron	125.0	1,025.11	9.60	6.94	4.19
P-1070	1,426.00	6.0	Ductile Iron	125.0	315.40	13.42	9.41	3.58
P-1075	1,132.00	4.0	Ductile Iron	125.0	81.40	6.25	5.52	2.08
P-1080	607.00	4.0	Ductile Iron	125.0	-165.89	12.53	20.64	4.24
P-1090	733.00	4.0	Ductile Iron	125.0	-165.89	15.13	20.64	4.24
P-1100	355.00	8.0	Ductile Iron	125.0	-858.46	5.26	14.81	5.48
P-1110	1,266.00	14.0	Ductile Iron	125.0	-2,257.32	7.36	5.81	4.70
P-1200	609.00	14.0	Ductile Iron	125.0	1,753.78	2.22	3.64	3.66
P-1205	1,038.00	12.0	Ductile Iron	125.0	1,427.64	5.47	5.27	4.05
P-1210	1,128.00	10.0	Ductile Iron	125.0	1,121.64	9.24	8.19	4.58
P-1220	808.00	10.0	Ductile Iron	125.0	1,121.64	6.62	8.19	4.58
P-1230	1,089.00	10.0	Ductile Iron	125.0	1,121.64	8.92	8.19	4.58
P-1240	1,041.00	10.0	Ductile Iron	125.0	1,047.49	7.51	7.22	4.28
P-1250	1,160.00	10.0	Ductile Iron	125.0	1,023.49	8.02	6.92	4.18
P-1260	1,064.00	6.0	Ductile Iron	125.0	250.35	6.53	6.14	2.84
P-1270	978.00	6.0	Ductile Iron	125.0	250.35	6.00	6.14	2.84
P-1280	1,338.00	6.0	Ductile Iron	125.0	250.35	8.21	6.14	2.84
P-1290	1,248.00	4.0	Ductile Iron	125.0	130.35	16.48	13.20	3.33
P-1300	1,319.00	4.0	Ductile Iron	125.0	-70.22	5.54	4.20	1.79
P-1310	1,479.00	6.0	Ductile Iron	125.0	-369.79	18.69	12.64	4.20
P-1320	419.00	8.0	Ductile Iron	125.0	-728.51	4.58	10.92	4.65
P-1400	141.00	18.0	Ductile Iron	125.0	3,798.00	0.63	4.48	4.79
P-1410	306.00	18.0	Ductile Iron	125.0	3,798.00	1.37	4.48	4.79
P-1420	1,088.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1430	893.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1440	533.00	18.0	Ductile Iron	125.0	3,798.00	2.39	4.48	4.79
P-1450	501.00	18.0	Ductile Iron	125.0	3,798.00	2.24	4.48	4.79
P-1460	564.00	18.0	Ductile Iron	125.0	3,798.00	2.53	4.48	4.79
P-1470	1,262.00	18.0	Ductile Iron	125.0	3,732.00	5.47	4.33	4.71
P-1480	1,231.00	18.0	Ductile Iron	125.0	3,732.00	5.34	4.33	4.71
P-1490	1,006.00	18.0	Ductile Iron	125.0	3,732.00	4.36	4.33	4.71
P-1500	1,260.00	18.0	Ductile Iron	125.0	3,468.00	4.77	3.78	4.37

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-1510	567.00	16.0	Ductile Iron	125.0	3,468.00	3.81	6.72	5.53
P-1520	1,407.00	16.0	Ductile Iron	125.0	3,468.00	9.45	6.72	5.53
P-1530	1,239.00	16.0	Ductile Iron	125.0	3,468.00	8.32	6.72	5.53
P-1540	1,613.00	16.0	Ductile Iron	125.0	3,348.00	10.15	6.29	5.34
P-1550	2,157.00	16.0	Ductile Iron	125.0	2,508.00	7.95	3.68	4.00
P-1560	874.00	14.0	Ductile Iron	125.0	2,308.29	5.29	6.06	4.81
P-1570	2,114.00	14.0	Ductile Iron	125.0	2,068.29	10.45	4.94	4.31
P-1580	1,163.00	12.0	Ductile Iron	125.0	1,668.86	8.18	7.04	4.73
P-1590	1,394.00	12.0	Ductile Iron	125.0	1,385.57	6.95	4.99	3.93
P-1600	1,359.00	10.0	Ductile Iron	125.0	913.71	7.62	5.60	3.73
P-1610	1,848.00	8.0	Ductile Iron	125.0	596.57	13.94	7.55	3.81
P-1620	1,814.00	8.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-110	1,985.00	Zone	Demand	0.00	Fixed	0.00	1,995.90	4.71
J-120	1,990.00	Zone	Demand	0.00	Fixed	0.00	1,994.84	2.09
J-130	1,984.00	Zone	Demand	39.00	Fixed	39.00	1,993.39	4.06
J-140	1,972.00	Zone	Demand	285.86	Fixed	285.86	1,992.45	8.85
J-150	1,950.00	Zone	Demand	240.00	Fixed	240.00	1,989.91	17.27
J-300	1,938.00	Zone	Demand	191.14	Fixed	191.14	1,987.99	21.63
J-310	1,946.00	Zone	Demand	134.57	Fixed	134.57	1,986.99	17.73
J-320	1,935.00	Zone	Demand	139.29	Fixed	139.29	1,984.52	21.43
J-330	1,931.00	Zone	Demand	478.71	Fixed	478.71	1,983.57	22.74
J-340	1,914.00	Zone	Demand	216.43	Fixed	216.43	1,981.03	29.00
J-350	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,979.99	37.63
J-360	1,887.00	Zone	Demand	0.00	Fixed	0.00	1,978.90	39.76
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,977.87	40.61
J-380	1,869.00	Zone	Demand	595.71	Fixed	595.71	1,974.43	45.61
J-390	1,852.00	Zone	Demand	754.71	Fixed	754.71	1,970.86	51.42
J-400	1,833.00	Zone	Demand	813.00	Fixed	813.00	1,967.25	58.08
J-405	1,800.00	Zone	Demand	66.00	Fixed	66.00	1,961.58	69.91
J-410	1,778.00	Zone	Demand	332.14	Fixed	332.14	1,955.87	76.96
J-420	1,751.00	Zone	Demand	101.14	Fixed	101.14	1,945.98	84.36
J-430	1,747.00	Zone	Demand	109.29	Fixed	109.29	1,941.94	84.34
J-440	1,747.00	Zone	Demand	208.29	Fixed	208.29	1,937.66	82.49
J-450	1,740.00	Zone	Demand	835.72	Fixed	835.72	1,934.24	84.04
J-460	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,930.91	92.98
J-470	1,705.00	Zone	Demand	0.00	Fixed	0.00	1,927.63	96.32
J-480	1,699.00	Zone	Demand	814.29	Fixed	814.29	1,923.28	97.03
J-490	1,692.00	Zone	Demand	271.29	Fixed	271.29	1,919.88	98.59
J-500	1,671.00	Zone	Demand	401.57	Fixed	401.57	1,911.81	104.19
J-510	1,626.00	Zone	Demand	1,448.57	Fixed	1,448.57	1,902.84	119.78
J-520	1,618.00	Zone	Demand	361.71	Fixed	361.71	1,900.31	122.14
J-524	1,604.00	Zone	Demand	803.57	Fixed	803.57	1,893.19	125.12
J-527	1,590.00	Zone	Demand	695.57	Fixed	695.57	1,889.95	129.77
J-530	1,577.00	Zone	Demand	501.43	Fixed	501.43	1,886.80	134.03
J-535	1,557.00	Zone	Demand	549.00	Fixed	549.00	1,878.00	138.88
J-540	1,536.00	Zone	Demand	777.86	Fixed	777.86	1,871.20	145.02
J-545	1,516.00	Zone	Demand	123.86	Fixed	123.86	1,864.58	150.81
J-550	1,486.00	Zone	Demand	120.00	Fixed	120.00	1,858.37	161.11
J-553	1,474.00	Zone	Demand	694.29	Fixed	694.29	1,852.84	163.90
J-557	1,448.00	Zone	Demand	187.71	Fixed	187.71	1,834.86	167.38
J-560	1,424.00	Zone	Demand	98.14	Fixed	98.14	1,827.81	174.71
J-570	1,387.00	Zone	Demand	0.00	Fixed	0.00	1,787.96	173.48
J-580	1,359.00	Zone	Demand	887.14	Fixed	887.14	1,729.99	160.51
J-710	1,948.00	Zone	Demand	1,134.43	Fixed	1,134.43	1,976.12	12.17
J-720	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,974.04	9.53
J-740	1,959.00	Zone	Demand	505.71	Fixed	505.71	1,970.49	4.97
J-750	1,952.00	Zone	Demand	2.14	Fixed	2.14	1,966.91	6.45
J-760	1,948.00	Zone	Demand	48.00	Fixed	48.00	1,962.24	6.16
J-770	1,953.00	Zone	Demand	136.71	Fixed	136.71	1,958.88	2.55
J-775	1,950.00	Zone	Demand	57.00	Fixed	57.00	1,956.33	2.74
J-780	1,945.00	Zone	Demand	55.29	Fixed	55.29	1,952.06	3.06
J-790	1,935.00	Zone	Demand	75.43	Fixed	75.43	1,945.56	4.57
J-800	1,928.00	Zone	Demand	300.43	Fixed	300.43	1,943.47	6.69
J-810	1,929.00	Zone	Demand	249.86	Fixed	249.86	1,942.53	5.85

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-820	1,933.00	Zone	Demand	108.00	Fixed	108.00	1,939.44	2.79
J-830	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,939.44	5.38
J-900	1,893.00	Zone	Demand	529.29	Fixed	529.29	1,976.95	36.32
J-910	1,878.00	Zone	Demand	982.71	Fixed	982.71	1,974.88	41.91
J-920	1,857.00	Zone	Demand	1,532.14	Fixed	1,532.14	1,969.10	48.50
J-930	1,849.00	Zone	Demand	691.71	Fixed	691.71	1,965.31	50.32
J-940	1,843.00	Zone	Demand	0.00	Fixed	0.00	1,960.75	50.95
J-950	1,838.00	Zone	Demand	0.00	Fixed	0.00	1,957.18	51.56
J-960	1,829.00	Zone	Demand	298.71	Fixed	298.71	1,952.88	53.60
J-970	1,814.00	Zone	Demand	0.00	Fixed	0.00	1,949.15	58.47
J-980	1,810.00	Zone	Demand	331.71	Fixed	331.71	1,947.30	59.40
J-990	1,807.00	Zone	Demand	128.57	Fixed	128.57	1,944.17	59.35
J-1000	1,796.00	Zone	Demand	123.00	Fixed	123.00	1,941.06	62.76
J-1010	1,781.00	Zone	Demand	430.29	Fixed	430.29	1,938.09	67.97
J-1020	1,763.00	Zone	Demand	60.00	Fixed	60.00	1,930.72	72.56
J-1030	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,924.63	77.29
J-1040	1,730.00	Zone	Demand	102.86	Fixed	102.86	1,914.26	79.72
J-1050	1,731.00	Zone	Demand	120.00	Fixed	120.00	1,908.89	76.96
J-1060	1,722.00	Zone	Demand	709.71	Fixed	709.71	1,899.29	76.70
J-1065	1,716.00	Zone	Demand	234.00	Fixed	234.00	1,885.87	73.49
J-1070	1,707.00	Zone	Demand	247.29	Fixed	247.29	1,879.62	74.68
J-1080	1,697.00	Zone	Demand	0.00	Fixed	0.00	1,892.14	84.43
J-1090	1,695.00	Zone	Demand	692.57	Fixed	692.57	1,907.27	91.84
J-1100	1,689.00	Zone	Demand	1,398.86	Fixed	1,398.86	1,912.52	96.71
J-1200	1,842.00	Zone	Demand	326.14	Fixed	326.14	1,963.09	52.39
J-1205	1,833.00	Zone	Demand	306.00	Fixed	306.00	1,957.62	53.92
J-1210	1,827.00	Zone	Demand	0.00	Fixed	0.00	1,948.38	52.51
J-1220	1,830.00	Zone	Demand	0.00	Fixed	0.00	1,941.76	48.35
J-1230	1,829.00	Zone	Demand	74.14	Fixed	74.14	1,932.83	44.92
J-1240	1,816.00	Zone	Demand	24.00	Fixed	24.00	1,925.32	47.30
J-1250	1,795.00	Zone	Demand	773.14	Fixed	773.14	1,917.30	52.91
J-1260	1,787.00	Zone	Demand	0.00	Fixed	0.00	1,910.77	53.55
J-1270	1,776.00	Zone	Demand	0.00	Fixed	0.00	1,904.77	55.71
J-1280	1,768.00	Zone	Demand	120.00	Fixed	120.00	1,896.56	55.62
J-1290	1,760.00	Zone	Demand	200.57	Fixed	200.57	1,880.08	51.95
J-1300	1,756.00	Zone	Demand	299.57	Fixed	299.57	1,885.62	56.08
J-1310	1,736.00	Zone	Demand	358.71	Fixed	358.71	1,904.31	72.82
J-1410	1,930.00	Zone	Demand	0.00	Fixed	0.00	1,932.37	1.02
J-1420	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,931.00	1.73
J-1430	1,901.00	Zone	Demand	0.00	Fixed	0.00	1,954.43	23.12
J-1440	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,928.61	0.70
J-1450	1,925.00	Zone	Demand	0.00	Fixed	0.00	1,926.37	0.59
J-1460	1,921.00	Zone	Demand	66.00	Fixed	66.00	1,923.84	1.23
J-1470	1,910.00	Zone	Demand	0.00	Fixed	0.00	1,918.37	3.62
J-1480	1,894.00	Zone	Demand	0.00	Fixed	0.00	1,913.04	8.24
J-1490	1,884.00	Zone	Demand	264.00	Fixed	264.00	1,908.68	10.68
J-1500	1,881.00	Zone	Demand	0.00	Fixed	0.00	1,903.91	9.91
J-1510	1,864.00	Zone	Demand	0.00	Fixed	0.00	1,900.10	15.62
J-1520	1,847.00	Zone	Demand	0.00	Fixed	0.00	1,890.65	18.89
J-1530	1,848.00	Zone	Demand	120.00	Fixed	120.00	1,882.33	14.85
J-1540	1,826.00	Zone	Demand	840.00	Fixed	840.00	1,872.18	19.98
J-1550	1,816.00	Zone	Demand	199.71	Fixed	199.71	1,864.23	20.87

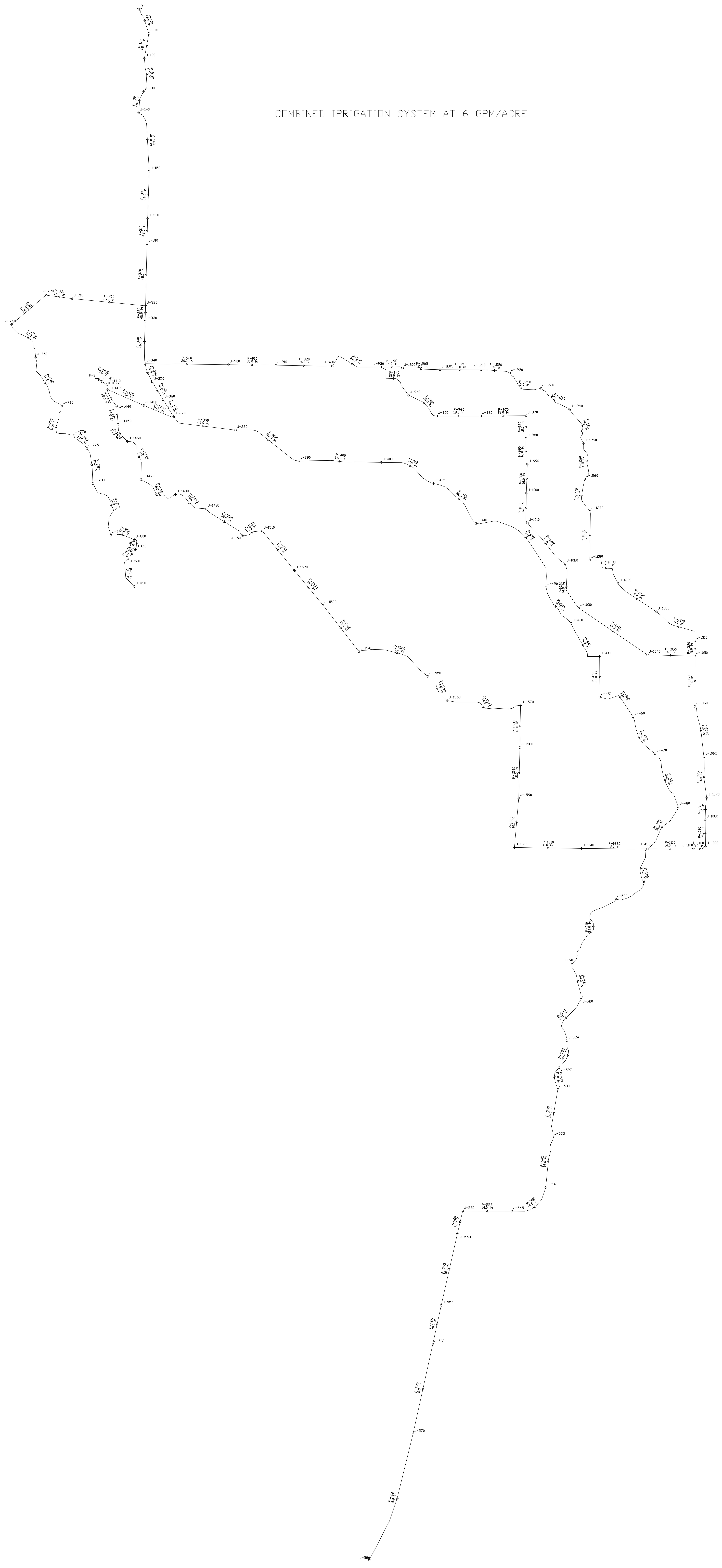
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1560	1,805.00	Zone	Demand	240.00	Fixed	240.00	1,858.94	23.34
J-1570	1,756.00	Zone	Demand	399.43	Fixed	399.43	1,848.49	40.02
J-1580	1,746.00	Zone	Demand	283.29	Fixed	283.29	1,840.31	40.80
J-1590	1,725.00	Zone	Demand	471.86	Fixed	471.86	1,833.36	46.88
J-1600	1,698.00	Zone	Demand	317.14	Fixed	317.14	1,825.74	55.27
J-1610	1,681.00	Zone	Demand	596.57	Fixed	596.57	1,811.80	56.59

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,997.00	Zone	-28,045.72	1,997.00
R-2	1,933.00	Zone	-3,798.00	1,933.00

COMBINED IRRIGATION SYSTEM AT 6 GPM/ACRE



Appendix C

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-100	722.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-110	693.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-120	944.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-130	618.00	72.0	Ductile Iron	125.0	-0.00	0.00	0.00	0.00
P-140	1,700.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-300	1,301.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-310	694.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-320	1,710.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-330	424.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-340	1,169.00	72.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-344	195.00	72.0	Ductile Iron	125.0	67,359.00	0.21	1.07	5.31
P-350	548.00	60.0	Ductile Iron	125.0	50,436.15	0.84	1.53	5.72
P-360	570.00	60.0	Ductile Iron	125.0	50,436.15	0.87	1.53	5.72
P-370	542.00	60.0	Ductile Iron	125.0	50,436.15	0.83	1.53	5.72
P-380	1,809.00	60.0	Ductile Iron	125.0	50,436.15	2.77	1.53	5.72
P-390	2,026.00	60.0	Ductile Iron	125.0	50,436.15	3.10	1.53	5.72
P-400	2,267.00	60.0	Ductile Iron	125.0	50,436.15	3.46	1.53	5.72
P-410	1,641.00	60.0	Ductile Iron	125.0	50,436.15	2.51	1.53	5.72
P-415	1,671.00	60.0	Ductile Iron	125.0	50,436.15	2.55	1.53	5.72
P-420	3,042.00	60.0	Ductile Iron	125.0	50,436.15	4.65	1.53	5.72
P-430	1,263.00	60.0	Ductile Iron	125.0	50,436.15	1.93	1.53	5.72
P-440	1,357.00	60.0	Ductile Iron	125.0	50,436.15	2.07	1.53	5.72
P-450	1,121.00	60.0	Ductile Iron	125.0	50,436.15	1.71	1.53	5.72
P-460	1,252.00	60.0	Ductile Iron	125.0	50,436.15	1.91	1.53	5.72
P-470	1,231.00	60.0	Ductile Iron	125.0	50,436.15	1.88	1.53	5.72
P-480	1,637.00	60.0	Ductile Iron	125.0	50,436.15	2.50	1.53	5.72
P-490	1,471.00	60.0	Ductile Iron	125.0	50,436.15	2.25	1.53	5.72
P-500	2,001.00	84.0	Ductile Iron	125.0	89,760.00	1.73	0.86	5.20
P-510	2,457.00	84.0	Ductile Iron	125.0	89,760.00	2.12	0.86	5.20
P-520	1,046.00	84.0	Ductile Iron	125.0	89,760.00	0.90	0.86	5.20
P-530	1,366.00	84.0	Ductile Iron	125.0	89,760.00	1.18	0.86	5.20
P-533	838.00	84.0	Ductile Iron	125.0	89,760.00	0.72	0.86	5.20
P-537	657.00	84.0	Ductile Iron	125.0	89,760.00	0.57	0.86	5.20
P-540	1,331.00	84.0	Ductile Iron	125.0	89,760.00	1.15	0.86	5.20
P-545	1,421.00	84.0	Ductile Iron	125.0	89,760.00	1.23	0.86	5.20
P-550	1,289.00	84.0	Ductile Iron	125.0	89,760.00	1.11	0.86	5.20
P-555	1,353.00	84.0	Ductile Iron	125.0	89,760.00	1.17	0.86	5.20
P-560	639.00	84.0	Ductile Iron	125.0	89,760.00	0.55	0.86	5.20
P-563	2,019.00	84.0	Ductile Iron	125.0	89,760.00	1.74	0.86	5.20
P-565	1,095.00	84.0	Ductile Iron	125.0	89,760.00	0.95	0.86	5.20
P-570	2,532.00	84.0	Ductile Iron	125.0	89,760.00	2.19	0.86	5.20
P-580	3,684.00	84.0	Ductile Iron	125.0	89,760.00	3.18	0.86	5.20
P-590	2,933.00	84.0	Ductile Iron	125.0	89,760.00	2.53	0.86	5.20
P-700	2,027.00	24.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-720	729.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-730	1,242.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-750	1,237.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-760	1,619.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-770	1,272.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-780	526.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-785	999.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-790	1,742.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-800	685.00	12.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-810	320.00	10.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-820	331.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-830	896.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-900	2,295.00	42.0	Ductile Iron	125.0	16,922.85	2.64	1.15	3.92
P-910	1,308.00	42.0	Ductile Iron	125.0	16,922.85	1.50	1.15	3.92
P-920	1,551.00	42.0	Ductile Iron	125.0	16,922.85	1.78	1.15	3.92
P-930	1,574.00	42.0	Ductile Iron	125.0	16,922.85	1.81	1.15	3.92
P-940	1,284.00	36.0	Ductile Iron	125.0	12,651.63	1.82	1.42	3.99
P-950	1,007.00	36.0	Ductile Iron	125.0	12,651.63	1.43	1.42	3.99
P-960	1,214.00	36.0	Ductile Iron	125.0	12,651.63	1.72	1.42	3.99
P-970	1,249.00	36.0	Ductile Iron	125.0	12,651.63	1.77	1.42	3.99
P-980	622.00	36.0	Ductile Iron	125.0	12,651.63	0.88	1.42	3.99
P-990	731.00	36.0	Ductile Iron	125.0	12,651.63	1.04	1.42	3.99
P-1000	796.00	36.0	Ductile Iron	125.0	12,651.63	1.13	1.42	3.99
P-1010	830.00	36.0	Ductile Iron	125.0	12,651.63	1.18	1.42	3.99
P-1020	1,535.00	36.0	Ductile Iron	125.0	12,651.63	2.18	1.42	3.99
P-1030	1,340.00	36.0	Ductile Iron	125.0	12,651.63	1.90	1.42	3.99
P-1040	2,284.00	36.0	Ductile Iron	125.0	12,651.63	3.25	1.42	3.99
P-1050	1,305.00	36.0	Ductile Iron	125.0	12,651.63	1.85	1.42	3.99
P-1060	1,384.00	42.0	Ductile Iron	125.0	16,922.85	1.59	1.15	3.92
P-1070	1,426.00	42.0	Ductile Iron	125.0	16,922.85	1.64	1.15	3.92
P-1075	1,132.00	42.0	Ductile Iron	125.0	16,922.85	1.30	1.15	3.92
P-1080	607.00	42.0	Ductile Iron	125.0	16,922.85	0.70	1.15	3.92
P-1090	733.00	42.0	Ductile Iron	125.0	16,922.85	0.84	1.15	3.92
P-1100	355.00	42.0	Ductile Iron	125.0	16,922.85	0.41	1.15	3.92
P-1110	1,266.00	42.0	Ductile Iron	125.0	16,922.85	1.46	1.15	3.92
P-1200	609.00	24.0	Ductile Iron	125.0	4,271.22	0.83	1.37	3.03
P-1205	1,038.00	24.0	Ductile Iron	125.0	4,271.22	1.42	1.37	3.03
P-1210	1,128.00	24.0	Ductile Iron	125.0	4,271.22	1.55	1.37	3.03
P-1220	808.00	24.0	Ductile Iron	125.0	4,271.22	1.11	1.37	3.03
P-1230	1,089.00	24.0	Ductile Iron	125.0	4,271.22	1.49	1.37	3.03
P-1240	1,041.00	24.0	Ductile Iron	125.0	4,271.22	1.43	1.37	3.03
P-1250	1,160.00	24.0	Ductile Iron	125.0	4,271.22	1.59	1.37	3.03
P-1260	1,064.00	24.0	Ductile Iron	125.0	4,271.22	1.46	1.37	3.03
P-1270	978.00	24.0	Ductile Iron	125.0	4,271.22	1.34	1.37	3.03
P-1280	1,338.00	24.0	Ductile Iron	125.0	4,271.22	1.83	1.37	3.03
P-1290	1,248.00	24.0	Ductile Iron	125.0	4,271.22	1.71	1.37	3.03
P-1300	1,319.00	24.0	Ductile Iron	125.0	4,271.22	1.81	1.37	3.03
P-1310	1,479.00	24.0	Ductile Iron	125.0	4,271.22	2.03	1.37	3.03
P-1320	419.00	24.0	Ductile Iron	125.0	4,271.22	0.57	1.37	3.03
P-1400	141.00	42.0	Ductile Iron	125.0	22,401.00	0.27	1.93	5.19
P-1410	306.00	42.0	Ductile Iron	125.0	22,401.00	0.59	1.93	5.19
P-1420	1,088.00	42.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1430	893.00	42.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-1440	533.00	42.0	Ductile Iron	125.0	22,401.00	1.03	1.93	5.19
P-1450	501.00	42.0	Ductile Iron	125.0	22,401.00	0.97	1.93	5.19
P-1460	564.00	42.0	Ductile Iron	125.0	22,401.00	1.09	1.93	5.19
P-1470	1,262.00	42.0	Ductile Iron	125.0	22,401.00	2.44	1.93	5.19
P-1480	1,231.00	42.0	Ductile Iron	125.0	22,401.00	2.38	1.93	5.19

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-1490	1,006.00	42.0	Ductile Iron	125.0	22,401.00	1.94	1.93	5.19
P-1500	1,260.00	42.0	Ductile Iron	125.0	22,401.00	2.43	1.93	5.19
P-1510	567.00	42.0	Ductile Iron	125.0	22,401.00	1.10	1.93	5.19
P-1520	1,407.00	42.0	Ductile Iron	125.0	22,401.00	2.72	1.93	5.19
P-1530	1,239.00	42.0	Ductile Iron	125.0	22,401.00	2.39	1.93	5.19
P-1540	1,613.00	42.0	Ductile Iron	125.0	22,401.00	3.12	1.93	5.19
P-1550	2,157.00	42.0	Ductile Iron	125.0	22,401.00	4.17	1.93	5.19
P-1560	874.00	42.0	Ductile Iron	125.0	22,401.00	1.69	1.93	5.19
P-1570	2,114.00	42.0	Ductile Iron	125.0	22,401.00	4.08	1.93	5.19
P-1580	1,163.00	42.0	Ductile Iron	125.0	22,401.00	2.25	1.93	5.19
P-1590	1,394.00	42.0	Ductile Iron	125.0	22,401.00	2.69	1.93	5.19
P-1600	1,359.00	42.0	Ductile Iron	125.0	22,401.00	2.63	1.93	5.19
P-1610	1,848.00	42.0	Ductile Iron	125.0	22,401.00	3.57	1.93	5.19
P-1620	1,814.00	42.0	Ductile Iron	125.0	22,401.00	3.50	1.93	5.19

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-110	1,985.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	5.19
J-120	1,990.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	3.03
J-130	1,984.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	5.62
J-140	1,972.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	10.82
J-150	1,950.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	20.33
J-300	1,938.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	25.53
J-310	1,946.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	22.07
J-320	1,935.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	26.82
J-330	1,931.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	28.56
J-340	1,914.00	Zone	Demand	0.00	Fixed	0.00	1,921.79	3.37
J-350	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,920.95	12.09
J-360	1,887.00	Zone	Demand	0.00	Fixed	0.00	1,920.08	14.31
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,919.25	15.25
J-380	1,869.00	Zone	Demand	0.00	Fixed	0.00	1,916.49	20.55
J-390	1,852.00	Zone	Demand	0.00	Fixed	0.00	1,913.39	26.56
J-400	1,833.00	Zone	Demand	0.00	Fixed	0.00	1,909.93	33.28
J-405	1,800.00	Zone	Demand	0.00	Fixed	0.00	1,907.42	46.47
J-410	1,778.00	Zone	Demand	0.00	Fixed	0.00	1,904.86	54.89
J-420	1,751.00	Zone	Demand	0.00	Fixed	0.00	1,900.22	64.56
J-430	1,747.00	Zone	Demand	0.00	Fixed	0.00	1,898.28	65.45
J-440	1,747.00	Zone	Demand	0.00	Fixed	0.00	1,896.21	64.56
J-450	1,740.00	Zone	Demand	0.00	Fixed	0.00	1,894.50	66.84
J-460	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,892.58	76.40
J-470	1,705.00	Zone	Demand	0.00	Fixed	0.00	1,890.70	80.34
J-480	1,699.00	Zone	Demand	0.00	Fixed	0.00	1,888.20	81.86
J-490	1,692.00	Zone	Demand	0.00	Fixed	0.00	1,885.95	83.91
J-500	1,671.00	Zone	Demand	0.00	Fixed	0.00	1,884.22	92.25
J-510	1,626.00	Zone	Demand	0.00	Fixed	0.00	1,882.10	110.80
J-520	1,618.00	Zone	Demand	0.00	Fixed	0.00	1,881.20	113.87
J-524	1,604.00	Zone	Demand	0.00	Fixed	0.00	1,880.02	119.42
J-527	1,590.00	Zone	Demand	0.00	Fixed	0.00	1,879.30	125.17
J-530	1,577.00	Zone	Demand	0.00	Fixed	0.00	1,878.73	130.54
J-535	1,557.00	Zone	Demand	0.00	Fixed	0.00	1,877.58	138.70
J-540	1,536.00	Zone	Demand	0.00	Fixed	0.00	1,876.36	147.26
J-545	1,516.00	Zone	Demand	0.00	Fixed	0.00	1,875.24	155.43
J-550	1,486.00	Zone	Demand	0.00	Fixed	0.00	1,874.08	167.90
J-553	1,474.00	Zone	Demand	0.00	Fixed	0.00	1,873.52	172.86
J-557	1,448.00	Zone	Demand	0.00	Fixed	0.00	1,871.78	183.35
J-560	1,424.00	Zone	Demand	0.00	Fixed	0.00	1,870.84	193.32
J-570	1,387.00	Zone	Demand	0.00	Fixed	0.00	1,868.65	208.39
J-580	1,359.00	Zone	Demand	0.00	Fixed	0.00	1,865.47	219.13
J-590	1,252.00	Zone	Demand	89,760.00	Fixed	89,760.00	1,862.94	264.32
J-710	1,948.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	21.20
J-720	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	19.47
J-740	1,959.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	16.44
J-750	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	19.47
J-760	1,948.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	21.20
J-770	1,953.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	19.04
J-775	1,950.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	20.33
J-780	1,945.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	22.50
J-790	1,935.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	26.82
J-800	1,928.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	29.85

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-810	1,929.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	29.42
J-820	1,933.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	27.69
J-830	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,997.00	30.29
J-900	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,919.15	11.32
J-910	1,878.00	Zone	Demand	0.00	Fixed	0.00	1,917.65	17.15
J-920	1,857.00	Zone	Demand	0.00	Fixed	0.00	1,915.87	25.47
J-930	1,849.00	Zone	Demand	0.00	Fixed	0.00	1,914.06	28.15
J-940	1,843.00	Zone	Demand	0.00	Fixed	0.00	1,912.23	29.95
J-950	1,838.00	Zone	Demand	0.00	Fixed	0.00	1,910.80	31.50
J-960	1,829.00	Zone	Demand	0.00	Fixed	0.00	1,909.08	34.65
J-970	1,814.00	Zone	Demand	0.00	Fixed	0.00	1,907.30	40.37
J-980	1,810.00	Zone	Demand	0.00	Fixed	0.00	1,906.42	41.72
J-990	1,807.00	Zone	Demand	0.00	Fixed	0.00	1,905.38	42.56
J-1000	1,796.00	Zone	Demand	0.00	Fixed	0.00	1,904.25	46.83
J-1010	1,781.00	Zone	Demand	0.00	Fixed	0.00	1,903.07	52.81
J-1020	1,763.00	Zone	Demand	0.00	Fixed	0.00	1,900.89	59.66
J-1030	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,898.98	66.19
J-1040	1,730.00	Zone	Demand	0.00	Fixed	0.00	1,895.74	71.71
J-1050	1,731.00	Zone	Demand	0.00	Fixed	0.00	1,893.89	70.47
J-1060	1,722.00	Zone	Demand	0.00	Fixed	0.00	1,892.29	73.68
J-1065	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,890.66	75.57
J-1070	1,707.00	Zone	Demand	0.00	Fixed	0.00	1,889.35	78.90
J-1080	1,697.00	Zone	Demand	0.00	Fixed	0.00	1,888.66	82.92
J-1090	1,695.00	Zone	Demand	0.00	Fixed	0.00	1,887.81	83.42
J-1100	1,689.00	Zone	Demand	0.00	Fixed	0.00	1,887.41	85.84
J-1200	1,842.00	Zone	Demand	0.00	Fixed	0.00	1,913.22	30.81
J-1205	1,833.00	Zone	Demand	0.00	Fixed	0.00	1,911.80	34.09
J-1210	1,827.00	Zone	Demand	0.00	Fixed	0.00	1,910.25	36.02
J-1220	1,830.00	Zone	Demand	0.00	Fixed	0.00	1,909.15	34.24
J-1230	1,829.00	Zone	Demand	0.00	Fixed	0.00	1,907.65	34.03
J-1240	1,816.00	Zone	Demand	0.00	Fixed	0.00	1,906.23	39.04
J-1250	1,795.00	Zone	Demand	0.00	Fixed	0.00	1,904.64	47.44
J-1260	1,787.00	Zone	Demand	0.00	Fixed	0.00	1,903.18	50.27
J-1270	1,776.00	Zone	Demand	0.00	Fixed	0.00	1,901.84	54.44
J-1280	1,768.00	Zone	Demand	0.00	Fixed	0.00	1,900.01	57.11
J-1290	1,760.00	Zone	Demand	0.00	Fixed	0.00	1,898.29	59.83
J-1300	1,756.00	Zone	Demand	0.00	Fixed	0.00	1,896.49	60.78
J-1310	1,736.00	Zone	Demand	0.00	Fixed	0.00	1,894.46	68.56
J-1410	1,930.00	Zone	Demand	0.00	Fixed	0.00	1,932.73	1.18
J-1420	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,932.14	2.22
J-1430	1,901.00	Zone	Demand	0.00	Fixed	0.00	1,925.69	10.68
J-1440	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,931.11	1.78
J-1450	1,925.00	Zone	Demand	0.00	Fixed	0.00	1,930.14	2.22
J-1460	1,921.00	Zone	Demand	0.00	Fixed	0.00	1,929.05	3.48
J-1470	1,910.00	Zone	Demand	0.00	Fixed	0.00	1,926.61	7.19
J-1480	1,894.00	Zone	Demand	0.00	Fixed	0.00	1,924.23	13.08
J-1490	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,922.29	16.57
J-1500	1,881.00	Zone	Demand	0.00	Fixed	0.00	1,919.86	16.81
J-1510	1,864.00	Zone	Demand	0.00	Fixed	0.00	1,918.76	23.69
J-1520	1,847.00	Zone	Demand	0.00	Fixed	0.00	1,916.04	29.87
J-1530	1,848.00	Zone	Demand	0.00	Fixed	0.00	1,913.65	28.40
J-1540	1,826.00	Zone	Demand	0.00	Fixed	0.00	1,910.53	36.57

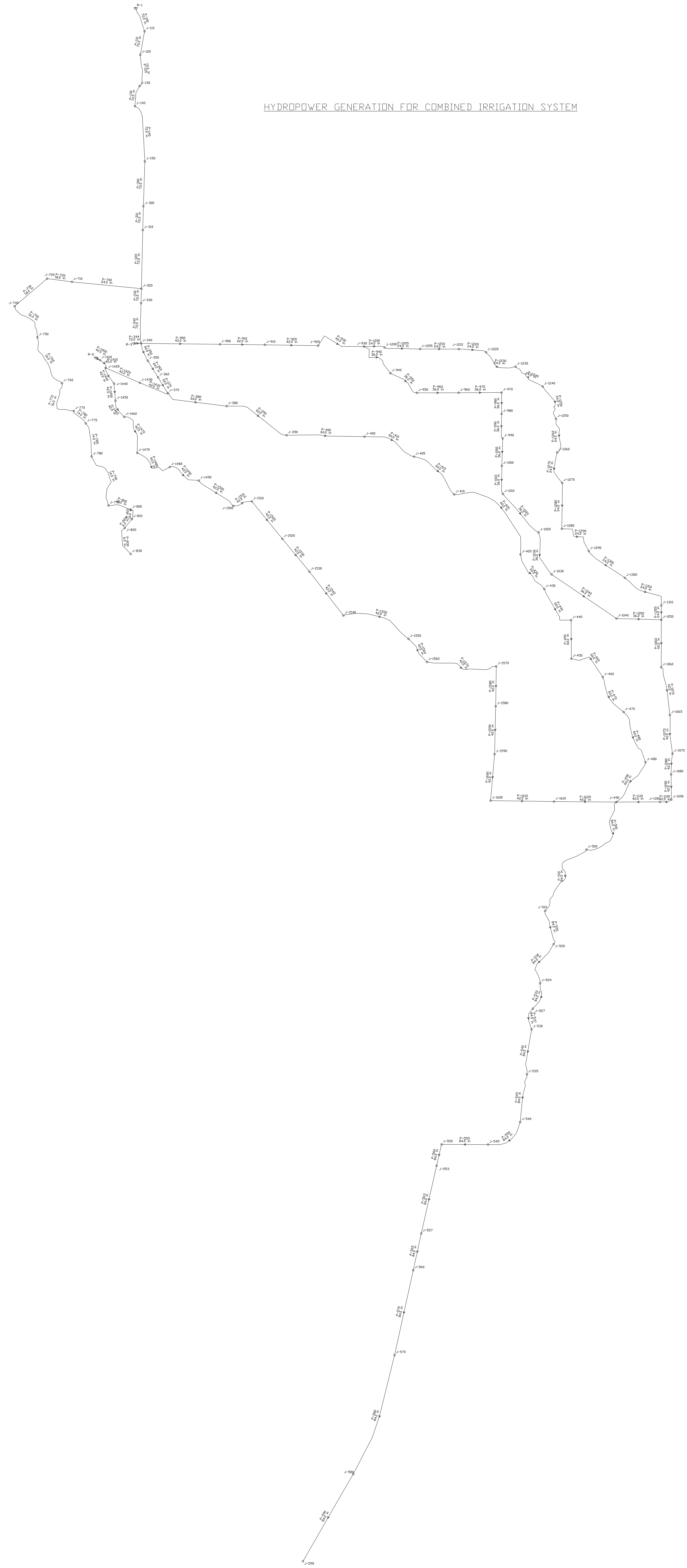
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1550	1,816.00	Zone	Demand	0.00	Fixed	0.00	1,906.36	39.10
J-1560	1,805.00	Zone	Demand	0.00	Fixed	0.00	1,904.68	43.13
J-1570	1,756.00	Zone	Demand	0.00	Fixed	0.00	1,900.59	62.56
J-1580	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,898.35	65.91
J-1590	1,725.00	Zone	Demand	0.00	Fixed	0.00	1,895.65	73.83
J-1600	1,698.00	Zone	Demand	0.00	Fixed	0.00	1,893.03	84.38
J-1610	1,681.00	Zone	Demand	0.00	Fixed	0.00	1,889.46	90.19

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,997.00	Zone	-0.00	1,997.00
R-2	1,933.00	Zone	-22,401.00	1,933.00
R-3	1,922.00	Zone	-67,359.00	1,922.00

HYDROPOWER GENERATION FOR COMBINED IRRIGATION SYSTEM



Appendix D

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-100	722.00	72.0	Ductile Iron	125.0	57,459.00	0.58	0.80	4.53
P-110	693.00	72.0	Ductile Iron	125.0	57,459.00	0.55	0.80	4.53
P-120	944.00	72.0	Ductile Iron	125.0	57,459.00	0.76	0.80	4.53
P-130	618.00	72.0	Ductile Iron	125.0	57,368.00	0.49	0.80	4.52
P-140	1,700.00	72.0	Ductile Iron	125.0	56,701.00	1.33	0.78	4.47
P-300	1,301.00	72.0	Ductile Iron	125.0	56,141.00	1.00	0.77	4.42
P-310	694.00	72.0	Ductile Iron	125.0	55,695.00	0.52	0.76	4.39
P-320	1,710.00	72.0	Ductile Iron	125.0	55,381.00	1.28	0.75	4.36
P-330	424.00	66.0	Ductile Iron	125.0	48,819.00	0.38	0.90	4.58
P-340	1,169.00	66.0	Ductile Iron	125.0	47,702.00	1.01	0.87	4.47
P-350	548.00	54.0	Ductile Iron	125.0	29,397.88	0.51	0.94	4.12
P-360	570.00	54.0	Ductile Iron	125.0	29,397.88	0.54	0.94	4.12
P-370	542.00	54.0	Ductile Iron	125.0	29,397.88	0.51	0.94	4.12
P-380	1,809.00	54.0	Ductile Iron	125.0	29,397.88	1.70	0.94	4.12
P-390	2,026.00	48.0	Ductile Iron	125.0	29,397.88	3.38	1.67	5.21
P-400	2,267.00	48.0	Ductile Iron	125.0	29,397.88	3.78	1.67	5.21
P-410	1,641.00	48.0	Ductile Iron	125.0	29,397.88	2.74	1.67	5.21
P-415	1,671.00	48.0	Ductile Iron	125.0	29,243.88	2.76	1.65	5.18
P-420	3,042.00	48.0	Ductile Iron	125.0	29,243.88	5.02	1.65	5.18
P-430	1,263.00	48.0	Ductile Iron	125.0	29,007.88	2.05	1.63	5.14
P-440	1,357.00	48.0	Ductile Iron	125.0	28,752.88	2.17	1.60	5.10
P-450	1,121.00	48.0	Ductile Iron	125.0	28,266.88	1.74	1.55	5.01
P-460	1,252.00	48.0	Ductile Iron	125.0	26,316.88	1.70	1.36	4.67
P-470	1,231.00	48.0	Ductile Iron	125.0	26,316.88	1.67	1.36	4.67
P-480	1,637.00	48.0	Ductile Iron	125.0	26,316.88	2.22	1.36	4.67
P-490	1,471.00	42.0	Ductile Iron	125.0	24,416.88	3.33	2.27	5.65
P-500	2,001.00	36.0	Ductile Iron	125.0	17,851.00	5.38	2.69	5.63
P-510	2,457.00	36.0	Ductile Iron	125.0	16,914.00	5.98	2.43	5.33
P-520	1,046.00	36.0	Ductile Iron	125.0	13,534.00	1.68	1.61	4.27
P-530	1,366.00	30.0	Ductile Iron	125.0	12,690.00	4.74	3.47	5.76
P-533	838.00	30.0	Ductile Iron	125.0	10,815.00	2.16	2.58	4.91
P-537	657.00	30.0	Ductile Iron	125.0	9,192.00	1.26	1.91	4.17
P-540	1,331.00	24.0	Ductile Iron	125.0	8,022.00	5.86	4.40	5.69
P-545	1,421.00	24.0	Ductile Iron	125.0	6,741.00	4.53	3.19	4.78
P-550	1,289.00	20.0	Ductile Iron	125.0	4,926.00	5.59	4.34	5.03
P-555	1,353.00	20.0	Ductile Iron	125.0	4,637.00	5.25	3.88	4.74
P-560	639.00	18.0	Ductile Iron	125.0	4,357.00	3.69	5.77	5.49
P-563	2,019.00	14.0	Ductile Iron	125.0	2,737.00	16.76	8.30	5.70
P-565	1,095.00	14.0	Ductile Iron	125.0	2,299.00	6.58	6.01	4.79
P-570	2,532.00	14.0	Ductile Iron	125.0	2,070.00	12.53	4.95	4.31
P-580	3,684.00	14.0	Ductile Iron	125.0	2,070.00	18.23	4.95	4.31
P-700	2,027.00	24.0	Ductile Iron	125.0	6,237.00	5.60	2.76	4.42
P-720	729.00	18.0	Ductile Iron	125.0	3,590.00	2.94	4.03	4.53
P-730	1,242.00	18.0	Ductile Iron	125.0	3,590.00	5.01	4.03	4.53
P-750	1,237.00	16.0	Ductile Iron	125.0	2,410.00	4.23	3.42	3.85
P-760	1,619.00	16.0	Ductile Iron	125.0	2,405.00	5.52	3.41	3.84
P-770	1,272.00	16.0	Ductile Iron	125.0	2,293.00	3.97	3.12	3.66
P-780	526.00	14.0	Ductile Iron	125.0	1,974.00	2.38	4.53	4.11
P-785	999.00	14.0	Ductile Iron	125.0	1,841.00	3.98	3.98	3.84
P-790	1,742.00	14.0	Ductile Iron	125.0	1,712.00	6.07	3.48	3.57
P-800	685.00	12.0	Ductile Iron	125.0	1,536.00	4.13	6.03	4.36

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-810	320.00	10.0	Ductile Iron	125.0	835.00	1.52	4.74	3.41
P-820	331.00	6.0	Ductile Iron	125.0	252.00	2.06	6.21	2.86
P-830	896.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-900	2,295.00	36.0	Ductile Iron	125.0	17,799.12	6.14	2.67	5.61
P-910	1,308.00	36.0	Ductile Iron	125.0	17,494.12	3.39	2.59	5.51
P-920	1,551.00	36.0	Ductile Iron	125.0	16,596.12	3.64	2.35	5.23
P-930	1,574.00	36.0	Ductile Iron	125.0	13,686.12	2.59	1.64	4.31
P-940	1,284.00	24.0	Ductile Iron	125.0	7,655.22	5.19	4.04	5.43
P-950	1,007.00	24.0	Ductile Iron	125.0	7,655.22	4.07	4.04	5.43
P-960	1,214.00	24.0	Ductile Iron	125.0	7,655.22	4.90	4.04	5.43
P-970	1,249.00	24.0	Ductile Iron	125.0	6,958.22	4.23	3.38	4.93
P-980	622.00	24.0	Ductile Iron	125.0	6,958.22	2.10	3.38	4.93
P-990	731.00	24.0	Ductile Iron	125.0	6,184.22	1.99	2.72	4.39
P-1000	796.00	24.0	Ductile Iron	125.0	5,884.22	1.97	2.48	4.17
P-1010	830.00	24.0	Ductile Iron	125.0	5,597.22	1.88	2.26	3.97
P-1020	1,535.00	20.0	Ductile Iron	125.0	4,593.22	5.85	3.81	4.69
P-1030	1,340.00	20.0	Ductile Iron	125.0	4,453.22	4.82	3.60	4.55
P-1040	2,284.00	20.0	Ductile Iron	125.0	4,453.22	8.22	3.60	4.55
P-1050	1,305.00	20.0	Ductile Iron	125.0	4,213.22	4.24	3.25	4.30
P-1060	1,384.00	16.0	Ductile Iron	125.0	2,558.12	5.29	3.82	4.08
P-1070	1,426.00	10.0	Ductile Iron	125.0	902.12	7.81	5.47	3.69
P-1075	1,132.00	6.0	Ductile Iron	125.0	356.12	13.34	11.78	4.04
P-1080	607.00	4.0	Ductile Iron	125.0	-220.88	21.27	35.05	5.64
P-1090	733.00	4.0	Ductile Iron	125.0	-220.88	25.69	35.05	5.64
P-1100	355.00	12.0	Ductile Iron	125.0	-1,836.88	2.98	8.40	5.21
P-1110	1,266.00	20.0	Ductile Iron	125.0	-5,100.88	5.86	4.63	5.21
P-1200	609.00	20.0	Ductile Iron	125.0	4,416.90	2.16	3.54	4.51
P-1205	1,038.00	18.0	Ductile Iron	125.0	3,655.90	4.33	4.17	4.61
P-1210	1,128.00	16.0	Ductile Iron	125.0	2,941.90	5.59	4.95	4.69
P-1220	808.00	16.0	Ductile Iron	125.0	2,941.90	4.00	4.95	4.69
P-1230	1,089.00	16.0	Ductile Iron	125.0	2,941.90	5.39	4.95	4.69
P-1240	1,041.00	16.0	Ductile Iron	125.0	2,768.90	4.61	4.43	4.42
P-1250	1,160.00	16.0	Ductile Iron	125.0	2,712.90	4.94	4.26	4.33
P-1260	1,064.00	10.0	Ductile Iron	125.0	908.90	5.90	5.55	3.71
P-1270	978.00	10.0	Ductile Iron	125.0	908.90	5.43	5.55	3.71
P-1280	1,338.00	10.0	Ductile Iron	125.0	908.90	7.42	5.55	3.71
P-1290	1,248.00	8.0	Ductile Iron	125.0	628.90	10.38	8.31	4.01
P-1300	1,319.00	6.0	Ductile Iron	125.0	160.90	3.53	2.67	1.83
P-1310	1,479.00	8.0	Ductile Iron	125.0	-538.10	9.21	6.23	3.43
P-1320	419.00	10.0	Ductile Iron	125.0	-1,375.10	5.01	11.95	5.62

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-110	1,985.00	Zone	Demand	0.00	Fixed	0.00	1,996.42	4.94
J-120	1,990.00	Zone	Demand	0.00	Fixed	0.00	1,995.87	2.54
J-130	1,984.00	Zone	Demand	91.00	Fixed	91.00	1,995.11	4.81
J-140	1,972.00	Zone	Demand	667.00	Fixed	667.00	1,994.62	9.79
J-150	1,950.00	Zone	Demand	560.00	Fixed	560.00	1,993.29	18.73
J-300	1,938.00	Zone	Demand	446.00	Fixed	446.00	1,992.29	23.49
J-310	1,946.00	Zone	Demand	314.00	Fixed	314.00	1,991.77	19.80
J-320	1,935.00	Zone	Demand	325.00	Fixed	325.00	1,990.49	24.01
J-330	1,931.00	Zone	Demand	1,117.00	Fixed	1,117.00	1,990.11	25.57
J-340	1,914.00	Zone	Demand	505.00	Fixed	505.00	1,989.09	32.49
J-350	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,988.58	41.35
J-360	1,887.00	Zone	Demand	0.00	Fixed	0.00	1,988.04	43.72
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,987.53	44.79
J-380	1,869.00	Zone	Demand	0.00	Fixed	0.00	1,985.83	50.55
J-390	1,852.00	Zone	Demand	0.00	Fixed	0.00	1,982.45	56.44
J-400	1,833.00	Zone	Demand	0.00	Fixed	0.00	1,978.67	63.03
J-405	1,800.00	Zone	Demand	154.00	Fixed	154.00	1,975.94	76.12
J-410	1,778.00	Zone	Demand	0.00	Fixed	0.00	1,973.18	84.44
J-420	1,751.00	Zone	Demand	236.00	Fixed	236.00	1,968.15	93.95
J-430	1,747.00	Zone	Demand	255.00	Fixed	255.00	1,966.10	94.79
J-440	1,747.00	Zone	Demand	486.00	Fixed	486.00	1,963.93	93.85
J-450	1,740.00	Zone	Demand	1,950.00	Fixed	1,950.00	1,962.19	96.13
J-460	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,960.49	105.78
J-470	1,705.00	Zone	Demand	0.00	Fixed	0.00	1,958.81	109.81
J-480	1,699.00	Zone	Demand	1,900.00	Fixed	1,900.00	1,956.59	111.45
J-490	1,692.00	Zone	Demand	1,465.00	Fixed	1,465.00	1,953.26	113.03
J-500	1,671.00	Zone	Demand	937.00	Fixed	937.00	1,947.88	119.79
J-510	1,626.00	Zone	Demand	3,380.00	Fixed	3,380.00	1,941.90	136.67
J-520	1,618.00	Zone	Demand	844.00	Fixed	844.00	1,940.22	139.41
J-524	1,604.00	Zone	Demand	1,875.00	Fixed	1,875.00	1,935.47	143.41
J-527	1,590.00	Zone	Demand	1,623.00	Fixed	1,623.00	1,933.31	148.53
J-530	1,577.00	Zone	Demand	1,170.00	Fixed	1,170.00	1,932.05	153.61
J-535	1,557.00	Zone	Demand	1,281.00	Fixed	1,281.00	1,926.19	159.73
J-540	1,536.00	Zone	Demand	1,815.00	Fixed	1,815.00	1,921.65	166.85
J-545	1,516.00	Zone	Demand	289.00	Fixed	289.00	1,916.06	173.09
J-550	1,486.00	Zone	Demand	280.00	Fixed	280.00	1,910.81	183.80
J-553	1,474.00	Zone	Demand	1,620.00	Fixed	1,620.00	1,907.12	187.39
J-557	1,448.00	Zone	Demand	438.00	Fixed	438.00	1,890.36	191.39
J-560	1,424.00	Zone	Demand	229.00	Fixed	229.00	1,883.78	198.93
J-570	1,387.00	Zone	Demand	0.00	Fixed	0.00	1,871.25	209.51
J-580	1,359.00	Zone	Demand	2,070.00	Fixed	2,070.00	1,853.02	213.74
J-710	1,948.00	Zone	Demand	2,647.00	Fixed	2,647.00	1,984.89	15.96
J-720	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,981.95	12.96
J-740	1,959.00	Zone	Demand	1,180.00	Fixed	1,180.00	1,976.94	7.76
J-750	1,952.00	Zone	Demand	5.00	Fixed	5.00	1,972.70	8.96
J-760	1,948.00	Zone	Demand	112.00	Fixed	112.00	1,967.18	8.30
J-770	1,953.00	Zone	Demand	319.00	Fixed	319.00	1,963.21	4.42
J-775	1,950.00	Zone	Demand	133.00	Fixed	133.00	1,960.83	4.68
J-780	1,945.00	Zone	Demand	129.00	Fixed	129.00	1,956.85	5.13
J-790	1,935.00	Zone	Demand	176.00	Fixed	176.00	1,950.78	6.83
J-800	1,928.00	Zone	Demand	701.00	Fixed	701.00	1,946.65	8.07
J-810	1,929.00	Zone	Demand	583.00	Fixed	583.00	1,945.13	6.98

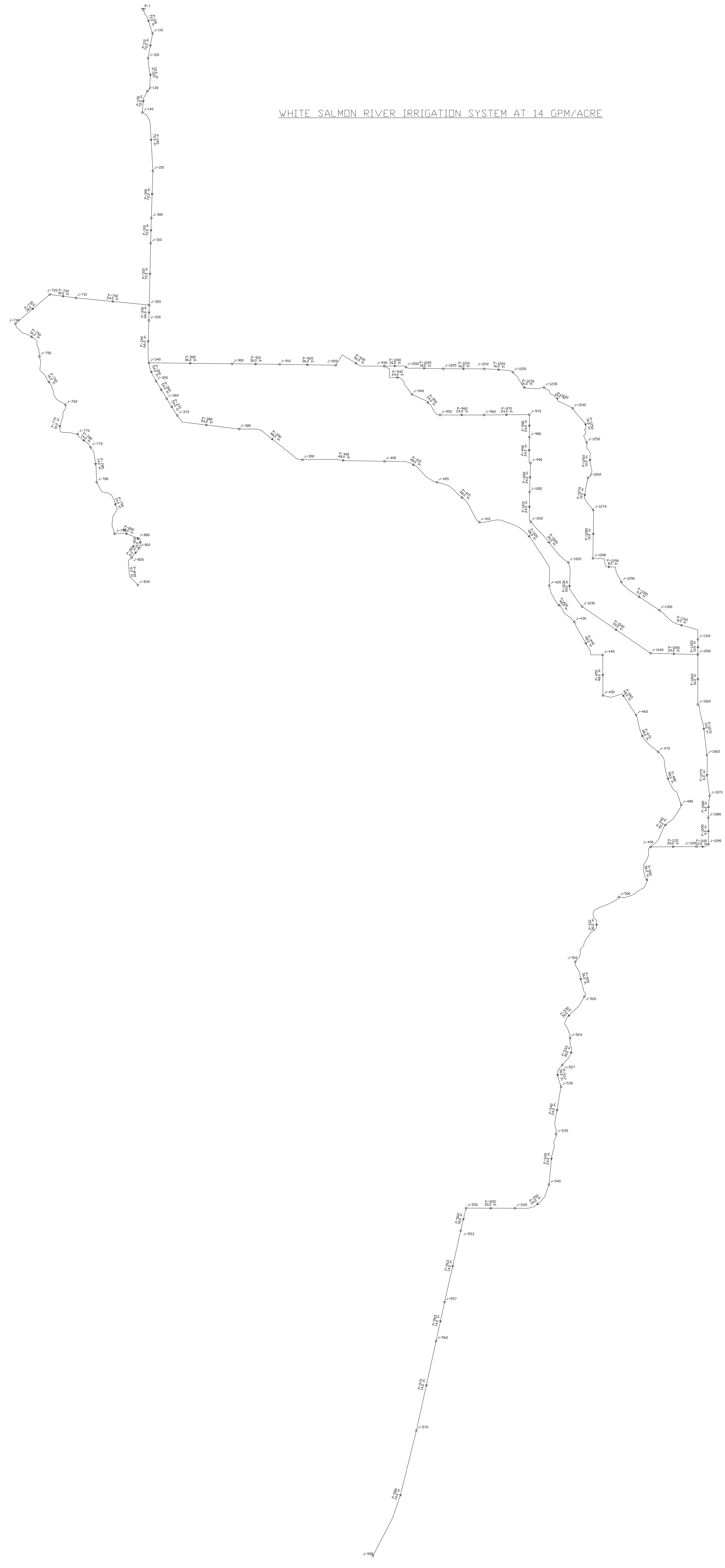
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-820	1,933.00	Zone	Demand	252.00	Fixed	252.00	1,943.08	4.36
J-830	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,943.08	6.96
J-900	1,893.00	Zone	Demand	305.00	Fixed	305.00	1,982.96	38.92
J-910	1,878.00	Zone	Demand	898.00	Fixed	898.00	1,979.57	43.94
J-920	1,857.00	Zone	Demand	2,910.00	Fixed	2,910.00	1,975.93	51.45
J-930	1,849.00	Zone	Demand	1,614.00	Fixed	1,614.00	1,973.34	53.80
J-940	1,843.00	Zone	Demand	0.00	Fixed	0.00	1,968.15	54.15
J-950	1,838.00	Zone	Demand	0.00	Fixed	0.00	1,964.09	54.55
J-960	1,829.00	Zone	Demand	697.00	Fixed	697.00	1,959.18	56.32
J-970	1,814.00	Zone	Demand	0.00	Fixed	0.00	1,954.96	60.99
J-980	1,810.00	Zone	Demand	774.00	Fixed	774.00	1,952.85	61.81
J-990	1,807.00	Zone	Demand	300.00	Fixed	300.00	1,950.86	62.24
J-1000	1,796.00	Zone	Demand	287.00	Fixed	287.00	1,948.89	66.15
J-1010	1,781.00	Zone	Demand	1,004.00	Fixed	1,004.00	1,947.01	71.83
J-1020	1,763.00	Zone	Demand	140.00	Fixed	140.00	1,941.16	77.08
J-1030	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,936.34	82.35
J-1040	1,730.00	Zone	Demand	240.00	Fixed	240.00	1,928.12	85.72
J-1050	1,731.00	Zone	Demand	280.00	Fixed	280.00	1,923.88	83.45
J-1060	1,722.00	Zone	Demand	1,656.00	Fixed	1,656.00	1,918.59	85.06
J-1065	1,716.00	Zone	Demand	546.00	Fixed	546.00	1,910.79	84.27
J-1070	1,707.00	Zone	Demand	577.00	Fixed	577.00	1,897.45	82.40
J-1080	1,697.00	Zone	Demand	0.00	Fixed	0.00	1,918.72	95.93
J-1090	1,695.00	Zone	Demand	1,616.00	Fixed	1,616.00	1,944.41	107.91
J-1100	1,689.00	Zone	Demand	3,264.00	Fixed	3,264.00	1,947.40	111.80
J-1200	1,842.00	Zone	Demand	761.00	Fixed	761.00	1,971.18	55.89
J-1205	1,833.00	Zone	Demand	714.00	Fixed	714.00	1,966.85	57.91
J-1210	1,827.00	Zone	Demand	0.00	Fixed	0.00	1,961.26	58.09
J-1220	1,830.00	Zone	Demand	0.00	Fixed	0.00	1,957.26	55.06
J-1230	1,829.00	Zone	Demand	173.00	Fixed	173.00	1,951.87	53.16
J-1240	1,816.00	Zone	Demand	56.00	Fixed	56.00	1,947.26	56.79
J-1250	1,795.00	Zone	Demand	1,804.00	Fixed	1,804.00	1,942.32	63.74
J-1260	1,787.00	Zone	Demand	0.00	Fixed	0.00	1,936.42	64.65
J-1270	1,776.00	Zone	Demand	0.00	Fixed	0.00	1,930.99	67.06
J-1280	1,768.00	Zone	Demand	280.00	Fixed	280.00	1,923.57	67.31
J-1290	1,760.00	Zone	Demand	468.00	Fixed	468.00	1,913.19	66.28
J-1300	1,756.00	Zone	Demand	699.00	Fixed	699.00	1,909.67	66.48
J-1310	1,736.00	Zone	Demand	837.00	Fixed	837.00	1,918.88	79.12

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,997.00	Zone	-57,459.00	1,997.00

WHITE SALMON RIVER IRRIGATION SYSTEM AT 14 GPM/ACRE



Appendix E

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-100	722.00	72.0	Ductile Iron	125.0	67,320.00	0.78	1.07	5.30
P-110	693.00	72.0	Ductile Iron	125.0	67,320.00	0.74	1.07	5.30
P-120	944.00	72.0	Ductile Iron	125.0	67,320.00	1.01	1.07	5.30
P-130	618.00	72.0	Ductile Iron	125.0	67,320.00	0.66	1.07	5.30
P-140	1,700.00	72.0	Ductile Iron	125.0	67,320.00	1.82	1.07	5.30
P-300	1,301.00	72.0	Ductile Iron	125.0	67,320.00	1.40	1.07	5.30
P-310	694.00	72.0	Ductile Iron	125.0	67,320.00	0.74	1.07	5.30
P-320	1,710.00	72.0	Ductile Iron	125.0	67,320.00	1.84	1.07	5.30
P-330	424.00	72.0	Ductile Iron	125.0	67,320.00	0.46	1.07	5.30
P-340	1,169.00	72.0	Ductile Iron	125.0	67,320.00	1.26	1.07	5.30
P-350	548.00	60.0	Ductile Iron	125.0	50,406.95	0.84	1.53	5.72
P-360	570.00	60.0	Ductile Iron	125.0	50,406.95	0.87	1.53	5.72
P-370	542.00	60.0	Ductile Iron	125.0	50,406.95	0.83	1.53	5.72
P-380	1,809.00	60.0	Ductile Iron	125.0	50,406.95	2.76	1.53	5.72
P-390	2,026.00	60.0	Ductile Iron	125.0	50,406.95	3.09	1.53	5.72
P-400	2,267.00	60.0	Ductile Iron	125.0	50,406.95	3.46	1.53	5.72
P-410	1,641.00	60.0	Ductile Iron	125.0	50,406.95	2.51	1.53	5.72
P-415	1,671.00	60.0	Ductile Iron	125.0	50,406.95	2.55	1.53	5.72
P-420	3,042.00	60.0	Ductile Iron	125.0	50,406.95	4.64	1.53	5.72
P-430	1,263.00	60.0	Ductile Iron	125.0	50,406.95	1.93	1.53	5.72
P-440	1,357.00	60.0	Ductile Iron	125.0	50,406.95	2.07	1.53	5.72
P-450	1,121.00	60.0	Ductile Iron	125.0	50,406.95	1.71	1.53	5.72
P-460	1,252.00	60.0	Ductile Iron	125.0	50,406.95	1.91	1.53	5.72
P-470	1,231.00	60.0	Ductile Iron	125.0	50,406.95	1.88	1.53	5.72
P-480	1,637.00	60.0	Ductile Iron	125.0	50,406.95	2.50	1.53	5.72
P-490	1,471.00	60.0	Ductile Iron	125.0	50,406.95	2.25	1.53	5.72
P-500	2,001.00	72.0	Ductile Iron	125.0	67,320.00	2.15	1.07	5.30
P-510	2,457.00	72.0	Ductile Iron	125.0	67,320.00	2.64	1.07	5.30
P-520	1,046.00	72.0	Ductile Iron	125.0	67,320.00	1.12	1.07	5.30
P-530	1,366.00	72.0	Ductile Iron	125.0	67,320.00	1.47	1.07	5.30
P-533	838.00	72.0	Ductile Iron	125.0	67,320.00	0.90	1.07	5.30
P-537	657.00	72.0	Ductile Iron	125.0	67,320.00	0.71	1.07	5.30
P-540	1,331.00	72.0	Ductile Iron	125.0	67,320.00	1.43	1.07	5.30
P-545	1,421.00	72.0	Ductile Iron	125.0	67,320.00	1.53	1.07	5.30
P-550	1,289.00	72.0	Ductile Iron	125.0	67,320.00	1.38	1.07	5.30
P-555	1,353.00	72.0	Ductile Iron	125.0	67,320.00	1.45	1.07	5.30
P-560	639.00	72.0	Ductile Iron	125.0	67,320.00	0.69	1.07	5.30
P-563	2,019.00	72.0	Ductile Iron	125.0	67,320.00	2.17	1.07	5.30
P-565	1,095.00	72.0	Ductile Iron	125.0	67,320.00	1.18	1.07	5.30
P-570	2,532.00	72.0	Ductile Iron	125.0	67,320.00	2.72	1.07	5.30
P-580	3,684.00	72.0	Ductile Iron	125.0	67,320.00	3.95	1.07	5.30
P-590	2,933.00	72.0	Ductile Iron	125.0	67,320.00	3.15	1.07	5.30
P-700	2,027.00	24.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-720	729.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-730	1,242.00	18.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-750	1,237.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-760	1,619.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-770	1,272.00	16.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-780	526.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-785	999.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-790	1,742.00	14.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-800	685.00	12.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-810	320.00	10.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-820	331.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-830	896.00	6.0	Ductile Iron	125.0	0.00	0.00	0.00	0.00
P-900	2,295.00	42.0	Ductile Iron	125.0	16,913.05	2.63	1.15	3.92
P-910	1,308.00	42.0	Ductile Iron	125.0	16,913.05	1.50	1.15	3.92
P-920	1,551.00	42.0	Ductile Iron	125.0	16,913.05	1.78	1.15	3.92
P-930	1,574.00	42.0	Ductile Iron	125.0	16,913.05	1.81	1.15	3.92
P-940	1,284.00	36.0	Ductile Iron	125.0	12,644.30	1.82	1.42	3.99
P-950	1,007.00	36.0	Ductile Iron	125.0	12,644.30	1.43	1.42	3.99
P-960	1,214.00	36.0	Ductile Iron	125.0	12,644.30	1.72	1.42	3.99
P-970	1,249.00	36.0	Ductile Iron	125.0	12,644.30	1.77	1.42	3.99
P-980	622.00	36.0	Ductile Iron	125.0	12,644.30	0.88	1.42	3.99
P-990	731.00	36.0	Ductile Iron	125.0	12,644.30	1.04	1.42	3.99
P-1000	796.00	36.0	Ductile Iron	125.0	12,644.30	1.13	1.42	3.99
P-1010	830.00	36.0	Ductile Iron	125.0	12,644.30	1.18	1.42	3.99
P-1020	1,535.00	36.0	Ductile Iron	125.0	12,644.30	2.18	1.42	3.99
P-1030	1,340.00	36.0	Ductile Iron	125.0	12,644.30	1.90	1.42	3.99
P-1040	2,284.00	36.0	Ductile Iron	125.0	12,644.30	3.24	1.42	3.99
P-1050	1,305.00	36.0	Ductile Iron	125.0	12,644.30	1.85	1.42	3.99
P-1060	1,384.00	42.0	Ductile Iron	125.0	16,913.05	1.59	1.15	3.92
P-1070	1,426.00	42.0	Ductile Iron	125.0	16,913.05	1.64	1.15	3.92
P-1075	1,132.00	42.0	Ductile Iron	125.0	16,913.05	1.30	1.15	3.92
P-1080	607.00	42.0	Ductile Iron	125.0	16,913.05	0.70	1.15	3.92
P-1090	733.00	42.0	Ductile Iron	125.0	16,913.05	0.84	1.15	3.92
P-1100	355.00	42.0	Ductile Iron	125.0	16,913.05	0.41	1.15	3.92
P-1110	1,266.00	42.0	Ductile Iron	125.0	16,913.05	1.45	1.15	3.92
P-1200	609.00	24.0	Ductile Iron	125.0	4,268.75	0.83	1.37	3.03
P-1205	1,038.00	24.0	Ductile Iron	125.0	4,268.75	1.42	1.37	3.03
P-1210	1,128.00	24.0	Ductile Iron	125.0	4,268.75	1.54	1.37	3.03
P-1220	808.00	24.0	Ductile Iron	125.0	4,268.75	1.11	1.37	3.03
P-1230	1,089.00	24.0	Ductile Iron	125.0	4,268.75	1.49	1.37	3.03
P-1240	1,041.00	24.0	Ductile Iron	125.0	4,268.75	1.43	1.37	3.03
P-1250	1,160.00	24.0	Ductile Iron	125.0	4,268.75	1.59	1.37	3.03
P-1260	1,064.00	24.0	Ductile Iron	125.0	4,268.75	1.46	1.37	3.03
P-1270	978.00	24.0	Ductile Iron	125.0	4,268.75	1.34	1.37	3.03
P-1280	1,338.00	24.0	Ductile Iron	125.0	4,268.75	1.83	1.37	3.03
P-1290	1,248.00	24.0	Ductile Iron	125.0	4,268.75	1.71	1.37	3.03
P-1300	1,319.00	24.0	Ductile Iron	125.0	4,268.75	1.81	1.37	3.03
P-1310	1,479.00	24.0	Ductile Iron	125.0	4,268.75	2.03	1.37	3.03
P-1320	419.00	24.0	Ductile Iron	125.0	4,268.75	0.57	1.37	3.03

Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-110	1,985.00	Zone	Demand	0.00	Fixed	0.00	1,996.22	4.86
J-120	1,990.00	Zone	Demand	0.00	Fixed	0.00	1,995.48	2.37
J-130	1,984.00	Zone	Demand	0.00	Fixed	0.00	1,994.47	4.53
J-140	1,972.00	Zone	Demand	0.00	Fixed	0.00	1,993.80	9.43
J-150	1,950.00	Zone	Demand	0.00	Fixed	0.00	1,991.98	18.16
J-300	1,938.00	Zone	Demand	0.00	Fixed	0.00	1,990.58	22.75
J-310	1,946.00	Zone	Demand	0.00	Fixed	0.00	1,989.84	18.97
J-320	1,935.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	22.93
J-330	1,931.00	Zone	Demand	0.00	Fixed	0.00	1,987.55	24.47
J-340	1,914.00	Zone	Demand	0.00	Fixed	0.00	1,986.29	31.28
J-350	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,985.46	40.00
J-360	1,887.00	Zone	Demand	0.00	Fixed	0.00	1,984.58	42.22
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,983.76	43.16
J-380	1,869.00	Zone	Demand	0.00	Fixed	0.00	1,981.00	48.46
J-390	1,852.00	Zone	Demand	0.00	Fixed	0.00	1,977.90	54.47
J-400	1,833.00	Zone	Demand	0.00	Fixed	0.00	1,974.44	61.19
J-405	1,800.00	Zone	Demand	0.00	Fixed	0.00	1,971.94	74.39
J-410	1,778.00	Zone	Demand	0.00	Fixed	0.00	1,969.38	82.80
J-420	1,751.00	Zone	Demand	0.00	Fixed	0.00	1,964.74	92.48
J-430	1,747.00	Zone	Demand	0.00	Fixed	0.00	1,962.81	93.37
J-440	1,747.00	Zone	Demand	0.00	Fixed	0.00	1,960.74	92.47
J-450	1,740.00	Zone	Demand	0.00	Fixed	0.00	1,959.03	94.76
J-460	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,957.12	104.32
J-470	1,705.00	Zone	Demand	0.00	Fixed	0.00	1,955.24	108.27
J-480	1,699.00	Zone	Demand	0.00	Fixed	0.00	1,952.74	109.78
J-490	1,692.00	Zone	Demand	0.00	Fixed	0.00	1,950.49	111.84
J-500	1,671.00	Zone	Demand	0.00	Fixed	0.00	1,948.34	119.99
J-510	1,626.00	Zone	Demand	0.00	Fixed	0.00	1,945.71	138.32
J-520	1,618.00	Zone	Demand	0.00	Fixed	0.00	1,944.58	141.30
J-524	1,604.00	Zone	Demand	0.00	Fixed	0.00	1,943.12	146.72
J-527	1,590.00	Zone	Demand	0.00	Fixed	0.00	1,942.22	152.39
J-530	1,577.00	Zone	Demand	0.00	Fixed	0.00	1,941.51	157.71
J-535	1,557.00	Zone	Demand	0.00	Fixed	0.00	1,940.08	165.74
J-540	1,536.00	Zone	Demand	0.00	Fixed	0.00	1,938.56	174.17
J-545	1,516.00	Zone	Demand	0.00	Fixed	0.00	1,937.17	182.22
J-550	1,486.00	Zone	Demand	0.00	Fixed	0.00	1,935.72	194.57
J-553	1,474.00	Zone	Demand	0.00	Fixed	0.00	1,935.04	199.47
J-557	1,448.00	Zone	Demand	0.00	Fixed	0.00	1,932.87	209.78
J-560	1,424.00	Zone	Demand	0.00	Fixed	0.00	1,931.69	219.65
J-570	1,387.00	Zone	Demand	0.00	Fixed	0.00	1,928.97	234.49
J-580	1,359.00	Zone	Demand	0.00	Fixed	0.00	1,925.02	244.89
J-590	1,252.00	Zone	Demand	67,320.00	Fixed	67,320.00	1,921.87	289.82
J-710	1,948.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	17.31
J-720	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	15.58
J-740	1,959.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	12.55
J-750	1,952.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	15.58
J-760	1,948.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	17.31
J-770	1,953.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	15.14
J-775	1,950.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	16.44
J-780	1,945.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	18.60
J-790	1,935.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	22.93
J-800	1,928.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	25.96

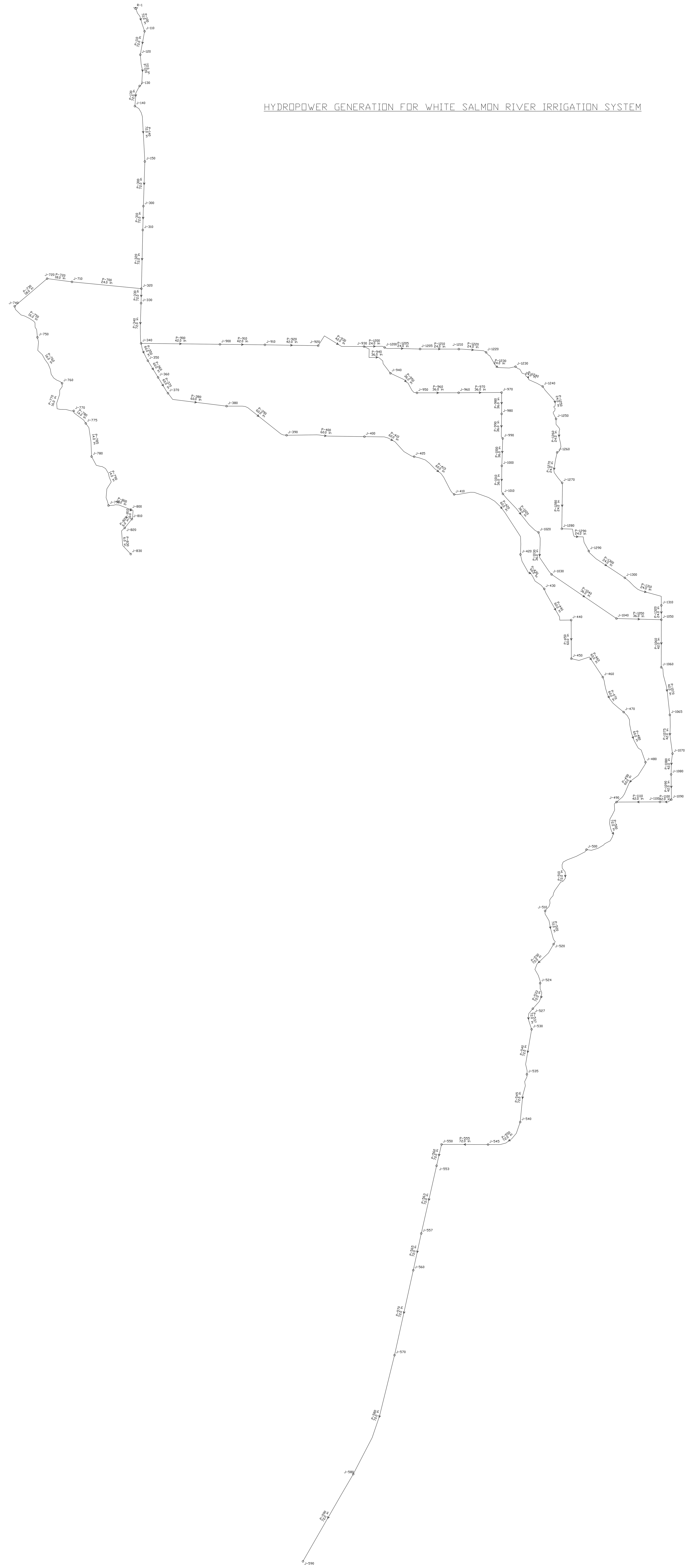
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-810	1,929.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	25.53
J-820	1,933.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	23.80
J-830	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,988.00	26.39
J-900	1,893.00	Zone	Demand	0.00	Fixed	0.00	1,983.66	39.22
J-910	1,878.00	Zone	Demand	0.00	Fixed	0.00	1,982.16	45.06
J-920	1,857.00	Zone	Demand	0.00	Fixed	0.00	1,980.37	53.38
J-930	1,849.00	Zone	Demand	0.00	Fixed	0.00	1,978.57	56.06
J-940	1,843.00	Zone	Demand	0.00	Fixed	0.00	1,976.75	57.87
J-950	1,838.00	Zone	Demand	0.00	Fixed	0.00	1,975.32	59.41
J-960	1,829.00	Zone	Demand	0.00	Fixed	0.00	1,973.59	62.56
J-970	1,814.00	Zone	Demand	0.00	Fixed	0.00	1,971.82	68.28
J-980	1,810.00	Zone	Demand	0.00	Fixed	0.00	1,970.94	69.63
J-990	1,807.00	Zone	Demand	0.00	Fixed	0.00	1,969.90	70.48
J-1000	1,796.00	Zone	Demand	0.00	Fixed	0.00	1,968.77	74.75
J-1010	1,781.00	Zone	Demand	0.00	Fixed	0.00	1,967.59	80.73
J-1020	1,763.00	Zone	Demand	0.00	Fixed	0.00	1,965.41	87.57
J-1030	1,746.00	Zone	Demand	0.00	Fixed	0.00	1,963.51	94.11
J-1040	1,730.00	Zone	Demand	0.00	Fixed	0.00	1,960.27	99.63
J-1050	1,731.00	Zone	Demand	0.00	Fixed	0.00	1,958.42	98.39
J-1060	1,722.00	Zone	Demand	0.00	Fixed	0.00	1,956.83	101.60
J-1065	1,716.00	Zone	Demand	0.00	Fixed	0.00	1,955.19	103.49
J-1070	1,707.00	Zone	Demand	0.00	Fixed	0.00	1,953.89	106.82
J-1080	1,697.00	Zone	Demand	0.00	Fixed	0.00	1,953.19	110.84
J-1090	1,695.00	Zone	Demand	0.00	Fixed	0.00	1,952.35	111.34
J-1100	1,689.00	Zone	Demand	0.00	Fixed	0.00	1,951.95	113.76
J-1200	1,842.00	Zone	Demand	0.00	Fixed	0.00	1,977.73	58.73
J-1205	1,833.00	Zone	Demand	0.00	Fixed	0.00	1,976.31	62.00
J-1210	1,827.00	Zone	Demand	0.00	Fixed	0.00	1,974.77	63.93
J-1220	1,830.00	Zone	Demand	0.00	Fixed	0.00	1,973.66	62.16
J-1230	1,829.00	Zone	Demand	0.00	Fixed	0.00	1,972.17	61.94
J-1240	1,816.00	Zone	Demand	0.00	Fixed	0.00	1,970.75	66.95
J-1250	1,795.00	Zone	Demand	0.00	Fixed	0.00	1,969.16	75.35
J-1260	1,787.00	Zone	Demand	0.00	Fixed	0.00	1,967.70	78.18
J-1270	1,776.00	Zone	Demand	0.00	Fixed	0.00	1,966.36	82.36
J-1280	1,768.00	Zone	Demand	0.00	Fixed	0.00	1,964.53	85.03
J-1290	1,760.00	Zone	Demand	0.00	Fixed	0.00	1,962.82	87.75
J-1300	1,756.00	Zone	Demand	0.00	Fixed	0.00	1,961.02	88.70
J-1310	1,736.00	Zone	Demand	0.00	Fixed	0.00	1,958.99	96.48

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,997.00	Zone	-67,320.00	1,997.00

HYDROPOWER GENERATION FOR WHITE SALMON RIVER IRRIGATION SYSTEM



Appendix F

Scenario: Base
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Velocity (ft/s)
P-350	1,668.00	16.0	Ductile Iron	125.0	-2,989.00	8.51	5.10	4.77
P-380	1,778.00	20.0	Ductile Iron	125.0	5,823.00	10.52	5.91	5.95
P-390	2,026.00	20.0	Ductile Iron	125.0	4,433.00	7.23	3.57	4.53
P-400	2,268.00	16.0	Ductile Iron	130.0	-2,672.00	8.74	3.85	4.26
P-410	3,312.00	8.0	Ductile Iron	130.0	-775.00	37.73	11.39	4.95
P-900	2,295.00	16.0	Ductile Iron	125.0	2,989.00	11.70	5.10	4.77
P-910	1,308.00	14.0	Ductile Iron	125.0	2,059.00	6.41	4.90	4.29
P-920	1,552.00	8.0	Ductile Iron	130.0	-664.00	13.28	8.56	4.24
P-1400	141.00	36.0	Ductile Iron	125.0	16,842.00	0.34	2.41	5.31
P-1410	306.00	36.0	Ductile Iron	125.0	13,853.00	0.51	1.68	4.37
P-1420	1,088.00	20.0	Ductile Iron	125.0	5,823.00	6.43	5.91	5.95
P-1430	887.00	20.0	Ductile Iron	125.0	5,823.00	5.25	5.91	5.95
P-1440	533.00	30.0	Ductile Iron	125.0	8,030.00	0.79	1.49	3.64
P-1450	501.00	30.0	Ductile Iron	125.0	8,030.00	0.75	1.49	3.64
P-1460	564.00	30.0	Ductile Iron	125.0	8,030.00	0.84	1.49	3.64
P-1470	1,262.00	30.0	Ductile Iron	125.0	7,876.00	1.81	1.44	3.57
P-1480	1,231.00	30.0	Ductile Iron	125.0	7,876.00	1.77	1.44	3.57
P-1490	1,006.00	30.0	Ductile Iron	125.0	7,876.00	1.44	1.44	3.57
P-1500	1,260.00	24.0	Ductile Iron	125.0	7,260.00	4.61	3.66	5.15
P-1510	567.00	24.0	Ductile Iron	125.0	7,260.00	2.08	3.66	5.15
P-1520	1,407.00	24.0	Ductile Iron	125.0	7,260.00	5.15	3.66	5.15
P-1530	1,239.00	24.0	Ductile Iron	125.0	7,260.00	4.54	3.66	5.15
P-1540	1,613.00	24.0	Ductile Iron	125.0	6,980.00	5.49	3.40	4.95
P-1550	2,157.00	20.0	Ductile Iron	125.0	5,020.00	9.69	4.49	5.13
P-1560	874.00	20.0	Ductile Iron	125.0	4,554.00	3.28	3.75	4.65
P-1570	2,114.00	18.0	Ductile Iron	125.0	3,994.00	10.39	4.91	5.04
P-1580	1,163.00	16.0	Ductile Iron	125.0	3,062.00	6.20	5.33	4.89
P-1590	1,394.00	14.0	Ductile Iron	125.0	2,401.00	9.08	6.51	5.00
P-1600	1,359.00	10.0	Ductile Iron	125.0	1,300.00	14.63	10.77	5.31
P-1610	1,848.00	8.0	Ductile Iron	125.0	560.00	12.40	6.71	3.57

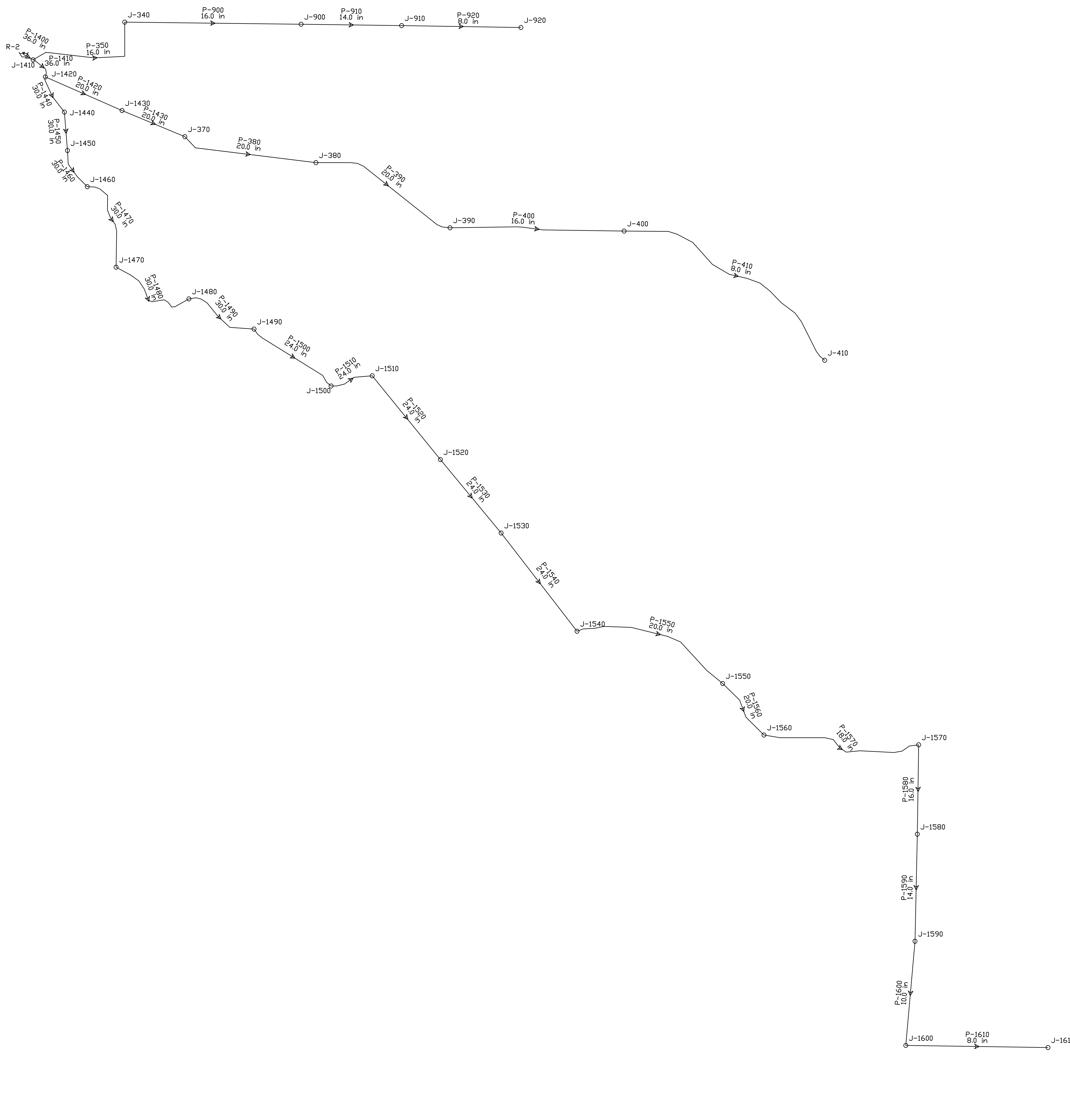
Scenario: Base
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-340	1,914.00	Zone	Demand	0.00	Fixed	0.00	1,924.15	4.39
J-370	1,884.00	Zone	Demand	0.00	Fixed	0.00	1,920.47	15.78
J-380	1,869.00	Zone	Demand	1,390.00	Fixed	1,390.00	1,909.95	17.72
J-390	1,852.00	Zone	Demand	1,761.00	Fixed	1,761.00	1,902.72	21.94
J-400	1,833.00	Zone	Demand	1,897.00	Fixed	1,897.00	1,893.98	26.38
J-410	1,778.00	Zone	Demand	775.00	Fixed	775.00	1,856.25	33.85
J-900	1,893.00	Zone	Demand	930.00	Fixed	930.00	1,912.45	8.41
J-910	1,878.00	Zone	Demand	1,395.00	Fixed	1,395.00	1,906.04	12.13
J-920	1,857.00	Zone	Demand	664.00	Fixed	664.00	1,892.76	15.47
J-1410	1,930.00	Zone	Demand	0.00	Fixed	0.00	1,932.66	1.15
J-1420	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,932.15	2.23
J-1430	1,901.00	Zone	Demand	0.00	Fixed	0.00	1,925.71	10.69
J-1440	1,927.00	Zone	Demand	0.00	Fixed	0.00	1,931.35	1.88
J-1450	1,925.00	Zone	Demand	0.00	Fixed	0.00	1,930.61	2.43
J-1460	1,921.00	Zone	Demand	154.00	Fixed	154.00	1,929.77	3.79
J-1470	1,910.00	Zone	Demand	0.00	Fixed	0.00	1,927.96	7.77
J-1480	1,894.00	Zone	Demand	0.00	Fixed	0.00	1,926.19	13.93
J-1490	1,884.00	Zone	Demand	616.00	Fixed	616.00	1,924.74	17.63
J-1500	1,881.00	Zone	Demand	0.00	Fixed	0.00	1,920.13	16.93
J-1510	1,864.00	Zone	Demand	0.00	Fixed	0.00	1,918.06	23.39
J-1520	1,847.00	Zone	Demand	0.00	Fixed	0.00	1,912.90	28.51
J-1530	1,848.00	Zone	Demand	280.00	Fixed	280.00	1,908.37	26.12
J-1540	1,826.00	Zone	Demand	1,960.00	Fixed	1,960.00	1,902.88	33.26
J-1550	1,816.00	Zone	Demand	466.00	Fixed	466.00	1,893.19	33.40
J-1560	1,805.00	Zone	Demand	560.00	Fixed	560.00	1,889.91	36.74
J-1570	1,756.00	Zone	Demand	932.00	Fixed	932.00	1,879.52	53.44
J-1580	1,746.00	Zone	Demand	661.00	Fixed	661.00	1,873.32	55.08
J-1590	1,725.00	Zone	Demand	1,101.00	Fixed	1,101.00	1,864.24	60.24
J-1600	1,698.00	Zone	Demand	740.00	Fixed	740.00	1,849.60	65.59
J-1610	1,681.00	Zone	Demand	560.00	Fixed	560.00	1,837.20	67.58

Scenario: Base
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-2	1,933.00	Zone	-16,842.00	1,933.00

TROUT LAKE CREEK IRRIGATION SYSTEM AT 14 GPM/ACRE



S:\UnderwoodConservationDistrict\008-36_TroutLakeReconnaissanceStudy\Water Model\Model_Irrg-TroutCk.dwf, Model, 3/28/2012 3:08:04 PM, dchristman, DWG To PDF.pc3

Appendix G

Meeting with Underwood Conservation District/Yakama Nation Memo

anderson perry & associates, inc.
engineering • surveying • materials testing

MEMO

To: Trout Lake Irrigators Group

From: Dale Buser DJB

Subject: **Meeting with Underwood Conservation District/Yakama Nation**

Date: November 2, 2011

Job/File No. 6006-36-29

cc: Alan Schroeder, AP

I attended a meeting in White Salmon, Washington, regarding the Trout Lake Irrigation Improvement and Hydropower Reconnaissance Study. My primary mission was to begin identifying Tribal concerns related to this project going forward. The current study is conceptual in nature and that actual design and construction may not occur for several years to a decade.

Venue, Attendees, and General Observations. The meeting was scheduled for 11:00 a.m. at the Underwood Conservation District office located at 170 N.W. Lincoln Street, lower floor Park Center Building, White Salmon, Washington.

Tova Tillinghast, District Manager, Underwood Conservation District.

Three people represented the Yakama Nation at the meeting:

Bill Sharp, Yakama/Klickitat Fisheries Project (YKFP) research scientist, Fisheries Resource Management, Confederated Tribes and Bands, Yakama Nation, office phone (509) 865-5121 extension 6355, cell (509) 945-3167, e-mail sharp@yakama.com. Bill seemed to lead the Tribal team, at least from a major issue standpoint. He definitely had an interest in fish passage, including lamprey, and wanted an efficient program to achieve this goal. This could be as simple as screening diversions and retrofitting weirs with fish-friendly elements.

Tom Ring, hydrogeologist, Yakama Nation Water Program, office phone (509) 865-5121 extension 6709, e-mail ringt@yakama.com. Tom talked about water quantity issues, especially about potential difficulties with water rights and the large water withdrawals given the acreage irrigated and the crops grown.

Jeanette Burkhardt, watershed planner. Jeanette primarily listened and took notes.

A staff list was available via http://host119.yakama.com/YKFP/ykfp.htm and is cut and pasted below for future utility and convenience.

First Name	Last Name	Title	Telephone	e-mail
Michael	Babcock	Klickitat Data Manager	509-369-3271	mbabcock@ykfp.org
Joe	Blodgett		509-786-9908	joewb@earthlink.net
Bill	Bosch	Data Manager	509-972-8847	bbosch@yakama.com
Jeanette	Burkhardt	Watershed Planner	509-369-3157	jeanette@ykfp.org
Will	Conley	Hydrologist	509-369-3183	will@ykfp.org
Melinda	Davis	Yakima River Fall Chinook Project Lead	6340	mdavis@yakama.com
Elaine	Espirito	Fisheries Biologist	509-773-3147	elaine@ykfp.org
Dave	Fast	Research Manager	509-966-5291	fast@yakama.com
Bill	Fiander	Fisheries Biologist	6372	bfiander@yakama.com
Henry	Fraser		509-963-1159	henry.fraser@cwu.edu
Chris	Frederiksen	EDT/AHA Modeler	509-966-5156	chrisf@yakama.com
Paul	Huffman	Data Manager	509-972-4571	huffmanp@yakama.com
Mark	Johnston	Research Scientist	6346	markj@yakama.com
David	Lind	Data Manager	509-965-6270	lind@yakama.com
David	Lindley	Habitat Biologist	509-369-3565	dlindley@ykfp.org
Shane	Keep	Fisheries Biologist		skeep@ykfp.org
John	Marvin	Habitat Biologist	509-966-7406	jmarvin@yakama.com
Todd	Newsome	Yakima River Coho Project Lead	6353	tnews@yakama.com
Scott	Nicolai	Habitat Biologist	509-962-6142	ykfphabitat@elltel.net
Michael	Porter	Avian Predation Study	509-966-4975	michaelp@yakama.com
Jason	Rau	YKFP Klickitat Hatchery Manager	509-364-3310	jayrau@ykfp.org
Nicolas	Romero	Fisheries Biologist	509-360-3568	nromero@ykfp.org
Mel	Sampson	Project Manager	6303	mel@yakama.com
Bill	Sharp	Klickitat Coordinator	6365	sharp@yakama.com
Charlie	Strom	Cle Elum Hatchery Manager	509-674-3701	osprey@eburg.com
Joe	Zendt	Research Scientist	509-369-3184	jzendt@ykfp.org

Summary of Major Topics of Discussion.

Expectations and Familiarity. The meeting commenced with introductions and a project thumbnail presented by Tova. I got the feeling that Tova had anticipated the meeting would begin with a technical update from Anderson·Perry & Associates, Inc. (AP) addressing such issues as pipe routing, hydraulics, and water rights. The Tribal staff was not familiar with what has been done to date, so we substituted a review of the conceptual routing, hydropower, and other factors to bring them up to speed. Bill of the Yakama Nation asked questions to establish "who is Anderson·Perry." He wanted to know if we had worked on similar projects in the past and so forth. I told him we had worked for a number of irrigation districts on similar projects, and pointed out some of the salient information in our proposal. All in all, the Tribal staff seemed satisfied and did not express uneasiness with AP's capabilities and credentials.

Technical Discussion. A number of technical elements were discussed as described below.

1. **Fishery.** Anadromous salmonids will benefit from the Condit Dam removal but natural barriers (falls) prevent them from ascending the White Salmon River to the project area located in the Trout Lake Valley. Nevertheless, anadromous lamprey are believed to be able to ascend falls. Lamprey and stream-resident fish utilize this reach of river and could benefit from irrigation system improvements. Lampreys are culturally significant species to the Yakama Nation, have experienced dramatic declines in abundance in recent decades and, therefore, are a species of concern to the Yakama Nation (Figure 1). I noted that I have worked on Great Lakes lamprey issues for several years. Bill questioned the suitability of screens to prevent entrainment of juvenile lamprey. I mentioned the relationship with the company (Farmers Conservation Alliance) currently doing research on this issue who manufactures such screens.

Figure 1 – Pacific Lamprey.

Bull trout (a federally threatened species) were identified in the upper White Salmon River in the recent past but have not been collected for over 12 years. Rainbow trout, brook trout (exotic that hybridizes with bull trout), and other native fish also inhabit the White Salmon River in the study area. All species could benefit from improving stream connectivity, water flow regimes, and water quality. I underscored the benefit to enhance habitat characteristics for the species assemblage, not just individual high profile species. Bill's primary message was that changes that benefit these elements are of interest regardless of other "benefits." For example, diversion screening is required and must be completed, but retrofitting existing dams may be just as beneficial as rebuilding dams. Bill did not seem overly interested in the fact that the plan may reduce the number of diversions from 8 to 2; he was more interested in making any set of dam/diversion structures/flow regimes fish friendly.

I asked if the Yakama Nation had used environmental DNA (eDNA) to help characterize fish assemblages in the White Salmon and its tributaries. They were unfamiliar with the technique, so I explained its utility to monument species composition, success/failure of migration impediment programs, and to preserve a "library" of species composition at a set point in time. Species lists do not need to be limited to fish and can be expanded to include mussels, viruses, etc. I discussed its application and limitations and promised them a short summary report for a recent project.

2. **Hydroelectric Facility.** We spoke of the desire to divert water year-round to operate the hydroelectric facility. Bill seemed concerned about this element. I mentioned some basic issues such as the return point to the river seems like it could be relocated a short distance to develop an additional 200 feet of head. I admitted that I was not very familiar with the stream's flow regime but would believe it necessary to evaluate the effect winter diversion may have on water flow volumes, water temperature, and ice formation. Frazzle and anchor ice can be deleterious to fish survival, and colder water may retard embryo development. I also stated that the project may be able to modulate undesirably large winter flows to reduce scour of redds and enhance passage problems that result from high flows/velocities.

   There was a discussion about the right to divert water for hydroelectric facility operation and how this right may be available from the downstream Condit Dam. Tom mentioned that there could be permitting conditions and issues to overcome to allow this transfer to proceed. These include transfer of water rights, National Environmental Policy Act of 1969, State Environmental Policy Act of 1971, and the Federal Energy Regulatory Commission.

3. **Water Quantity/Water Rights/Water Quality.** A significant amount of time was devoted to water quantity discussion. Tom mentioned that conservation measures must focus on reducing consumptive demand since loss in transmission is not generally a loss from the watershed. I concurred with this statement but mentioned that losses from ditch networks can foster growth of phreatophytes in areas where they normally would not persist and hence result in more overall consumptive use. Therefore, a less leaky transmission network may indeed reduce watershed-wide consumptive demand in some instances.

   The group asked about the seniority of water rights, the volumes of water the rights entitle irrigators to, and the acreage irrigated. Tom did some "back of the envelope" calculations and found that the diversions greatly exceed the consumptive needs of the crops and acreage at hand. I mentioned that some of the diverted water may now be returned to the White Salmon and that we must factor in an amount of water to assure flushing of salts through the soil to guard against encrustation and soil structure changes.

   Tom mentioned the Washington Irrigation Guide as a document listing crop demands, and for hay it is quoted to require 2 to 3 acre-feet per acre per year. Diversion claims greatly exceed this value. When transferring consumptive rights, the value is generally set to equal the highest use during 2 of the past 5 years, and irrigators may not increase consumptive use. They may increase acreage and Tom asked if the irrigators have the capacity to do this. Tova thought they had the ability to increase the amount of irrigated lands. Transfer of rights could trigger an "extent and validity" process wherein historical photos and other records are used to evaluate the volume diverted by a certain patent holder in the past (regardless of the volume permitted). Consumptive demand can be transferred anywhere down to the Pacific Ocean whereas nonconsumptive demand can be transferred only between the point of diversion and return flow.

Diversion and return flow may influence baseflow volumes and water quality. Returning water may be higher in dissolved salts, nutrients, and anthropogenic compounds such as pesticides. Surface water return flow may have warmer or colder temperatures than river water. Subsurface return flow water may act to cool the river during the summer and warm the river in winter. Warmer water may benefit lamprey and be detrimental to other native species (e.g., sculpin, bull trout).

Suggested Follow-Up and Study Elements. The following points are my interpretations and suggestions that resulted from the meeting:

- I suggest that AP update Tova by the November 17 meeting with a focus on delivering preliminary data outlined in our proposal.

- The Yakama Nation desires to use this project as a tool to enhance the benefits they derive from the stream. A primary benefit may be lamprey production but the Yakama Nation would consider increasing sustainable populations of other fish as desirable.

- The Yakama Nation will want a comprehensive water balance study completed. The results will address the volumes of water *needed* for irrigation as opposed to patented volumes. The Yakama Nation and others may not consider solving transmission network losses as "conservation" since the lost water likely returns to the stream at present. Water quality and temperature influences should be included in this future effort.

- Transfer of the hydroelectric permit may be a major permitting effort.

- The Yakama Nation will want an evaluation of the influence of winter hydroelectric power diversion on winter flow regime and water temperature. Ice and low water temperatures can compromise the ability of aquatic organisms to survive and/or reproduce.

DB/jg
Enclosure
G:\Clients\Underwood Conservation District\6006-36\Correspondence\Revised 103111Meeting Summary Memo.doc

Appendix H

Conceptual Hydropower Evaluation Notes

Trout Lake Irrigators Group
c/o Underwood Conservation District
Trout Lake Irrigation Improvement and
Hydropower Reconnaissance Study

Conceptual Hydropower Evaluation Notes

- Several flow rates were looked at to see how they would pan out with various loan scenarios.
- A nominal pipe diameter was used to keep pipe velocity around 5 fps. Nominal means one or more pipes could be used to provide the required area.
- Peak power is based upon available head, taking into account head loss and turbine efficiency.
- Estimated annual power is for the months of October/November through June. July through September was not used because of the low river flow.
- Static Head was from the Trout Creek Diversion to the Hydro plant site, i.e. 1920± minus 1270.
- Annual revenue is based upon 0.04 per kwhr. This used to be 8 to 10 cents but has dropped off recently.
- The important number for the power generation is the Annual Net Revenue. This money is what is used to pay off the debt shown in the Loan table.
- The penstock cost is just the penstock line and does account for laterals, valves, services, etc. Until we decide how the piping is going to be laid out and what lines are part of the penstock, this is the best we can do.
- Transmission and Substation costs recognize that the plant will be far away from the dam. There will be at least wheeling costs and the system could require a substation.
- ROW is the same for each flow rate because it will not vary significantly, except for temporary ROW.
- Indirect cost includes legal, environmental, and engineering
- The loan tables show at what amount of grant funding a project will be paid off using the net revenue generated and a 2 percent interest rate on the loan.
    - The 200 cfs plant requires a 20 percent grant to pay off in 60 years, a 30 percent grant to pay off in 50 years, and a 40 percent grant to pay off in 40 years. The big factor is the Power Rate of 0.04 per kwhr.
    - The 50 cfs plant does not pay off with any of the terms and grant percentages.

This table is a conceptual model that gives the big picture of how the hydro power feasibility would work. The numbers are very rough and not intended to convey the actual numbers that will be in the final feasibility. Several things still need to be determined before the final feasibility, i.e. accuracy of Power Rate, Penstock configuration, inclusion of other associated cost, flow rate available per month etc. However, it does show where we are headed and gives the road map for the feasibility.

Appendix I

Trout Lake Area Ditch Flow-Measurements, Summarized

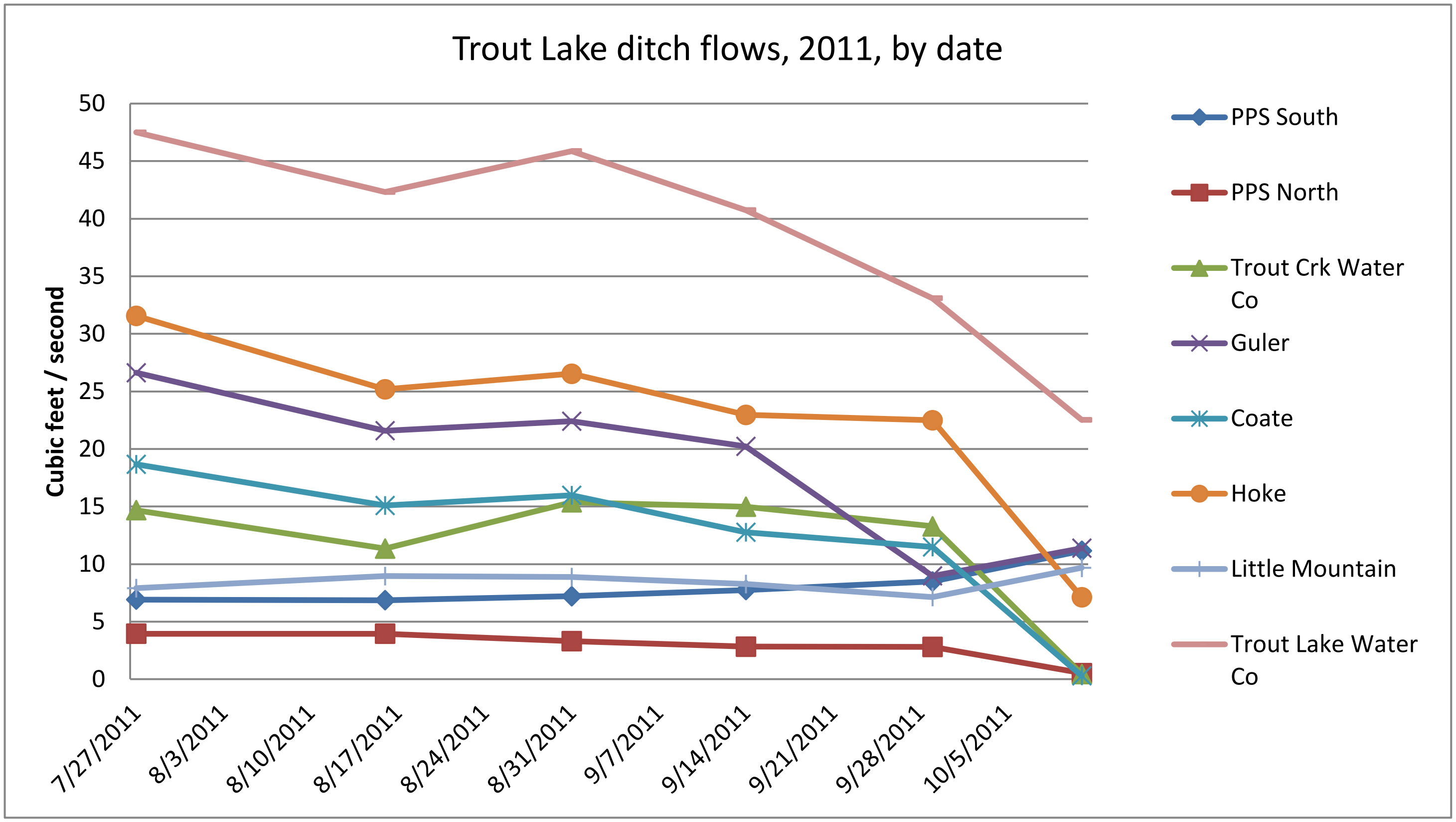
Trout Lake area ditch flow-measurements, summarized
First season flows (late July - early October 2011)

Individual ditch flow data sheets are on record, as well.
The technician for all measurements was Dan Richardson;
the device used was the Marsh-McBirney Flo-Mate Model 2000.

Measurements were taken to 0.01 cfs.

Flow, measured near ditch headgates, in cubic feet per second (cfs)

DATE	*DITCH*								
	PPS South	PPS North	Trout Crk Water Co	Guler	Coate	Hoke	Little Mountain	Trout Lake Water Co	*System Total*
7/27/2011	6.92	3.96	14.69	26.62	18.67	31.56	7.91	47.5	*157.83*
8/16/2011	6.87	3.96	11.35	21.59	15.09	25.18	8.96	42.32	*135.32*
8/31/2011	7.21	3.31	15.37	22.41	15.98	26.53	8.87	45.88	*145.56*
9/14/2011	7.75	2.83	14.99	20.23	12.77	22.96	8.27	40.75	*130.55*
9/29/2011	8.49	2.81	13.28	8.98	11.49	22.49	7.15	33.1	*107.79*
10/11/2011	11.16	0.53	0.45	11.39	0.3	7.12	9.68	22.53	*63.16*


Trout Lake ditch flows, 2011, by date
Cubic feet / second
50
45
40
35
30
25
20
15
10
5
0
7/27/2011
8/3/2011
8/10/2011
8/17/2011
8/24/2011
8/31/2011
9/7/2011
9/14/2011
9/21/2011
9/28/2011
10/5/2011
PPS South
PPS North
Trout Crk Water Co
Guler
Coate
Hoke
Little Mountain
Trout Lake Water Co

Appendix J
Comments on Draft Report

Minutes of 5/10/12 Trustee's Meeting of Trout Lake Water Company

At 5:00pm a meeting was held at the Dam.

Present: Rick Graves
Janine Scott
Steve Koenig
Kevin Ernst
Mike Wellman
Frank Childs
(Scott Dinger is out of town)

Old Business- None

New Business

1. Business Unrelated to Recon Study – Redacted
   [redacted]
2. Re-Conn Study
   It was agreed unanimously that at this point further meetings with Irrigators and the Underwood Conservation District would not be needed unless there is a consensus with the other Irrigation Companies(and cost participation) that establishing an Irrigation District is needed. The Study is excellent and incorporates important data and cost estimates, however unless there is funding available for additional work it appears that the pitfalls and barriers discussed in the Study put the proposed pressurized system far into the future.

Minutes by Frank Childs

Alan Schroeder

From: Patricia Arnold [greenpastures@gorge.net]
Sent: Thursday, April 05, 2012 9:53 AM
To: 'Tova B. Tillinghast'; Alan Schroeder; Robin Harris; brooks@gorge.net; fchilds@centurylink.net; ciallaway@gmail.com
Subject: RE: June 19 - Klickitat County Presentation of the Trout Lake Irrigation Study

Yes, I thought the evening went well, and the presentation was good. Between UCD and Anderson Perry, a lot of work has been done that will serve well I the future.

If UCD has a contractual obligation, then you gotta do it.

--Pat

From: Tova B. Tillinghast [mailto:tovatillinghast@gorge.net]
Sent: Thursday, April 05, 2012 8:28 AM
To: 'Patricia Arnold'; 'Alan Schroeder'; 'Robin Harris'; brooks@gorge.net; fchilds@centurylink.net; ciallaway@gmail.com
Subject: RE: June 19 - Klickitat County Presentation of the Trout Lake Irrigation Study

Hi Pat and all,
Thanks for a good meeting lastnight.

Our requirements laid out in the Interlocal Agreement for EDA funding between UCD and the County outlines the following written and verbal reporting requirements (italicized notes are my own):

Section 16.0: Deliverables/Public Benefit
Underwood Conservation District shall... provide the Board of Commissioners written and verbal reports of project progress... due at or near the following:

1. Midway through project *(provided in written format in August 2011).*
2. Upon completion of draft but prior to final report *(draft report will be available next week; not sure if we need a meeting with the Commissioners at this time? Comments from the Commissioners can be provided for integration into the final report until May 11).*
3. Upon completion of final report *(verbal and written report to be provided June 19th).*

That was why I set up the meeting on June 19. Other thoughts?

Tova B. Tillinghast
District Manager
Underwood Conservation District
170 NW Lincoln St., PO Box 96,
White Salmon, WA 98672
509.493.1936
w3.gorge.net/ucd

In "New Strategies for America's Watersheds," the National Research Council concluded that when local communities take responsibility for protecting their natural resources or environment, "they do it more effectively and more economically than a top-down regulatory approach."

From: tovatillinghast@gorge.net
To: tovatillinghast@gorge.net
Subject: Trout Lake Irrigation DRAFT Study Available
Date: Mon, 16 Apr 2012 14:14:45 -0700

Good afternoon,
I hope the lack of response I've received from the e-mail below is a sign that you're all carefully studying the draft report available for review, referred to below. ☺

Please take a look at the report on the website noted below. I now have two hard copies of the report available for loan to those who either have slow internet connections or can't stare at a computer screen very long. Unfortunately the hard copies are too large to mail out, but we can make arrangements somehow if anyone wants to request these. Please let me know.

Thank you,

Tova

From: Tova B. Tillinghast [mailto:tovatillinghast@gorge.net]
Sent: Tuesday, April 10, 2012 10:31 AM
To: 'Tova B. Tillinghast'
Subject: Trout Lake Irrigation DRAFT Study Available
Importance: High

Please go to the Underwood Conservation District website - http://w3.gorge.net/ucd/ - to download and view the *Draft* Reconnaissance Study of potential improvements to the Trout Lake Irrigation System. See below and attached for more information.

Members of the community are welcome to read the study, ask questions, and make comments. **Comments on the *draft* study must be submitted to UCD by May 11, 2012 in order to be considered before the study is finalized.** Please submit comments and questions to Tova at: 509-493-1936 or tovatillinghast@gorge.net

As always, UCD is available to assist the community and irrigators in Trout Lake in taking further steps toward the conservation and improvement of their natural resources, water, habitat, working farmlands and more. We encourage the community and ditch companies to discuss among yourselves how you would like to proceed with this project.

Tova B. Tillinghast
District Manager
Underwood Conservation District
170 NW Lincoln St., PO Box 96,
White Salmon, WA 98672
509.493.1936
w3.gorge.net/ucd

In "New Strategies for America's Watersheds," the National Research Council concluded that when local communities take responsibility for protecting their natural resources or environment, "they do it more effectively and more economically than a top-down regulatory approach."

From: Tova B. Tillinghast [mailto:tovatillinghast@gorge.net]
Sent: Wednesday, April 04, 2012 11:21 AM
To: 'Tova B. Tillinghast'
Subject: TONIGHT - Trout Lake Irrigation Study Presentation
Importance: High

Here's a quick reminder about **tonight's meeting**!

Greetings Trout Lake irrigators, community members, and interested citizens,

You are invited to an informational presentation at the next **Trout Lake Community Council Meeting:**

Location: Trout Lake School
Time: Wednesday, April 4, 2012, at 7:00pm

After a brief presentation about Underwood Conservation District's Firewise Program by Jim White, the Trout Lake Community Council will be hearing a presentation from Tova Tillinghast and Anderson-Perry & Associates, who will present the *Draft* Reconnaissance Study of potential improvements to the Trout Lake Irrigation System.

The *draft* study will be made available for review on-line after April 12 at: w3.gorge.net/ucd

Comments on the *draft* study may be submitted to UCD until May 11, 2012.

See attached flier, agenda and infosheet, and invite your neighbors. If you have any questions, please contact Tova Tillinghast, Underwood Conservation District (UCD), at 509-493-1936.

Tova B. Tillinghast
District Manager
Underwood Conservation District
170 NW Lincoln St., PO Box 96,
White Salmon, WA 98672
509.493.1936
w3.gorge.net/ucd

In "New Strategies for America's Watersheds," the National Research Council concluded that when local communities take responsibility for protecting their natural resources or environment, "they do it more effectively and more economically than a top-down regulatory approach."

Alan Schroeder

From: Tova B. Tillinghast [tovatillinghast@gorge.net]
Sent: Tuesday, June 12, 2012 5:53 PM
To: Alan Schroeder; Robin Harris
Subject: One public comment

Importance: High

From: Bev Hoeffer/ Carol Beeston [mailto:hoefferb@msn.com]
Sent: Sunday, May 06, 2012 11:03 PM
To: Tova B. Tillinghast
Subject: RE: Trout Lake Irrigation DRAFT Study Available
Importance: High

To: Tova Tillinghast

Re: Trout Lake Reconnaissance study dated April 2012

From: Carol Beeston and Beverly Hoeffer

We have several concerns about the proposal to enclose the ditches.

The work description and scope of the document do not address the natural habitat which has developed along these ditches over the long period of time, a century for some, that many have been in existence. Closing over the ditches would result in multiple changes to the current ecosystem along the open ditches as well as the aesthetic values of the riparian zone. Doing so would have a detrimental effect on the landscape within the Trout Lake Valley.

Along the stretch of ditch (the Pearson-Peterson-Stadleman) that crosses 40 acres of our property like a natural stream, the trees and songbirds are a major source of pleasure to those or us living near or passing through in the vicinity of the ditch. We have documented more than seventy different bird species utilizing the cover and food found in the trees. There are frogs. One wonders if they are the endangered spotted frog? In addition to the birds, frogs, and trees, mammals such as deer, elk and coyote utilize the ditch as a source of drinking water, many of which would be lost to this area were it not for an open ditch. The trees provide shade to areas of grass that then remain greener, enabling those areas to support viable edible pasture for browsers. All of this would be lost to the valley should the ditch be covered along its entire length

Irrigation is not available to all who wish to use the water, especially the "latecomers", merely to those who have been in the valley long enough and were prescient enough to have preserved those rights as the laws changed.

There are major areas of leakage of water as opposed to the seepage referred to in the study. Whether or not the porposal to cover the ditch goes forward, those leaks could be plugged and thus provide more water downstream while preserving natural habitat.

We would appreciate thoughtful consideration of our comments above as the study moves forward into its next phase and to be kept informed about those phases and public forums. Thank you for compiling and making public the concerns of all of us who have taken time to express them.

Alan Schroeder

From: Tova B. Tillinghast [tovatillinghast@gorge.net]
Sent: Tuesday, June 12, 2012 5:50 PM
To: Alan Schroeder; Robin Harris
Subject: TLIG report comments
Attachments: Information on various organizational structures.doc

Hi Alan and Robin,
I'm really sorry these comments are coming in so late. I have compiled these based on just my own reading of the report and background knowledge of the project.

I hope they can be incorporated, where you think they're helpful, in the final report. I also have just one other comment from the Trout Lake public about the report, which we discussed attaching as an Appendix to the report. I will forward that to you momentarily.

Tova's Comments:

- Page 1-1, about ¾ page down, rephrase UCD's mission to reflect current wording: *The mission of Underwood Conservation District is to enhance natural resources and stewardship in Skamania County and western Klickitat County.*
- Page 1-1, bottom of page, add that Pacific Lamprey are likely to be reintroduced as well.
- Page 1-2, middle of page,add "y" to the word "deliver" in "... to improve water deliver operations."
- Page 1-2, middle of page, could use more introduction on the Klickitat County EDA funds. Describe that EDA stands for Economic Development Authority and UCD applied for these funds with support from the TLIG and TL Community Council.
- Page 1-3, top of page, not all irrigators believe hydropower is essential.
- Page 1-3, middle of page, could use more intro on the Condit Dam water right in the hydropower option.
- Page 2-1, Mention crop types in irrigation summary?
- Page 2-2, define DOE as Dept. of Ecology (we use ECY, and I think they prefer that too).
- Page 2-3, top of page, remove "state of ignorance" in the community (not good to offend the audience!)
- Page 2-4 near bottom, WRIA 29 watershed process ended (need date). I'm not totally sure on this – call Dave McClure at Klickitat County Natural Resources Dept. (509-773-2481) as he was leading the effort.
- Page 3-1, Route Selection – is there only one alternative for this, and can you explain why?
- Page 3-4, section C. define water hammer.
- Page 3-6, ¾ page down, Need more power rate options... what's the scenario if rates go up?
- Page 4-3, section 4.6, clarify that this option does not include hydropower.
- Page 5-1, Section 5.1, can you estimate how many pumps exist currently? How much money and energy would be saved by reducing pumping? Would pressurized delivery enable more high-value crops to be grown in the valley?
- Page 5-1, section 5.2, clarify that saved water wouldn't be withdrawn and remain in the bypass reaches in the TL valley?
- Page 5-1, section 5.3, Is 1,000 gpm the amount of flow available or the amount deliverable by fire districts? Clarify please.

- Page 5-2, section 5.4, Can you elaborate on ideas that would benefit fish? Timing of withdrawal? Installing fish screens? We met with Yakama Nation Fisheries Program staff; "Yakama Nation" conveys tribal council or anything else; I think it'd be best to be more specific to the fisheries staff.
- Page 5-2, section 5.5, in addition to (add the word instream to it too) "reducing man-made *instream* obstructions" add that we'd reduce "diversion hazards" (withdrawals without screens).
- Page 5-2, section 5.6, can you explain how returns or outtakes would be eliminated? There would be only one?
- Page 5-2, section 5.7, Maybe focus this point only on the Condit Dam water right, and add an additional point about economic benefits to the valley/county, including specific numbers of jobs and revenue brought to the community.
- Page 5-2, additional benefits should be included: Water Quality, measuring in-valley water rights and proving use, provision of local electricity (reduced cost, independence), compliance with fish laws.
- Page 6-4, second bullet point, add Diversion Improvements *and Removals.*
- Page 6-5, second bullet point, What are the site property costs to purchase? Or would that be part of ROW?
- Page 7-1, section 7.0, second paragraph, explain a little more why "maximizing overlap" is important? To minimize material costs?
- Section 7.1, A-F. not sure what your organization is here, and the relationship between the heading "TLIG" and the sub-headings, the different funding sources.
- Page 7-2, section A. Project concerns from YN need to be addressed as well.
- Page 7-2, section D. Last I was aware, AWEP could allow irrigators valley-wide to receive a lump of funds for the valley (they may need an entity like UCD to sponsor the combined funding request), but once funded, then individual farmers would need to contract with NRCS for individual projects – not sure how well this would fit a valley-wide system without contracting with each landowner/producer involved. Maybe you know more about it than I do, but that's what I understand.
- Page 7-3, section E. First sentence is long and needs rewording. Does this program fund construction too?
- Section 8.0, for each alternative, can you give us some context for what is normal for $/acre to cover irrigation operation and maintenance for that type of system? Like a statewide average or a similar valley/crop types average? Can you illustrate different power rate scenarios too?
- Out of all the scenarios in Section 8.0, does any one rise to the top as a recommended alternative by A-P?
- Page 9-1, section 9.2, can you, sensitively, touch on whether there are adequate proven rights to fulfill the design criteria?
- Page 9-1, section 9.3, USACE also regulates any work within the OHWM.
- Page 9-2, section 9.6, not sure what the County's process will be and whether it will be public... maybe we shouldn't assume.
- Page 10-3, section 10.5, Condit Dam hasn't been completely removed. It was "breached" in fall of 2011.
- Page 10-3, section 10.6, Can you clarify whether the idea of 50% grant coverage is included in the previous cost estimates? How would grant funding realistically affect the cost scenarios and the cost to the irrigator? Is there a grant funding amount to aim for (besides the cost of a feasibility study)?
- Page 10-3, section 10.7, this seems to be the first mention of phasing the project? How would this affect the project costs?
- Page 10-3, section 10.8, can you refer to the RCW and specific steps required to form and irrigation district? (http://apps.leg.wa.gov/RCW/default.aspx?cite=87.03&full=true; I developed the attached document, which is still rough, but outlines various options for organizational structures; feel free to use all or part)

Tova B. Tillinghast
District Manager
Underwood Conservation District
170 NW Lincoln St., PO Box 96,
White Salmon, WA 98672
509.493.1936
w3.gorge.net/ucd

In "New Strategies for America's Watersheds," the National Research Council concluded that when local communities take responsibility for protecting their natural resources or environment, "they do it more effectively and more economically than a top-down regulatory approach."