Preliminary Investigative Report for the Swalley Irrigation District Irrigation Modernization Project

Appendix: Swalley Irrigation District System Improvement Plan

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Swalley IRRIGATION DISTRICT

System Improvement Plan

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Executive Summary

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

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

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

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

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

Section 1

System Modernization Summary At-A-Glance

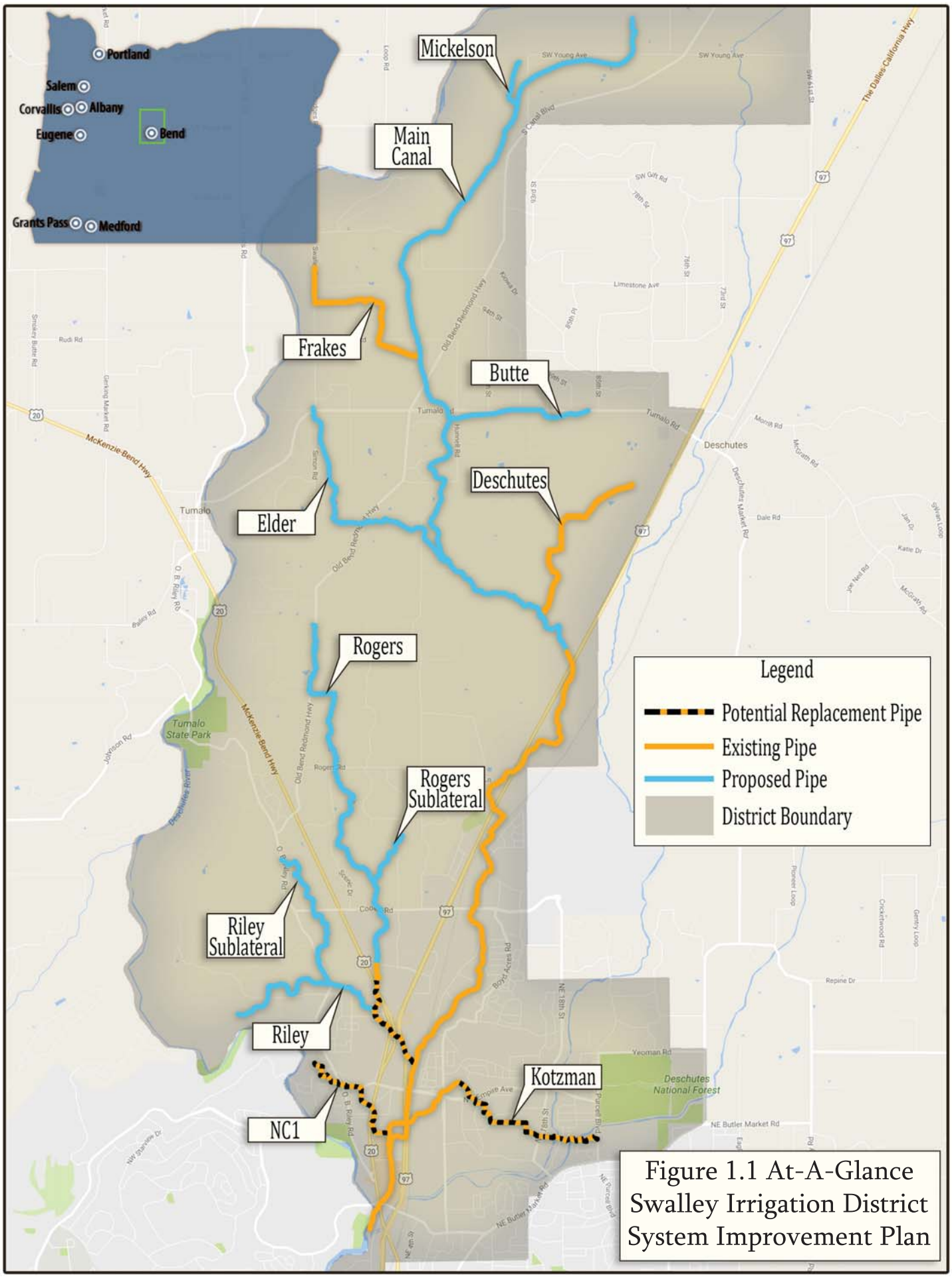


Figure 1.1 At-A-Glance
Swalley Irrigation District
System Improvement Plan

Table 1.1

AT-A-GLANCE MAIN CANAL AND LATERAL PIPING SUMMARY				
LATERAL/CANAL	EST. WATER CONSERVATION (CFS)	EST. ENERGY CONSERVATION (KWH/YR)	LENGTH PIPED (FT)	RECON-ESTIMATED COST
Kotzman (1)	0.0	70,601	7,010	$272,311
NC1 (1)	0.0	19,255	5,051	$247,942
Rogers (1)	3.1	320,626	19,892	$3,270,003
Rogers Sublateral	0.2	58,076	2,235	$450,806
Riley	0.7	57,461	7,272	$893,412
Riley Sublateral	0.2	45,379	6,623	$528,676
Deschutes (2)	0.0	136,539	0	$0
Elder	2.1	286,566	10,057	$1,456,611
Butte	0.2	62,994	5,434	$423,631
Frakes (2)	0.0	185,435	0	$0
Mickelson	0.0	142,936	1,877	$194,879
Main Canal	9.6	1,069,426	34,174	$7,260,586
400 HP Pump Sta.				$591,500
TOTAL	**16.0**	**2,455,294**	**100,625**	**$15,590,357**
(1) Existing Lateral Partially Piped (2) Existing Lateral Piping to Remain				

Section 2

Project Description and Overview

2.0 **Authorization**

This study was commissioned by Farmers Conservation Alliance (through support from Energy Trust of Oregon) and authorized March 29, 2016 through a Consultant Services Agreement by and between the Farmers Conservation Alliance (FCA) and Black Rock Consulting (BRC).

2.1 **Purpose**

The Deschutes Reclamation and Irrigation Company, the predecessor to the Swalley Irrigation District (SID) was founded in 1899 and obtained its water rights for natural flow diversion from the Deschutes River with a priority date of September 1, 1899. From 1891 to 1923, the irrigation delivery system was constructed to serve what became the Swalley Irrigation District. The district currently serves approximately 4,333 acres (including instream leases) of irrigated lands located from Bend, Oregon, northerly and generally between State Highway 97 and State Highway 20. The District boundary is approximately 14 miles long (north to south) and 4 miles wide and serves approximately 668 delivery accounts.

The District operates and maintains over 28-miles of main canal and laterals, including existing piped segments. The volcanic nature of the Central Oregon geology presents fractured basalt, cinder and varied substrates that results in a propensity for seepage losses in many areas of the SID Canal system.

The purpose of this System Improvement Plan (SIP) is to develop a well-considered evaluation of the District's primary and secondary canal systems, a mitigation plan for the seepage losses, and consideration of resulting pressurized deliveries. Consistent with its existing modernization program, well under way, system piping is to be the primary method proposed for such mitigation.

The plan will become a key element of the District's planning documents and is expected to become the basis for future phased construction of the District's conveyance system.

2.2 **Scope of Services**

Black Rock Consulting (hereinafter "BRC") was employed to provide the following services and deliverables in conjunction with this plan:

Kickoff Meeting –

> BRC met with District staff and management on two separate occasions to confirm approach to the study. BRC developed a list of questions to review with District staff. At these meetings BRC requested documents for major

system elements that affected system hydraulic modeling, requested a copy of the District Water Conservation Plan, and requested water diversion and water right information, and associated operational input from the District.

BRC discussed seepage loss information with the District and discussed the ongoing loss assessment program implemented by BRC within the District.

BRC inquired about energy dissipation approach preferences of the District (i.e. hydroelectric power generation and pressurized delivery preferences).

Review of Materials -

BRC reviewed materials obtained from the District following the kick-off meetings to insure that required materials for moving the study forward were obtained or readily supplemented during the study to develop the deliverables indicated below. Data gaps that were found during the meeting process were identified and resolved with District staff.

Coordination -

BRC coordinated with the SID staff at various project milestones to confirm that the System Improvement Plan continued to be developed in accordance with the direction of SID.

Seepage Loss Study -

BRC coordinated the development of seepage loss study with SID staff. The seepage loss study identified a program of seepage loss measurements for the SID system to support loss assumptions to be used in the SIP and to assist with water conservation estimates and system implementation phasing development.

Review of Provided Flow Data -

BRC provided a thorough review of diversion data and on-farm delivery rates (per water right certificates) to insure a clear understanding of delivery approach. BRC coordinated with the District to insure rates used in system evaluation and modeling were as directed by the District.

SID SIP Base Map Development -

In conjunction with SID mapping staff, BRC, SID, and FireWhat? developed an SIP primary and secondary canal and lateral system base map. The base map was populated with the SID primary and secondary canal system in its existing state.

SID SIP Improvement Map Development -

BRC (with SID input) developed a proposed primary and secondary system piping overlay on the base map. To the extent possible, existing mapping obtained as described above was used for this purpose. This map included an aerial underlay as available and as practical to manage file size.

SID SIP Hydraulic Model -

BRC confirmed approach regarding system pressurization with SID. Following the agreed approach discussed with SID and following delivery of basic system control and elevation information from FireWhat?, BRC then modeled the primary and secondary system elements (i.e. primary and secondary system canals and laterals) with EPANET hydraulic modeling software. Flow assumptions were based upon the rates agreed with SID staff. From iterations of model runs, BRC developed system elements including piping, pressure reducing elements; i.e. PRV stations, hydroelectric plant locations, primary system valving points, etc. Pipe materials and diameters were determined during this analysis.

SID SIP Phasing Approach -

In conjunction with the system model and upon review with SID, BRC developed a system improvement cost estimate that was broken down by District lateral elements. This will allow the District flexibility in implementation development and design decisions based upon funding availability and other critical considerations.

SID SIP Conservation Table -

BRC developed a table indicating water conservation estimates based upon historic diversions, desired delivery rates within a fully piped system, and also corroborated by the loss assessment program results.

Final SIP Mapping -

In conjunction with SID staff, BRC developed a final SIP map indicating primary and secondary canal system elements, indications of existing and proposed piping, and other key system elements.

Reconnaissance-Level Cost Estimate -

BRC coordinated with a reputable material vendor and developed reconnaissance-level cost estimating for the proposed piping system and pumping identified for the District.

SIP Reporting -

BRC compiled the results of the SIP study into this System Improvement Plan draft report for review and comment by SID. Comments received were incorporated as appropriate into the Final SIP Report. The report includes mapping, and summarizes all findings for elements identified above.

2.3 Goals and Objectives – District Meeting(s)

As indicated in the scope, Black Rock Consulting met with District staff on two occasions in August and September of 2016. Black Rock Consulting and District staff discussed key project parameters required to establish the approach for the SIP.

The meetings were attended by:

Jer Camarata, General Manager
Karl Conklin, District Field Operations
Kathy Ferguson, District Administrations
Kevin L. Crew, Principal, Black Rock Consulting

Key agenda items addressed were as summarized below:

1) Data Needs: District Water Right Certificates, District's Water Management and Conservation Plan, District's Most Recent Irrigated Acre Accounting (Direct River Points of Delivery and Primary Diversion).

   Over the two meetings held, these materials were provided to Black Rock Consulting (including the hydroelectric power water right) and discussed in some detail. Clarifications were provided by the District including that the Central Oregon Irrigation District and the Swalley Irrigation District serve small groups of each other's patrons. Also, current accounting of direct points of delivery from the Deschutes River and current acreage served from the District's primary point of diversion and main canal and lateral systems were provided.

2) What are the plans for piping and pressurization of the District?

   The District has a significant amount of piping already in place, and also has an operational hydroelectric plant in place (Ponderosa Hydro) approximately ½-way down its primary canal sitting just west of Highway 97. The District has already pressurized the system along its main canal from its intake structure at the North Canal Diversion Dam to the hydroelectric power plant.

The District has also piped other major elements of its system including the largest portion of the Kotzman, Deschutes, Frakes,and the NC-1 laterals. Other piping has been performed in the District in specific areas and the need for replacement of these elements will need to be addressed on a case-by-case basis during the design process and subject to District determination at the time of implementation.

Generally, the District plans to pipe their entire system, however, prioritization and timing of the piping will be an ongoing consideration, primarily a function of funding availability. Some areas of the District (in the urban and upper extremities of the system) would not be subject to significant pressure increases with piping or replaced piping. In these areas, such as the end of the NC-1, Kotzman, Riley, and Riley Sublaterals, the District must carefully consider the cost versus benefits of piping (or re-piping).

The conveyance system below the hydroelectric plant was discussed in some detail. Currently, the hydroelectric plant converts all pressurized water and kinetic energy received upstream of the plant to power, and delivers water below the plant into open canal at atmospheric pressure. Given future power sales rates uncertainty, and given a desire by the District toprovide pressurized deliveries where practical, the District chose to evaluate piping below the hydroelectric power plant as a pressurized system commencing at 35 Pounds per Square Inch(PSI) directly below the plant, and then increasing in pressure as the system is piped to the District's northern extremity. Initially, this could be accomplished by 1) adding a Variable Frequency Drive (VFD)pump station downstream of the hydroelectric plant to re-pressurize the system to 35 PSI, or 2) the hydroelectric plant could be modified to take less pressure out of the water passing through it and thereby reducing existing power production. In either method, the main canal and laterals below (north) the existing hydroelectric plant, once piped, would realize increased pressures and thus the pipe selections for that portion of the system should be based upon anticipated pressures (starting at 35 PSI directly below the existing hydroelectric plant and increasing from there).

3) Given that certificated water rights would dictate a delivery of 13.42 GPM/Acre for peak delivery flow rate to the District's irrigated properties, what flow rate should be used in the model for peak flow rates?

The model should use 7 GPM/Acre for normal (present day practices) delivery modeling at 5 FT/S velocities or less in system elements per NRCS guidelines. It must also be confirmed that one additional condition will work within the proposed systems: An uncommon high

flow rate of 9 GPM/Acre with allowance for velocities to exceed 5 FT/S should be evaluated. This will insure that the system will operate satisfactorily under future scenarios if additional irrigated lands were attributed to the conveyance system, and to address future climate change scenarios.

4) Black Rock Consulting indicated that it planned to break the canal piping cost estimates into lateral by lateral estimates, and the remaining primary canal estimate to provide the District with a high level of flexibility in project financial planning and implementation packaging.

   The District agreed with this approach.

Section 3

Existing System

3.0 Existing System Description (Refer to Figure 3.0.1)

Please refer to Figure 3.0.1 regarding the existing District Delivery System that indicates District service territory boundary, measurement points, and the primary conveyance system.

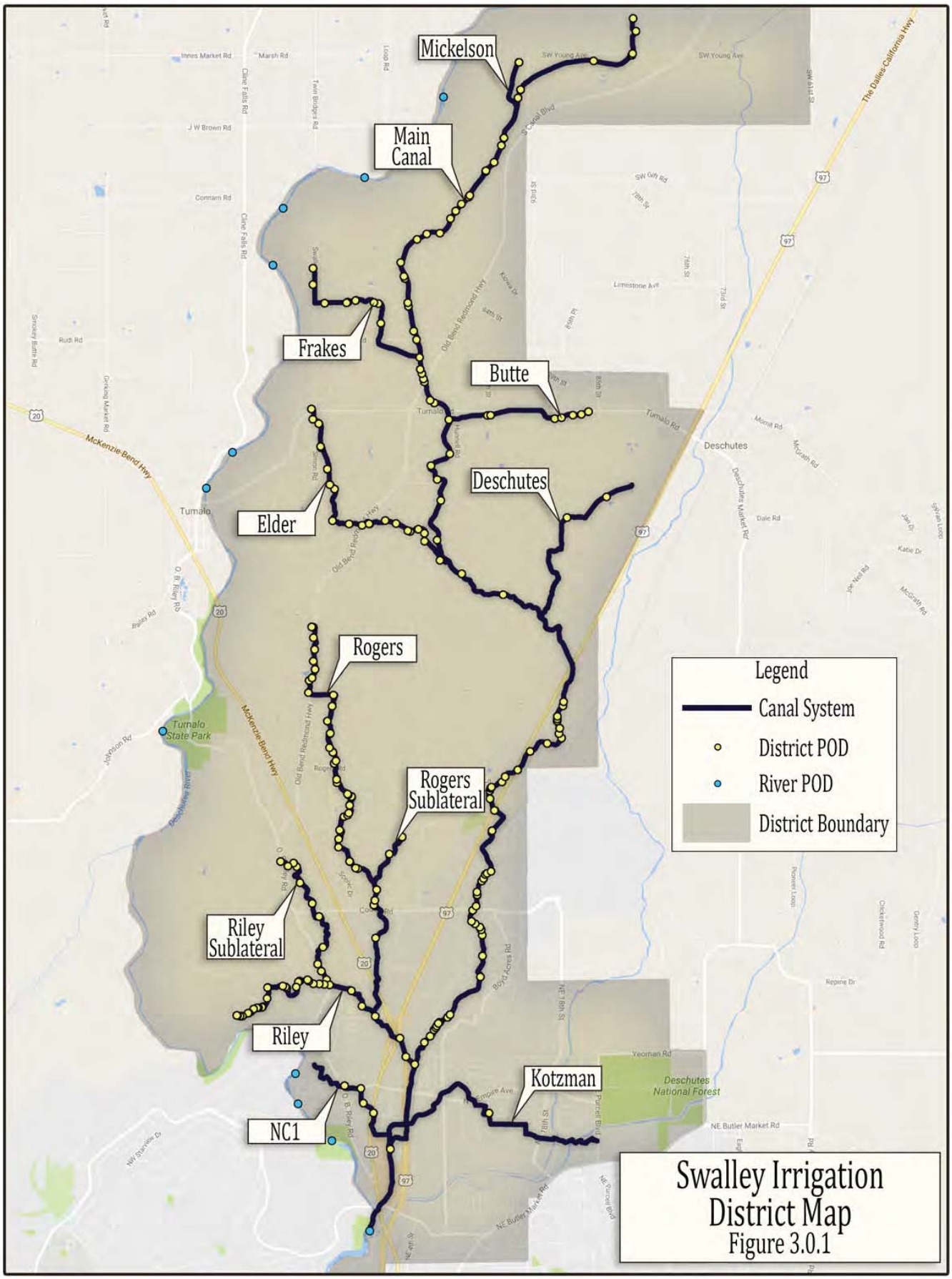
Under its certificated water rights, senior to all others in the vicinity, the Swalley Irrigation District diverts water directly from the Deschutes River. Given the seniority of its irrigation water rights, the District does not require storage, as it is able to divert its water rights from natural river flows available during the irrigation season. The District cooperatively operates with the Central Oregon Irrigation District at its intake structure from the Deschutes River adjacent to the North Canal Diversion Dam in Bend, Oregon. Flows coming into the shared intake structure split into the Central Oregon Irrigation District's Pilot Butte Canal and into the Swalley Irrigation District's main canal after passing through an automated fish screen and passing through its automated entrance vertical slide gate. Once past its entrance gate, flows pass into an existing segment of steel pipe where the flows are metered and then passed into High Density Polyethylene (HDPE) pipe.

As indicated in Figure 3.0.1, the SID main canal conveys water generally northerly in high density polyethylene solid-wall pressure rated pipe approximately 5.1-miles to the north where it ends at the District's 0.75MW Ponderosa Hydroelectric Plant. Main canal pipe diameters range from 54-IN and reduce as deliveries and laterals withdraw water from the system along its path. The primary canal continues another approximate 7-miles to the terminus of the primary delivery system in open-channel, earthen canal. Several laterals stemming from the main canal have been piped including portions of the NC-1, Kotzman, Rogers, Deschutes, and the Frakes Laterals. Private canals also exist in the District's system, including some piped segments and other open-channel segments. The At-A-Glance Map (Figure 1.1) on page 3 of this SIP distinguishes piped sections from those that are not.

Water diverted into the Swalley Irrigation District conveyance system falls approximately 400-FT as it travels from its diversion in Bend to the northern limit of the main canal.

In addition to the main canal system which feeds its laterals, the District has several direct deliveries from the Deschutes River as indicated in Figure 3.0.1. These individual direct deliveries (Points of Delivery "POD"s) account for approximately 328 acres of the District's total certificated water rights and are monitored and metered by the District (see Section 4.0, page 21).

Patron turnouts from the District's main canal and laterals are typically gate regulated and weir measured. The District regulates flows to each system lateral and patron turnout via its field staff.


Mickelson
Main Canal
Frakes
Butte
Deschutes
Elder
Rogers
Rogers Sublateral
Riley Sublateral
Riley
Kotzman
NC1
Legend
Canal System
District POD
River POD
District Boundary
Swalley Irrigation District Map
Figure 3.0.1

3.1 Water Supply and Certificates

The Swalley Irrigation District operates based upon two water right certificates: its irrigation water right certificate (called for modification by CW-54) and its hydroelectric water right certificate. Complete water right information is not included in this SIP but may be obtained from the Oregon Water Resources Department and viewed in the District's Water Management and Conservation Plan on file with the Oregon Water Resources Department. It should be noted that the District's water rights change from time to time with conservation activities, hydroelectric development, water right transfers, and other water right activities. For the purposes of this SIP, the primary goal is to evaluate the modernization of the District's conveyance system, therefore information regarding the State of Oregon Order Finalizing the Allocation and Assignment of Conserved Water indicating required modifications to the District's Water Right Certificate #74145 is provided below.

CW-54 (and Elements of Cert. 74145):

Source - Deschutes River, a tributary to the Columbia River

Priority – September 1, 1899

Use - Primary source for entire District

Irrigation – 4123.20 acres

Pond Maintenance – 22.36 acres/equivalent

Nursery – 157.00 acres/equivalent

Dust Abatement – 3.50 acres

Maximum Rate – 87.217 cfs

Duty - Main Canal at 9.58 AF maximum per acre at the diversion from the source. (43% transmission loss in the canal system as allowed by the Court. No transmission loss allowed for direct withdrawals at individual points of delivery from the Deschutes River.)

<u>QUANTITY FOR CANAL DIVERSIONS FROM SOURCE</u>

Season 1 (30%): April 1 - April 30 and Oct. 1 - Oct. 31: 34.548 CFS – 1 CFS to 83 AC

Season 2 (50%): May 1- May 14 and Sept. 15-Sept. 30: 46.199 CFS – 1 CFS to 62 AC

Season 3 (100%): May 15- Sept. 14: 87.217 CFS – 1 CFS to 33.45 AC

For the purposes of this SIP, the most critical elements of this certificate are the duty and the rates allowable for "Canal Diversions from the Source". As indicated in the duty criteria, above, there is currently an allowance of 43% for transmission losses

within the canal system. This loss accounts for evapotranspiration, seepage and other losses within the District canal conveyance system as water is conveyed in open canals that cross a variety of rocky and soil substrates. The piping evaluated to improve the open canal system in the Swalley Irrigation District will mitigate system losses. The extent of mitigation is further discussed in the System Loss Assessment section of this SIP.

In terms of quantities allowed for diversion into the District canals, the peak allowable rate is 1 CFS per 33.45 Acres. This equates to approximately 13.42 GPM/Acre. After multiplying this flow rate by 57%, the on-farm delivery flow rate is determined at approximately 7.64 GPM/Acre. Therefore, given a "tight" system with little or no losses, the diversion flow rate may clearly be reduced significantly. It should also be noted that at the beginning and the end of the irrigation season the allowable low flow rate for diversion from the Deschutes River is 1 CFS per 83.0 Acres (or 5.41 GPM/Acre) and to each farm is 3.08 GPM/ Acre (after reducing by 43%). This is important to the SIP simply to note that system improvements should include provisions to not only accommodate peak system flow rates, but to accommodate lower system flow rates that may create problematic sedimentation and other operational issues if not properly accounted for.

3.2 On-Farm Water Demand Analysis - Acreage and Duty

As indicated above, the current allowable diversion during peak irrigation season is 9.58 AF/Acre with an assumption after losses of 5.46 AF/Acre on-farm. The rate during peak season is 7.64 GPM/Acre after reducing the diversion rate by the certificated transmission losses.

For the purposes of this SIP, and based upon District input as indicated above, a target SIP design delivery flow rate to on-farm was established at 7 GPM/Acre. It should be noted that this SIP design flow rate is not intended to change the certificated on-farm peak flow rate of 7.64 GPM/Acre. The reason for using 7 GPM/Acre versus 7.64 GPM/Acre is based upon the assumption that all acreages within the District may not be irrigating at peak flow rates at the same moment. Typically, farming operations cycle between farms and farmers i.e. with alfalfa and hay cuttings slightly staggered and other crop patterns requiring slightly differing irrigation cycles. The approximate 10% reduction from peak flow accounts for this and is used to try to keep the pipe sizing for the SIP as close to the actual need as possible. As indicated above, pipe modeling for this SIP was based upon 7 GPM. Acre and 5 FT/S of maximal velocity in the proposed pipelines. Should temporary flow peaks exceed 7 GPM/Acre and approach the 7.64 GPM/ Acre water right, slightly exceeding the 5 FT/S will not be an issue and the pipe models were evaluated to an extreme value of 9 GPM/Acre to insure that the system would still function properly, and to insure future operations.

3.3 System Loss Assessment

Black Rock Consulting worked with the District to coordinate a seepage loss study performed by Farmers Conservation Alliance staff under Black Rock Consulting/Kevin L. Crew, P.E and David C. Prull, P.E. direction. This supplemented previously acquired data for laterals located upstream of the Ponderosa Hydroelectric Plant.

During the summer of 2016, the seepage Loss Assessment Program (LAP) funded by Farmers Conservation Alliance, the Energy Trust of Oregon, and supported by Oregon State University and the Oregon Water Resources Department, was implemented in 7 of the 8 Central Oregon irrigation districts to inform the Districts of current system losses and to enhance SIP development for these Districts. The program included the use of newly purchased and calibrated Flowtracker II technology, manual, office and field training, all in accordance with the United States Geological Survey and United States Bureau of Reclamation "Discharge Measurements at Gauging Stations – Chapter 8 of Book 3, Section A, Techniques and Methods 3-A8". The program was managed by Oregon Registered Professional Engineers, Kevin L. Crew, P.E. and David C. Prull, P.E.

The primary purpose of the LAP program as applied to the Districts was to perform a one-time measurement program in each District to inform the District SIPs of approximate seepage losses in elements of each system. The measurements were performed at different times of the irrigation season within each District, therefore the percentage of peak flow varied by District as the LAP team entered, measured and exited each District. The results were used to provide a strong indication of losses. The results were interpolated or extrapolated based upon the maximal expected loss within each District as indicated in the SIP below. The final loss information was used to identify losses associated by project phase or lateral depending upon each specific District SIP. In instances where grants are to be allocated in direct exchange for conserved irrigation water to be dedicated by revised water rights certificates to instream flow, the grantor may be compelled to confirm these seepage loss results by conducting a subsequent loss measurement program performed by the USGS and/or the Oregon Water Resources Department prior to project implementation.

For Swalley Irrigation District, the LAP was implemented in the north end of the system below and downstream of the Ponderosa Hydroelectric Plant. The loss assessment included the main canal and associated system laterals. Tabular results for the LAP study within SID are included in Appendix A. For system laterals upstream of the Ponderosa Hydroelectric Plant, loss measurements were performed previously in a conservation study prepared by Black Rock Consulting in 2013. The 2013 loss assessment was performed by Deschutes River Conservancy and Oregon Water Resources Department staff in conjunction with District staff. During that assessment, patron deliveries were largely turned off therefore simplifying the measurement of canal and lateral losses in the system. The results of the 2016 LAP

and the 2013 Conservation Program are provided in detail in Appendix A. A tabulated summary of the results is provided in Table 3.3.1.

Table 3.3.1

SWALLEY IRRIGATION DISTRICT CONSERVATION ESTIMATE BY CANAL AND LATERAL				
CANAL/LATERAL	MEASURED (Y/N)	LOSS MEASURED (CFS)	ADJUSTMENT FACTOR	ADJUSTED CONSERVATION ESTIMATE (CFS)
Kotzman	No-Piped	0	0.796	0.0
NC1	No-Piped	0	0.796	0.0
Rogers	Yes	3.9	0.796	3.1
Rogers Sublateral	Yes	0.2	0.796	0.2
Riley	Yes	0.9	0.796	0.7
Riley Sublateral	Yes	0.3	0.796	0.2
Deschutes	No-Piped	0	0.796	0.0
Elder	Yes	2.6	0.796	2.1
Butte	Yes	0.2	0.796	0.2
Frakes	No-Piped	0	0.796	0.0
Mickelson	Yes	0	0.796	0.0
Main Canal	Yes- Partially Piped	12	0.796	9.6
	TOTAL=	**20.1**		**16.0**
SPECIFIC PRIVATE DELIVERY SYSTEM LOSS ASSESSMENT				
Brady-Private	Yes	0.3	1	0.3
Tower Box-Private	Yes	0.2	1	0.2

The adjustment factor provided in Table 3.3.1 is the simple ratio of the estimated total piped water conservation (fully piped system) at a delivery rate of 7.64 GPM/Acre, 16 CFS (see Table 3.3.2), versus the measured system loss of 20.1 CFS.

Total piped system water conservation estimates were developed. Delivery acreages as assessed for the SID system were used to estimate the fully piped system flow rates at the peak certificate rate (7.64 GPM/ Acre) and at the hydraulically modeled rate of 7 GPM/Acre. Flow diversion data for the District were evaluated to determine the peak diverted flow rate over the last seven years of operation (approximately 85 CFS peak). This peak was compared to the peak piped flow rate to estimate potential conservation based upon a completely piped hydraulic delivery system (including all laterals and private laterals down to the individual patron turnouts). Total conservation estimates are in Table 3.3.2.

Table 3.3.2

SWALLEY IRRIGATION DISTRICT TOTAL PIPED CONSERVATION ESTIMATE					
Diverted Acreage	Maximum Diversion 2010-2016 (CFS)	Diversion Flow Rate at 7.64 GPM/Acre (CFS)	Estimated Cons. At 7.64 GPM/Acre (CFS)	Diversion Flow Rate at 7 GPM/Acre (CFS)	Estimated Cons. At 7.0 GPM/Acre (CFS)
4,062	**85**	**69**	**16**	**63**	**22**

Section 4

System Improvement

4.0 System Improvement Approach

This SIP was commissioned by Farmers Conservation Alliance with support from Energy Trust of Oregon to identify water conservation, hydroelectric power, and pumped power conservation possibilities for the District. Although significant piping has already occurred in the District, there remains a significant open canal system that calls for modernization and water loss mitigation through piping. Consistent with its Scope of Services and the subsequent goals and direction provided by the District, Black Rock Consulting performed a comprehensive hydraulic and piping evaluation of the District.

There are two primary alternatives for the mitigation of seepage losses. The first is canal lining and the second is canal piping. Within each of these alternatives there are a variety of material choices. Canal lining involves the installation of an impervious system to cover the canal bottom and banks. Materials typically employed include geomembranes, rubber liners, shotcrete or similar materials. Canal lining does not provide pressurization of the irrigation system and it also increases canal velocities, thus increasing risk to people. Black Rock Consulting has performed 50-year life-cycle evaluations of lining versus piping alternatives to the District and has not included these in this Plan. In summary, over a 50-year life cycle, it was found that canal lining may be less expensive to implement in its first installation cycle than piping, however canal lining requires significant maintenance and replacement cycles that ultimately cause it to exceed the cost of piping over time. Also, given the significant elevation differential across the District and the desire of the District to provide pressurized deliveries to its patrons and significantly reduce pumping electricity effects on the utility grid, piping was chosen as the District's preferred choice for canal water loss mitigation.

Black Rock Consulting commenced the process of hydraulic modeling for the Swalley Irrigation District by receiving base EPANET files from FireWhat? in electronic form. The files were generated by FireWhat? by including spatially (i.e. northing, easting and elevation) correct patron turnout locations including patron delivery flow rates at each turnout. Updated acreages by patron were provided by the District for this purpose. EPANET modeling is discussed later in this SIP. From the base files, Black Rock Consulting inserted the data in EPANET and then began the process of including existing piped elements of the District. The District was modeled based upon existing intake at the Deschutes River and downstream gravity pressurization of the system to the existing Ponderosa Hydroelectric Plant. Based upon discussions and subsequent direction by the District, piping below the Ponderosa Hydroelectric Plant was assumed to be booster-pump pressurized to 35 PSI just downstream of the plant and then naturally increasing in pressure through gravity as the piped system progresses northward/downward.

The above described approach will insure that piping of the conveyance system north of the hydroelectric facility will be designed to handle potential pressurization consistent with the District's desire to provide pressurized deliveries to its patrons

and thus allow patrons to reduce or eliminate on-farm pumping and energy consumption

The system was evaluated as a completely closed system, i.e. fully piped and pressurized to all distal extremities where on-farm, private deliveries start and District-owned infrastructure ends. The completed model was calibrated and pipes were sized based upon selected pipe manufacturer information and a peak velocity of 5 FT/S for proposed piping at 7 GPM/Acre throughout the system.

Direct points of delivery (POD) from the Deschutes River were also evaluated by District staff. Where future supply by District-owned pipe extensions to these PODs appeared feasible, the District provided those locations to Black Rock Consulting to verify that the as-modeled system included capacity to serve these potential locations in the future, as follows:

* POD 10, 11: 45.25 Acres of Water Rights – Potentially Served from the End of the Elder Lateral

* POD 12, 13: 25 Acres of Water Rights – Potentially Served from the End of the Frakes Lateral

Once this process was completed, the system was evaluated for cost as further detailed below. To provide the greatest flexibility to the District for funding and project "packaging" a lateral by lateral and main canal piping breakdown was provided.

4.1 Pipe and Valve Materials

Pipe materials selections were made by Kevin L. Crew, P.E., based upon 29 years of experience with large diameter piping systems, including 20 years of experience in Central Oregon. From the hydraulic model, both static and dynamic pressures were evaluated throughout the system to select appropriate pipe material options. For pipe up to 48-inches in diameter (covering all future District piping needs), high density polyethylene solid-wall pipe was selected due to its outstanding abrasion resistance, longevity, and ability to be pulled into canal-curve alignments. Costs for materials were obtained from large, reputable vendors active in bidding to Central Oregon projects.

While pressure reducing valves were not proposed in this SIP, they were evaluated in the event that any may be required for future use in parallel with hydroelectric power production or other energy dissipation needs that may arise. Valves for pressure reducing stations were technically assessed and narrowed down to plunger and Cla-Val valve types. Both use internal energy dissipation technology within the valve to accomplish the needed pressure-sustaining function downstream of the valves. Cla-Val valves use a control-tubing and

diaphragm/bonnet arrangement to adjust pressures within the pressure reducing apparatus. No power is necessary for the operation of a Cla-Val. Should pressure reducing valves be required in the future, Cla-Val E-90-01 pressure reducing valves should be considered.

4.2 Hydroelectric Potential, Pumping Mitigation/Energy Conservation, and Pressurization Approach

As indicated above, the District installed and operates a 750kW hydroelectric plant located approximately one-half the distance down its main canal. This location was selected by the District based upon long-term financial ability of the District at the time. The District has contracts in place for sale of power to PacifiCorp, and to the Energy Trust of Oregon for a large grant received. Therefore, at least within the Power Purchase Agreement (PPA) period (2010-2030), the District has little flexibility in modifying the hydroelectric plant size, output or location. However, the potential to make incremental upgrades to the existing hydroelectric facility to boost power production, and remain within the scope and terms of such existing contracts with PacifiCorp, is possible. The District has an energy production efficiency study from 2015 showing that upgrades to the existing turbine/runner alone could boost power production by 4-7%. This energy production efficiency study was not thoroughly analyzed as a part of this SIP, but should be considered as a potential means to offset or net-meter future VFD booster-pump demands.

Based upon District direction that patron pressurization is a priority for the District as it moves forward with its system improvements, the hydraulic analysis for the District indicates that there is no appreciable, additional hydroelectric power potential beyond what it is already producing at the existing plant (notwithstanding the possibility of minor, existing facility system modifications).

Pressurization of existing open channel laterals that exist upstream of the hydroelectric plant will become marginally pressurized as they are piped and connected to the existing main canal pipeline. Approximately one-half of the Rogers Lateral will deliver pressures high enough to fully sprinkler-irrigate with direct patron connections to the future pressurized system. The Kotzman, Riley, Riley Sublateral, Rogers Sublateral, and the upper half of the Rogers Lateral will provide pressures ranging from 11 PSI up to 30 PSI. The NC-1, if repiped as proposed, could be pressurized to irrigation pressures by the addition of a higher head pump to replace the existing pumping system, but the cost of this pumping addition exceeds the likely benefit of recouping such cost. Similarly, the tail end of the Kotzman Lateral includes piping installed over the history of the District. Integrity of such piping is unknown. The limited delivery volume at the tail of the Kotzman Lateral and the proportionately high cost of re-piping in an urban setting likely exceeds the ability of the District to recoup such cost, and as indicated above, the pressurization potential of the Kotzman Lateral is limited.

Pressurization downstream of the existing Ponderosa Hydroelectric Plant could be accomplished in two ways. The first being the introduction of a booster pump downstream of the hydroelectric plant and the second by modifying the existing hydroelectric plant to sustain downstream pressure. Such modification (i.e. retaining 35 PSI or more downstream of the plant) would reduce power output of the existing plant and would require substantial modification thereby jeopardizing the District's contracts with PacifiCorp. As an interim measure, the District could employ pumping from atmospheric pressure (downstream of the existing hydroelectric plant) to 35 PSI or more to pressurize the north end of the District's system. Given that the hydroelectric plant is contracted through the PPA period (until 2030), the in-line booster pumping alternative was chosen for the purposes of this SIPs hydraulic modeling to increase pressures in the north end of the District to provide private pump offsetting pressures and energy conservation measures.

Although modeling was performed at a booster-pumped pressure of 35 PSI, this pressure did not fully pressurize all elements of the north system to fully offset private pumping in all areas. The hydraulic model assumed 7 GPM/Acre was being used at all turnouts at the same time, and if this were not the case, pressures in the north system will be higher than predicted in the model. It is suggested that 35PSI be used for this SIP. However, if implemented, the pumping system should be equipped with a variable frequency drive (VFD) and optional pressures up to 45 PSI (through VFD increase) should be considered during the engineering design phase. Efficient sprinkler heads available to consumers can operate well down to 35 PSI, although full pressurization for irrigation considered a goal of 50 PSI at patron deliveries as appropriate for estimation purposes.

Based upon booster-pumped pressurization of the north end of the system, system pressures ranged from 31 PSI to approximately 60 PSI. No pressure reducing valves were required in the system other than the pressure reduction that presently exists at the Ponderosa Hydroelectric Plant.

Based upon the following assumptions:

- 3 AC-FT/Acre of water applied to grow grass or alfalfa/season
- 70% application efficiency
- 4.28 AC-FT/Acre required to flow from the sprinkler heads/season
- 70% pumping efficiency
- 13,943 GPM pumping rate to the north end of the District to accomplish the above – assumed constant rate over the season for estimation purposes
- 35 PSI exiting booster pump(s)

The estimated power consumption by the proposed pumping plant (just downstream of the hydro plant) over a season would be 1,308,960 kWh, which if

net-metered at the existing hydroelectric plant would equate to a 57% annual reduction from existing power production levels.

Private patron (on-farm) pumping mitigation was also evaluated. All of the similar assumptions stated above were used in the assessment. Where partial pressurization was anticipated by the hydraulic model, a percent of pumping mitigated was assigned to the associated lateral or main canal. The overall District private pumping mitigation and associated patron kWh savings was estimated at 2,455,294 kWh/YR (Table 4.2.1), which if net-metered by the existing hydroelectric plant or extracted directly from the utility grid **would result in a net savings of 1,146,334 kWh/YR.**

Table 4.2.1

ESTIMATED PUMPING POWER SAVINGS THROUGH PRESSURIZATION					
LATERAL/CANAL	ACREAGE ASSOCIATED WITH SEGMENT	EST. % OF PUMPING MITIGATED	70% EFF. PUMPING PER ACRE AT 60 PSI/GRASS HAY (kWh)	SAVINGS/ACRE (kWh)	TOTAL ESTIMATED SAVINGS (kWh/Yr)
Kotzman	162.8	50%	867	434	70,601
NC1	22.2	100%	867	867	19,255
Rogers	528.1	70%	867	607	320,626
Rogers Sublateral	111.6	60%	867	520	58,076
Riley	265.0	25%	867	217	57,461
Riley Sublateral	130.8	40%	867	347	45,379
Deschutes	209.9	75%	867	650	136,539
Elder	472.0	70%	867	607	286,566
Butte	80.7	90%	867	781	62,994
Frakes	213.8	100%	867	867	185,435
Michelson	164.8	100%	867	867	142,936
Main Canal	1450.6	85%	867	737	1,069,426
TOTAL	**3812.3**				**2,455,294**

4.3 Elevation Data

Elevation data for use in modeling was obtained through a LiDAR flight performed in March of 2016 by Quantum Spatial of Corvallis, Oregon. The data was post-processed to the requirements of FCA and Black Rock Consulting. Specifications for the data collection are provided in Table 4.3.1.

With the use of on-ground RTK and OPUS corrections, the data was provided in 1-FT contour interval format and was considered better than 1-FT vertically accurate.

Units for the elevation information were reported and used in the following systems:

- Horizontal Projection: Oregon State Plane (ORSP) South Zone. International Feet
- Horizontal Datum: NAD83(2011)(Epoch2010.00)
- Vertical Datum: NAVD88 using Geoid12A

Table 4.3.1 LiDAR Data Collection Specifications

Multi-Swath Pulse Density	≥ 8 pulses/m^2
Scan Angle	≤30^o (+/-15^o from Nadir)
Returns Collected Per Laser Pulse	Up to 4
Intensity Range	1-255
Swath Overlap	50% side-lap (100% overlap)
Maximum GPS Baseline	13 nautical miles

4.4 Future Delivery Flexibility

The District has requested system flexibility to insure that, within reason, system changes, added and subtracted irrigated acreage, effects of climate change, effects of changes in cropping patterns and similar system demands may be addressed in this SIP. It was determined, given that 7 GPM/Acre was the chosen peak delivery flow rate, that using 9 GPM/Acre as an upper extreme flow limit for system flexibility and safety purposes was appropriate. This upper flow limit was modeled to determine the associated maximal system velocities under this scenario. It was determined through modeling at 9 GPM/Acre delivered to on-farm that the peak system velocities were an acceptable 6.41 FT/S and generally were below 6 FT/S. System pressures remained positive throughout the model. This was a satisfactory result to allow for future system flexibility and safety.

In addition to the 9 GPM/Acre system flexibility, the addition of POD flows were modeled at 7 GPM/Acre at the Elder and Frakes Laterals as indicated below:

* POD 10, 11: 45.25 Acres of Water Rights – Potentially Served from the End of the Elder Lateral

* POD 12, 13: 25.0 Acres of Water Rights – Potentially Served from the End of the Frakes Lateral

It was found that the modeled system was capable of delivering these POD flow rates without major system impacts. The Elder Lateral pressures dropped approximately 9 PSI at its end node (09-0350) to accomplish the additional delivery rate and the Frakes Lateral dropped approximately 4 PSI at its end node (11-0100) to accomplish the additional delivery at that location.

No other issues were noted with respect to increasing system velocities to 9 GPM/Acre should the District choose to do so.

4.5 Hydraulic Modeling

EPANET –

EPANET was used to model the District's proposed piped network. EPANET is a free-ware product that is maintained by the EPA. The Natural Resources Conservation Service technical offices in Oregon use EPANET exclusively for hydraulic modeling. For these reasons, EPANET was selected as the modeling software of choice for this SIP.

EPANET modeling capabilities go beyond steady-state hydraulic modeling. The software is capable of chemical transport analysis and varying flow modeling. A description of some of its capabilities follows:

EPANET is a computer program that performs extended period simulation of hydraulic and water quality behavior within pressurized pipe networks. A network consists of pipes, nodes (pipe junctions), pumps, valves and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

EPANET is designed to be a research tool for improving our understanding of the movement and fate of drinking water constituents within distribution systems. It can be used for many different kinds of applications in distribution systems analysis. Sampling program design, hydraulic model calibration, chlorine residual analysis, and consumer exposure assessment are some examples. EPANET can help assess alternative management strategies for improving water quality throughout a system. These can include:

- altering source utilization within multiple source systems,

- altering pumping and tank filling/emptying schedules,
- use of satellite treatment, such as re-chlorination at storage tanks,
- targeted pipe cleaning and replacement.

Running under Windows, EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots.

Hydraulic Modeling Capabilities –

Full-featured and accurate hydraulic modeling is a prerequisite for doing effective water quality modeling. EPANET contains a state-of-the-art hydraulic analysis engine that includes the following capabilities:

- places no limit on the size of the network that can be analyzed
- computes friction headloss using the Hazen-Williams, Darcy-Weisbach, or Chezy-Manning formulas
- includes minor head losses for bends, fittings, etc.
- models constant or variable speed pumps
- computes pumping energy and cost
- models various types of valves including shutoff, check, pressure regulating, and flow control valves
- allows storage tanks to have any shape (i.e., diameter can vary with height)
- considers multiple demand categories at nodes, each with its own pattern of time variation
- models pressure-dependent flow issuing from emitters (sprinkler heads)
- can base system operation on both simple tank level or timer controls and on complex rule-based controls.

Velocity Criteria –

As stated above, the maximal velocity criteria was set at 5 FT/S for on-farm deliveries at 7 GPM/Acre. The peak evaluated flow rate was 9 GPM/Acre for future system flexibility and safety and was allowed to increase beyond 5 FT/S in the modeling as indicated above.

Elevations –

As indicated above, elevation data was derived from a 2016 LiDAR flight.

Spatially Correct Layout –

Horizontal information for various system elements and patron turnouts was collected through a field survey performed by District staff in 2016. Turnout locations were "snapped" to the canal centerline (perpendicular to the centerline) as determined through post-processing of LiDAR data and locating canal and lateral centerlines. The "snapped" locations represented turnout node locations used during hydraulic modeling and were represented by Northing and Easting coordinates of the Oregon State Plane South Zone.

Pressure Reduction –

Where applicable, pressure reducing stations and/or hydroelectric plants potential were entered into the model as PRVs (Pressure Reducing Valves). These valves are a programmed element in EPANET. The diameter of the valve and the downstream pressure set-point are entered to establish the downstream system pressure to be held by the PRV. PRVs were also used to emulate the pressure reduction through hydroelectric plant(s).

Pipe Diameter Selection –

Pipe diameter selections were derived iteratively in the hydraulic model with the first iteration being a rough estimate. The second iteration utilized actual pipe diameters for high density polyethylene pipe material at the appropriate dimension ratio and pressure rating for each model "link" (pipe). Generally, the third iteration adjusted all pipes in the system to a range of 4 FT/S to 5 FT/S at the peak system flow rates based upon 7 GPM/ Acre.

Pipe Pressure Rating Selection –

HDPE solid-wall pipes (PE4710 resin) were sized from HDPE pipe sizing tables for the expected static pressure for each pipe segment.

The model for the Swalley Irrigation District is included in Appendix B.

4.6 Cost Estimating by Lateral (and Main Canal)

Pipe Estimates –

Pipe material estimates were provided by a reputable vendor that routinely supplies pipe materials to Central Oregon projects. Pipe material budgetary estimates are provided in Appendix C for reference.

PRV Station Estimates (Not Used in this SIP Model)

Turnouts –

For the purposes of this SIP, patron turnouts were assumed to be converted to pressurized delivery systems. A standard pressurized irrigation delivery turnout was assumed to include an appropriately sized tee from the mainline or lateral, a pressure relief valve, a gear-actuated plug valve (or gate or possibly butterfly valve in smaller turnout situations), a magnetic meter, a combination air and vacuum relief valve and associated hardware and spool pipe segments. Based upon experience with similar installations at irrigation districts in Central Oregon, the cost of installation of a turnout was set at an estimated average cost of $8,000 per installation.

Construction –

Contractor procurement may come in several forms in Oregon. Design-Bid-Build is a conventional process wherein the survey and design is developed first and then a traditional competitive bid is held to obtain the lowest-cost responsive and responsible bidding contractor. In this process, typically the design engineering firm will serve as the inspection/construction management firm during the course of construction. Given the magnitude of the project phases and for the purposes of this SIP, a Construction Manager General Contractor (CMGC) model was assumed. In this contractor procurement method, design would precede obtaining the contractor, however the contractor would include construction management in its delivery of the constructed project. An estimated contractor fee structure of 12%-18% of the project value was assumed for this construction delivery method depending upon the size of the lateral or main canal project being evaluated.

Engineering, Construction Management –

Engineering and Owner's Representative/Inspection services typically range as high as 10%-18% of construction value. For the purposes of this SIP, and assuming that project phases are constructed sequentially and annually, it was assumed that total fee of 6%-18% for survey, engineering design and inspection/owner's representative services would be appropriate depending upon the scale of the particular lateral or main canal project. This was based upon the experience of Black Rock Consulting on similar projects deployed in Central Oregon.

Contingency –

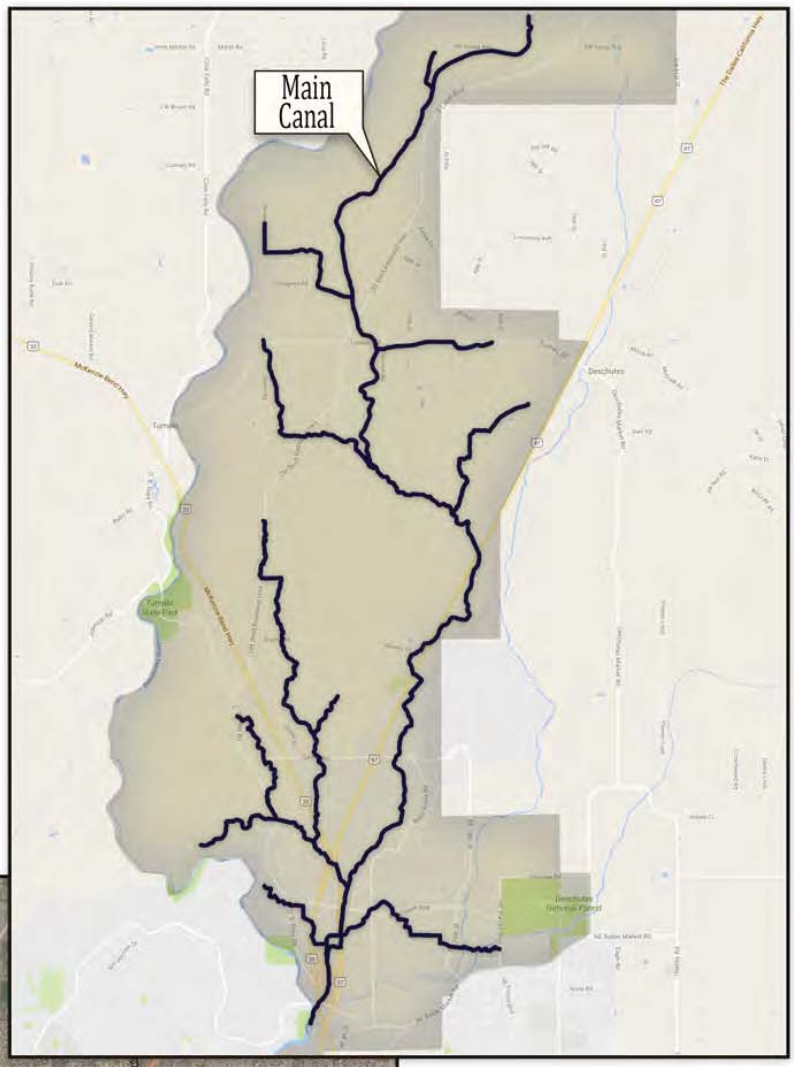
The contingency percentage was carefully considered. The Association for the Advancement of Cost Engineering (AACE) is a nationally recognized

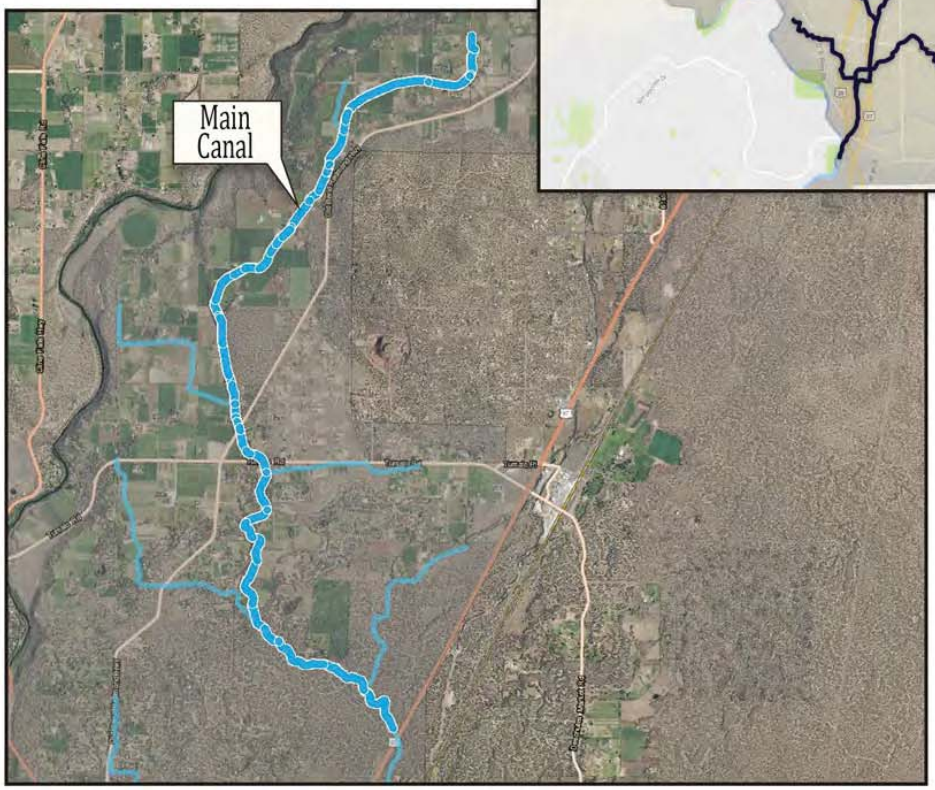
organization that has developed an accepted system of contingency ranges based upon project specificity level "Class". There are 5 project Classes starting from Class 5 with only conceptual project definition to Class 1 where a project has been completely developed and bid. This SIP was considered to fall within the Class 4 definition. The AACE Class 4 project specificity level (i.e. a project at 1%-15% definition) carries an anticipated contingency range from -15% to -30% on the low end of the range to +20% to +50% on the high end of the range. We selected a contingency value of +30% that is in the middle of the positive contingency range provided by AACE. It should be noted that the phased cost estimate is based largely upon the cost of pipe materials. Budgetary pricing for high density polyethylene pipe was found to be very competitive at the time of development of this SIP. High density polyethylene solid-wall pipe is manufactured from an oil-based pelletized product. The pellet pricing is tied directly to the cost of oil at the time of pipe manufacture ordering. Given that oil prices have been reduced in the past two years and will likely rebound, it should be anticipated that pipe material pricing will increase significantly with time. The timing of such increases will be dependent upon oil pricing, the economic conditions at the time of order, and the demand for pipe at the time of order. For construction that is completed soon after the development of this SIP, the cost estimates should remain robust. For work lagging several years beyond the development of this SIP, the risk of cost change is greater. For this reason, it is recommended that every 2 years a cost evaluation be performed to update the phased construction cost estimates.

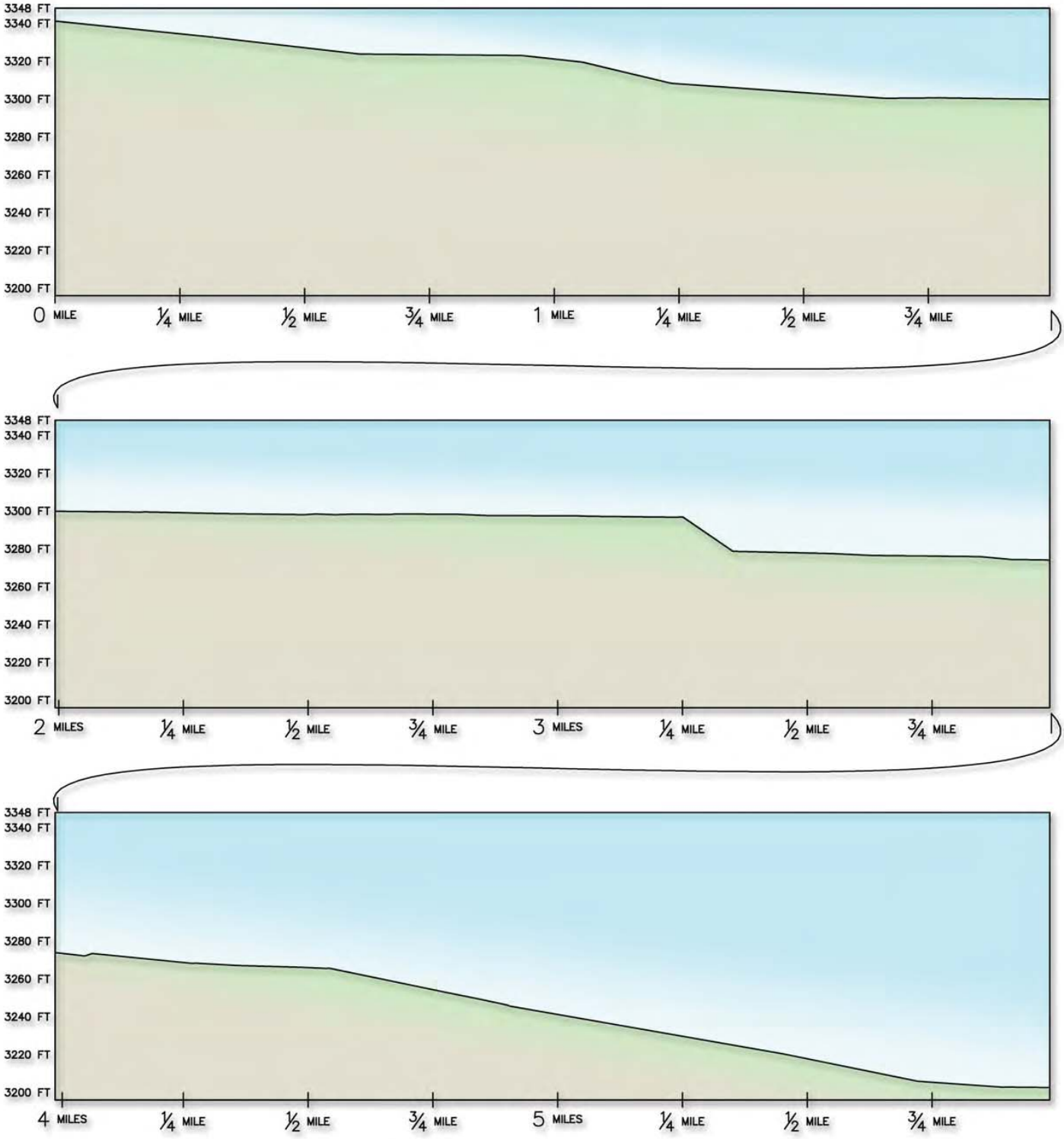
Section 5

Swalley Irrigation Improvements Per Lateral

Main Canal
Figure 5.0.1







Main Canal Profile
Figure 5.0.2

Table 5.0.1

Main Canal

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	48	2,094	LF	$211	$441,834
PIPE	32.5	42	4,560	LF	$164	$747,110
PIPE	32.5	36	6,709	LF	$126	$843,858
PIPE	32.5	34	1,933	LF	$109	$211,586
PIPE	32.5	32	831	LF	$94	$78,164
PIPE	32.5	28	3,086	LF	$74	$228,673
PIPE	26	28	1,665	LF	$90	$149,783
PIPE	26	26	2,746	LF	$80	$219,405
PIPE	26	24	2,534	LF	$66	$167,143
PIPE	26	20	1,283	LF	$48	$61,969
PIPE	26	18	344	LF	$48	$16,491
PIPE	21	18	320	LF	$56	$18,010
PIPE	21	16	3,039	LF	$44	$134,506
PIPE	21	14	1,566	LF	$28	$43,128
PIPE	21	12	66	LF	$23	$1,498
PIPE	21	10	872	LF	$18	$15,260
PIPE	21	8	526	LF	$20	$10,688
TURNOUT			168	EA	$8,000	$1,344,000
	SUBTOTAL					$4,733,107
	ENGINEERING, CM, SURVEY			6%		$283,986
	CMGC			12%		$567,973
	CONTINGENCY			30%		$1,675,520
	TOTAL					**$7,260,586**

Table 5.0.2

Swalley Pump Station (400 HP VFD)

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 11/22/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
Mobilization			1	LS	$20,000	$20,000
Civil Works			1	LS	$100,000	$100,000
Pump/Motor	400 HP		1	EA	$90,000	$90,000
Controls			1	LS	$35,000	$35,000
Electrical			1	LS	$75,000	$75,000
Building			1	EA	$30,000	$30,000
	SUBTOTAL					$350,000
	ENGINEERING, CM, SURVEY			12%		$42,000
	CMGC			18%		$63,000
	CONTINGENCY			30%		$136,500
	TOTAL					**$591,500**

NC1 Lateral
Figure 5.1.1

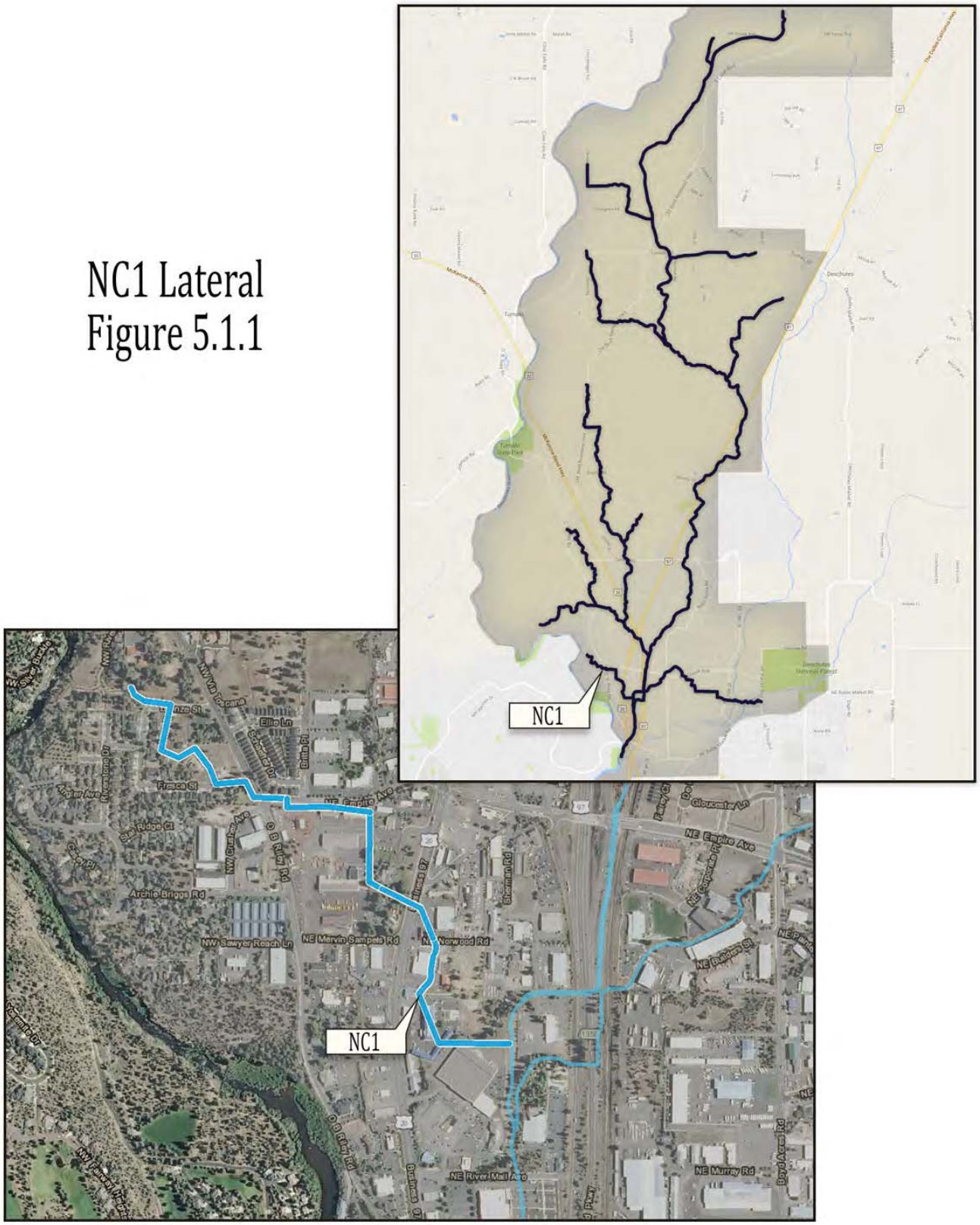


Table 5.1.1

NC1 Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	8	5,051	LF	$16	$79,402
TURNOUT			8	EA	$8,000	$64,000
	SUBTOTAL					$143,402
	ENGINEERING, CM, SURVEY			15%		$21,510
	CMGC			18%		$25,812
	CONTINGENCY			30%		$57,217
	TOTAL					**$247,942**

Note: The cost of re-piping this lateral versus limited benefit results in a low priority.

Kotzman Lateral
Figure 5.2.1

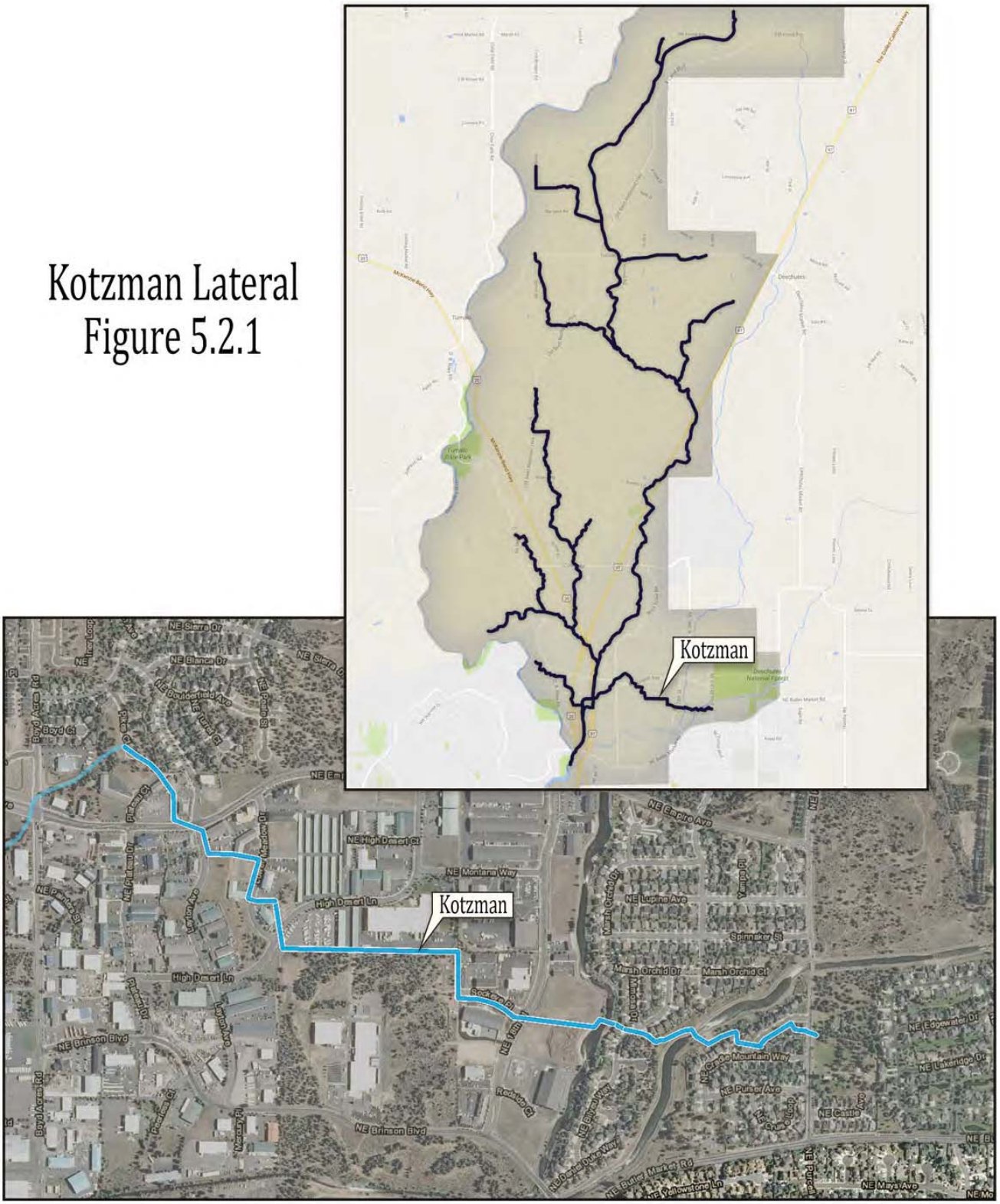


Table 5.2.1

Kotzman Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	12	, F010	L$	716	7109F496
TURNOUT			6	EA	78F000	748F000
	SUBTOTAL					715, F496
	ENGINEERINGFCMFSURVEY			15%		723F624
	CMGC			18%		728F349
	CONTINGENCY			30%		762F841
	TOTAL					**$272,311**

Note: The cost of re-piping this lateral versus limited benefit results in a low priority.

Riley Lateral
Figure 5.3.1

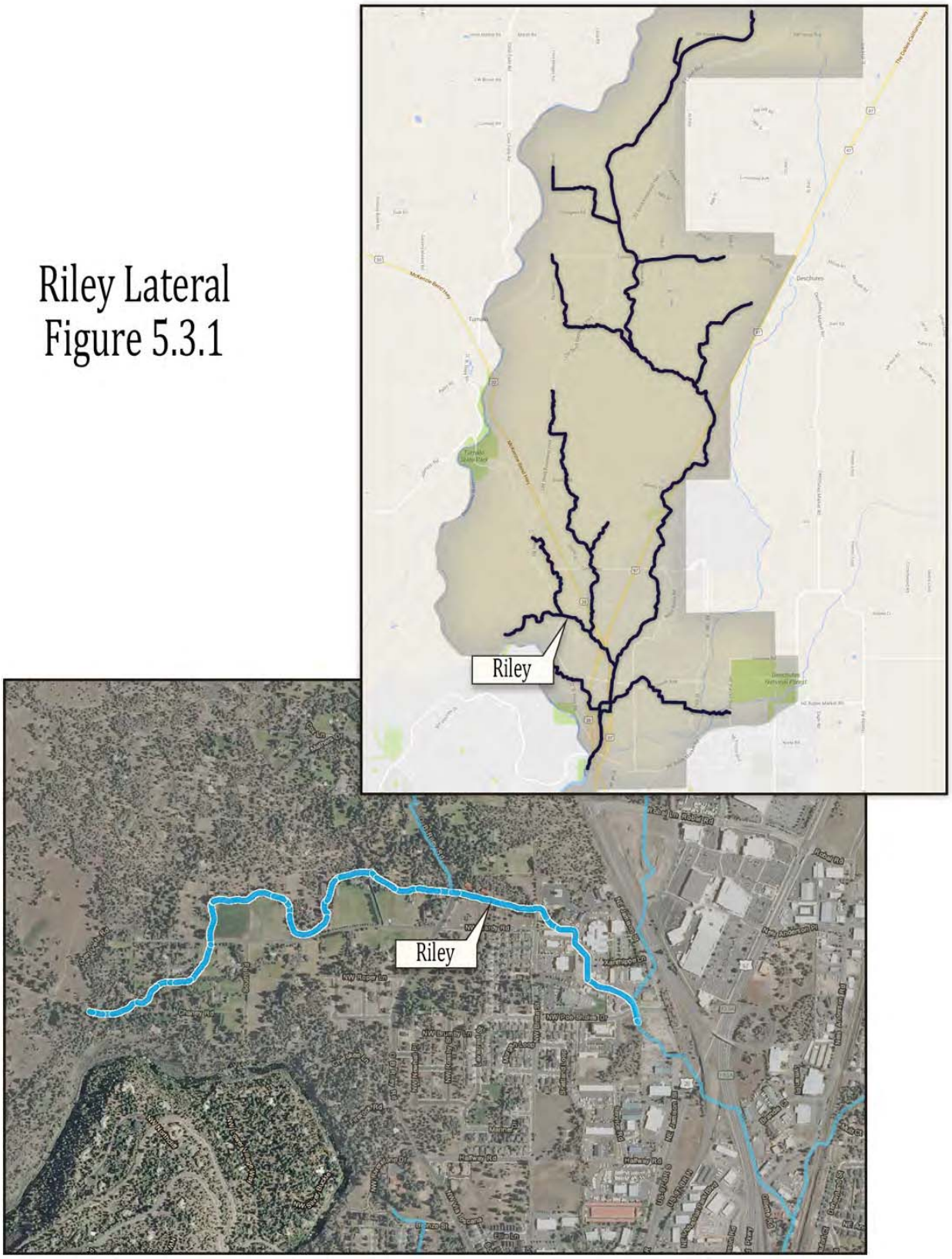


Table 5.3.1

Riley Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	20	2,449	LF	$39	$95,266
PIPE	32.5	16	1,113	LF	$31	$33,991
PIPE	32.5	14	2,972	LF	$19	$56,349
PIPE	32.5	12	738	LF	$16	$11,528
TURNOUT			43	EA	$8,000	$344,000
	SUBTOTAL					$541,134
	ENGINEERING, CM, SURVEY			12%		$64,936
	CMGC			15%		$81,170
	CONTINGENCY			30%		$206,172
	TOTAL					**$893,412**

Riley Sublateral
Figure 5.4.1

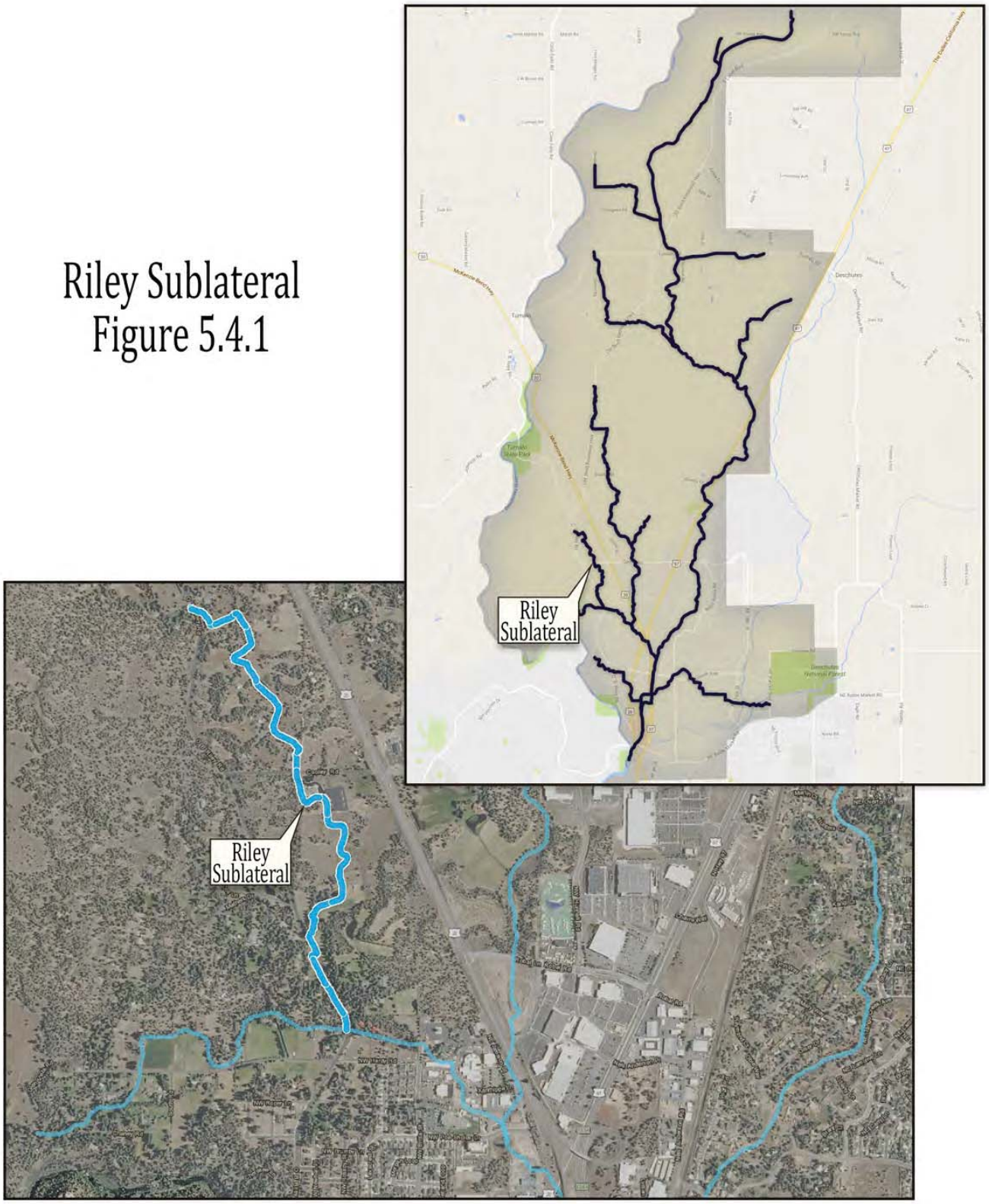


Table 5.4.1

Riley Sublateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	12	4,994	LF	$23	$117,009
PIPE	32.5	8	1,629	LF	$12	$19,206
TURNOUT			23	EA	$8,000	$184,000
	SUBTOTAL					$320,215
	ENGINEERING, CM, SURVEY			12%		$38,426
	CMGC			15%		$48,032
	CONTINGENCY			30%		$122,002
	TOTAL					**$528,676**

Rogers Lateral
Figure 5.5.1

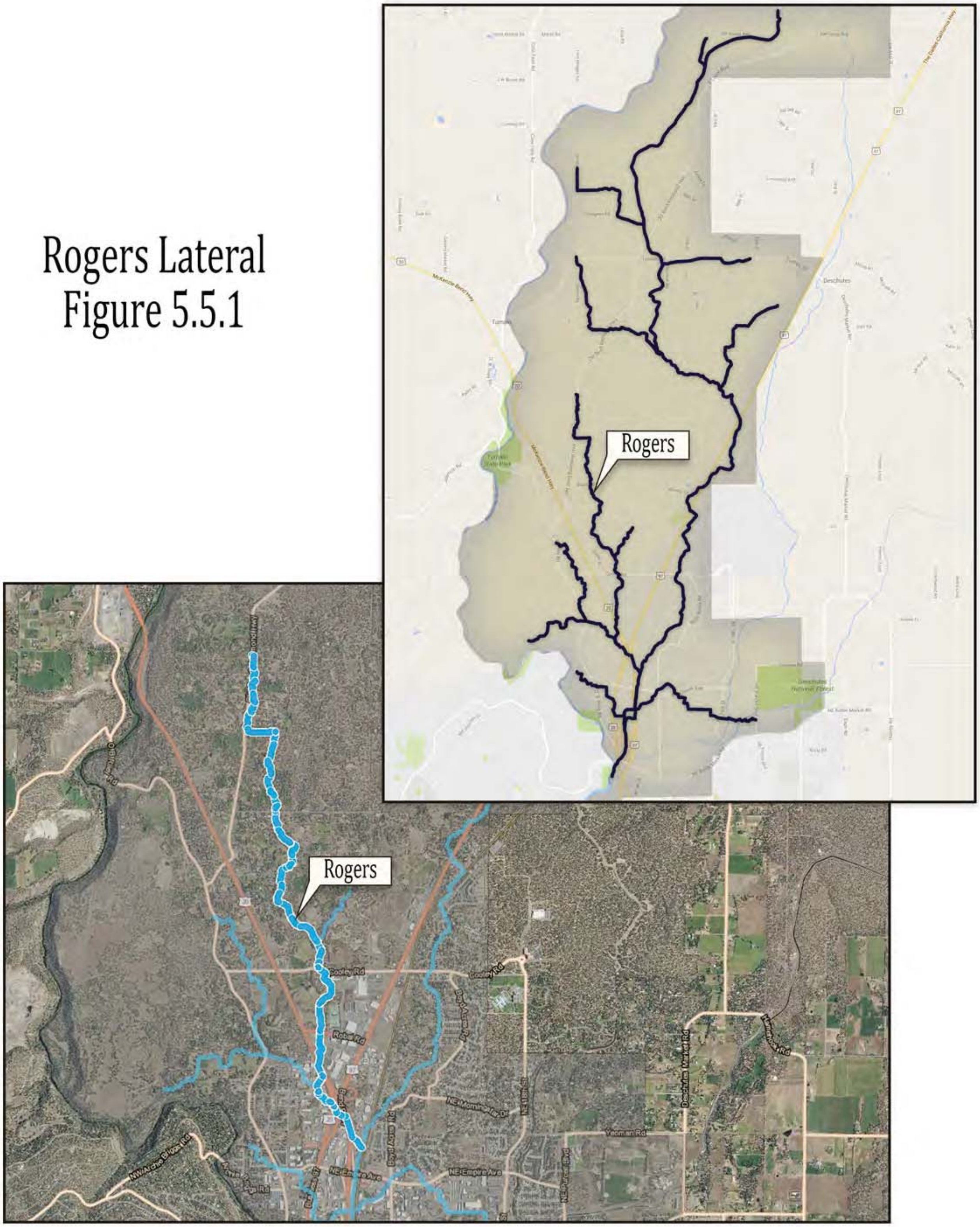


Table 5.5.1

Rogers Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	30	2,559	LF	$84	$215,724
PIPE	32.5	24	4,728	LF	$54	$253,988
PIPE	32.5	20	3,902	LF	$39	$151,788
PIPE	32.5	18	1,340	LF	$31	$41,299
PIPE	26	16	1,927	LF	$31	$60,161
PIPE	26	14	1,120	LF	$26	$28,627
PIPE	26	12	435	LF	$19	$8,317
PIPE	21	12	2,372	LF	$23	$53,844
PIPE	21	10	1,509	LF	$18	$26,408
TURNOUT			157	EA	$8,000	$1,256,000
	SUBTOTAL					$2,096,156
	ENGINEERING, CM, SURVEY			8%		$167,692
	CMGC			12%		$251,539
	CONTINGENCY			30%		$754,616
	TOTAL					**$3,270,003**

Rogers Sublateral
Figure 5.6.1

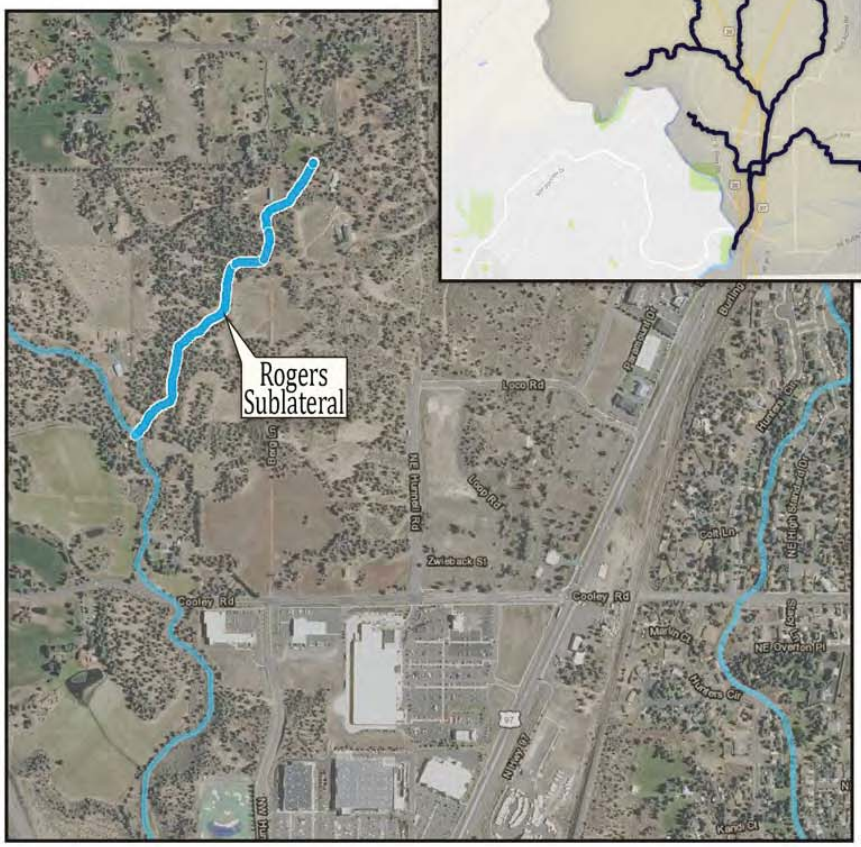


Table 5.6.1

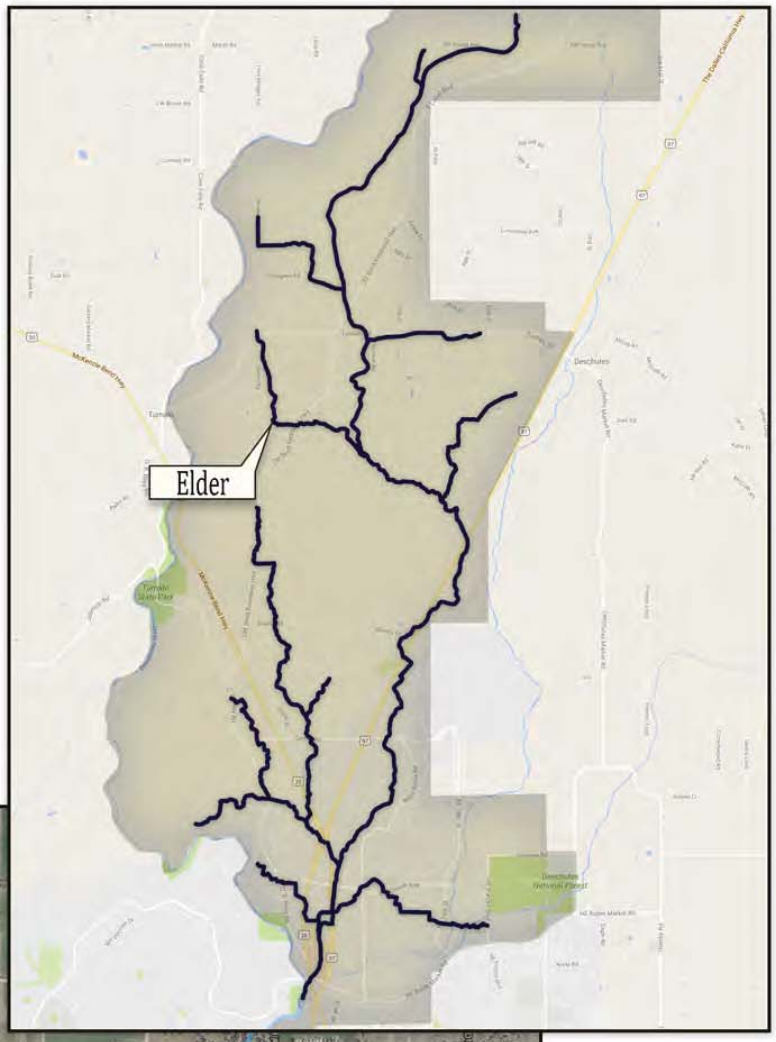
Rogers Sublateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	10	1,313	LF	$17	$22,925
PIPE	32.5	8	922	LF	$16	$14,494
TURNOUT			30	EA	$8,000	$240,000
	SUBTOTAL					$277,419
	ENGINEERING, CM, SURVEY			10%		$27,742
	CMGC			15%		$41,613
	CONTINGENCY			30%		$104,032
	TOTAL					**$450,806**

Elder Lateral
Figure 5.7.1



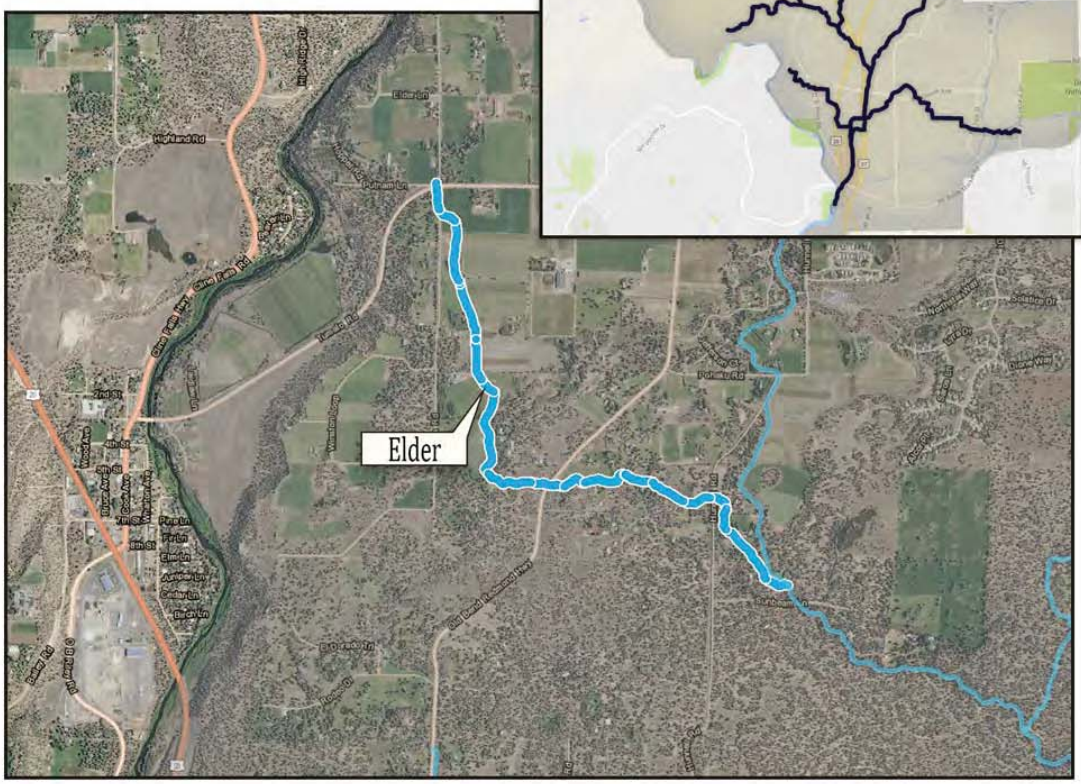


Table 5.7.1

Elder Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	18	4,305	LF	$31	$132,680
PIPE	32.5	16	1,183	LF	$31	$36,129
PIPE	32.5	14	1,530	LF	$19	$29,009
PIPE	32.5	12	604	LF	$16	$9,434
PIPE	32.5	10	882	LF	$12	$10,266
PIPE	32.5	8	1,553	LF	$8	$12,207
TURNOUT			88	EA	$8,000	$704,000
	SUBTOTAL					$933,725
	ENGINEERING, CM, SURVEY			8%		$74,698
	CMGC			12%		$112,047
	CONTINGENCY			30%		$336,141
	TOTAL					**$1,456,611**

Butte Lateral
Figure 5.8.1

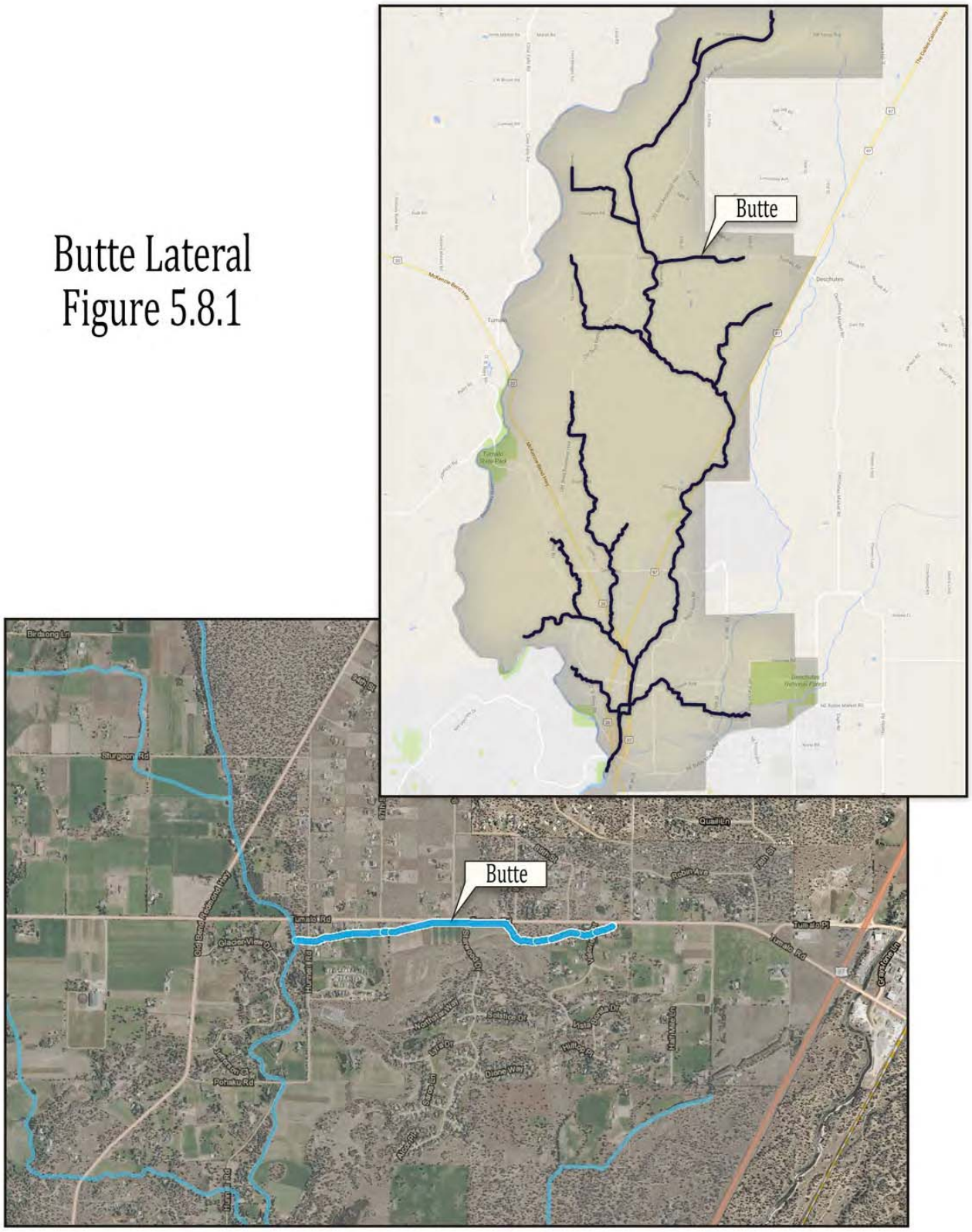


Table 5.8.1

Butte Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	32.5	8	4,378	LF	$16	$68,822
PIPE	26	8	1,056	LF	$19	$19,768
TURNOUT			21	EA	$8,000	$168,000
	SUBTOTAL					$256,590
	ENGINEERING, CM, SURVEY			12%		$30,791
	CMGC			15%		$38,489
	CONTINGENCY			30%		$97,761
	TOTAL					**$423,631**

Mickelson Lateral
Figure 5.9.1

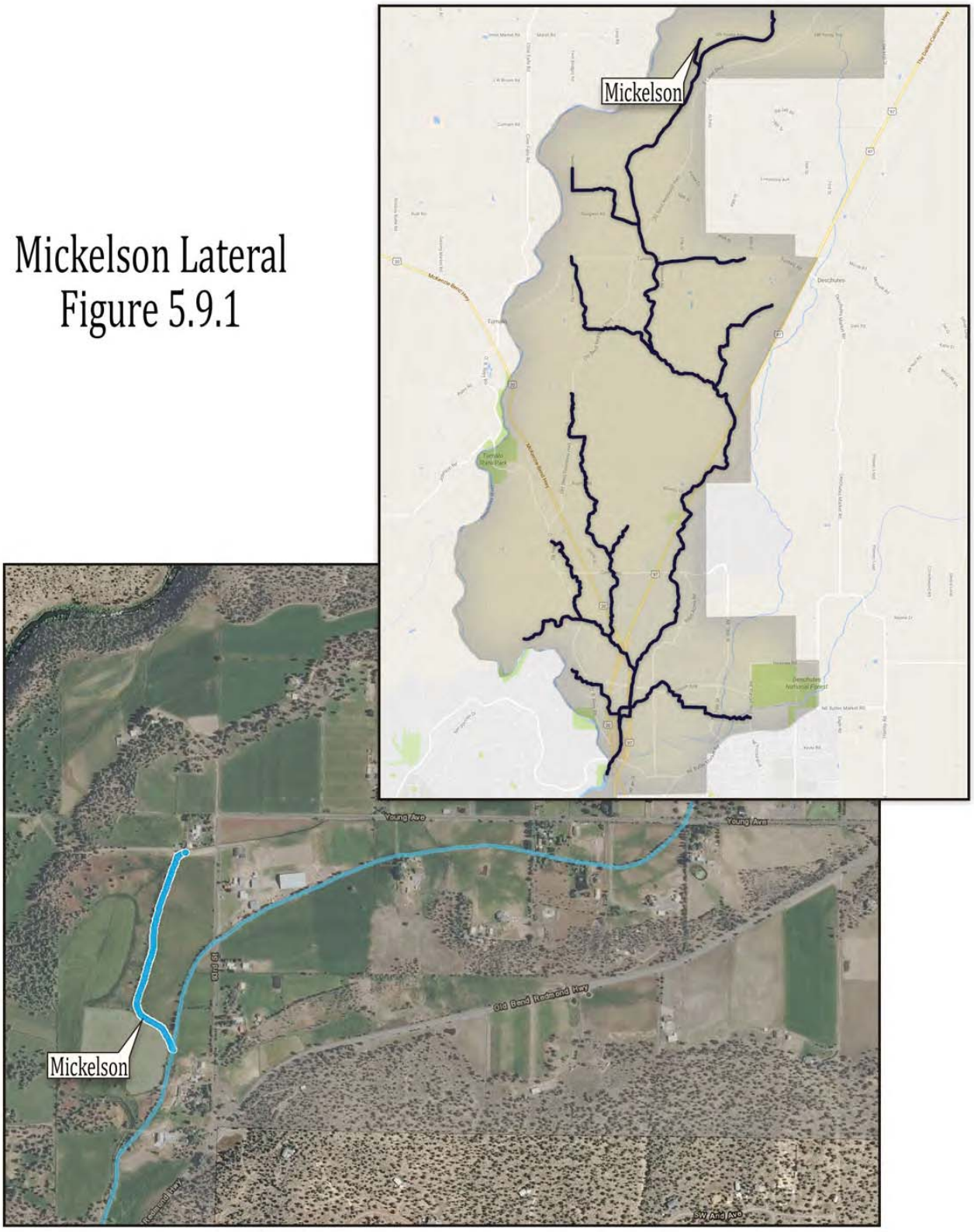


Table 5.9.1

Mickelson Lateral

Swalley Irrigation District

Reconnaissance-Level Construction Cost Estimate 9/28/2016

Feature	DR or PR	Dia. (In)	Length (ft)	Unit	$/Unit	Total Cost
PIPE	26	10	1,877	LF	$22	$40,712
TURNOUT			9	EA	$8,000	$72,000
	SUBTOTAL					$112,712
	ENGINEERING, CM, SURVEY			15%		$16,907
	CMGC			18%		$20,288
	CONTINGENCY			30%		$44,972
	TOTAL					**$194,879**

APPENDIX A
TABULATED SEEPAGE LOSS DATA

SWALLEY IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

9/16/2016
Final

	= Estimated Measurement
	= Included as turn out flow in-reach, and included as Intake flow over-all system measurements
	= Discharge Calculated (Upstream Q - Downstream Q)
NM	= Not Measured

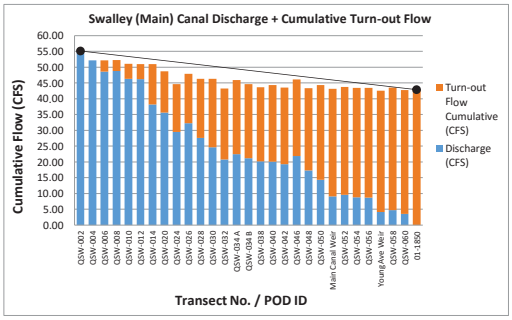
Transect No. Turn-out ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments
Swalley Main Canal				
QSW-002	**54.75**		0.00	Measurement rated as "Good"
QSW-004	**52.13**		0.00	Measurement rated as "Fair"
Deschutes Lateral		-3.49		Piped, Desch Lateral flow not measured, est. difference QSW-004 - QSW-006
QSW-006	**48.64**		3.49	Measurement rated as "Fair"
QSW-008	**48.76**		3.49	Measurement rated as "Good"
10-1030		-1.21		2 feet width (No Suggestions) weir, 3.875 inches depth at
QSW-010	**46.36**		4.70	Measurement rated as "Fair"
01-1040		-0.03		6 inches width (No Suggestions) weir, 0.75 inches depth
01-1045		-0.03		6 inches width (No Suggestions) weir, 0.75 inches depth
Waste Way		0.00		No flow in waste way 6/16/16
QSW-012	**46.21**		4.76	Measurement rated as "Fair"
Elder Lateral		-8.01		Not measured, calculated QSW-012 minus QSW-014
QSW-014	**38.20**		12.77	Measurement rated as "Fair"
01-1050		-0.20		Washed out, estimated flow >92 gpm
QSW-016	NM			Pump 01-1060 OFF, no flow measure made at QSW-016
01-1060		0.00		Off
QSW-018	NM			Pump 01-1060 OFF, no flow measure made at QSW-018
01-1100		0.00		Off
01-1110		-0.15		1.0 feet width (No Suggestions) weir, 1.50 inches depth
QSW-020	**35.62**		13.12	Measurement rated as "Fair"
01-1150		-0.39		2.0 feet width (No Suggestions) weir, 1.80 inches depth
01-1160		-0.15		1.0 feet width (No Suggestions) weir with 1.50 inches
QSW-022	NM			Weirs 01-1150 + 01-1160 measured, no transect Q measurement was made
01-1165				Not Measured
01-1170		-0.13		2.0 feet width (No Suggestions) weir, 0.85 inches depth
Butte Lateral		-1.38		2.0 feet width (No Suggestions) weir, 4.25 inches depth
QSW-024	**29.47**		15.17	Measurement rated as "Good"
01-1220		-0.37		1.0 feet width (No Suggestions) weir, 2.75 inches depth
01-1230		-0.09		Pump 01-1230 ON, estimated flow rate at 40 gpm
QSW-026	**32.26**		15.63	Measurement rated as "Good"
01-1250		-0.11		(2) Pumps at 01-1230 ON, estimated flow rate at 50 gpm
01-1270		-0.69		3.0 feet width (No Suggestions) weir, 2.00 inches depth
01-1300		-2.23		Tower Box washed out, estimated flow rate at 1,000 gpm
01-1320		-0.03		Pump 01-1320 ON, estimated flow rate at 15 gpm
QSW-028	**27.62**		18.69	Measurement rated as "Good"
Frakes Lateral		-2.43		Piped, no Q measure made on Frakes Lat., flow estimated at QSW-028 - QSW-030 - turnout 01-1330
01-1330		-0.55		2.0 feet width (No Suggestions) weir, 2.30 inches depth
QSW-030	**24.64**		21.66	Measurement rated as "Good"
01-1340				Not measured
01-1410		-0.15		1.0 feet width (No Suggestions) weir, 1.50 inches depth
01-1420		-0.63		1.5 feet width (No Suggestions) weir, 3.00 inches depth
01-1430		0.00		Pump 01-1430 is OFF
01-1435		0.00		Turn-out at 01-1435 is OFF
QSW-032	**20.80**		22.44	Measurement rated as "Poor"
01-1440		-0.50		Not Measured, estimated flow
01-1450		-0.50		Not Measured, estimated flow
QSW-034 A	**22.47**		23.44	Measurement rated as "Good" measured 6/16/16
QSW-034 B	**21.22**		23.44	Measurement rated as "Good" measured 6/20/16
QSW-036	NM			No measurement QSW-036
01-1460		-0.08		Weir washed out, estimated flow
QSW-038	**20.18**		23.52	Measurement rated as "Good"
01-1470		-0.73		2.0 feet width (No Suggestions) weir, 2.75 inches depth
01-1480		0.00		Not active turn-out
QSW-040	**20.10**		24.25	Measurement rated as "Fair"
01-1500		0.00		Weir washed out, estimated flow
QSW-042	**19.34**		24.25	Measurement rated as "Good"
QSW-044	NM			Pump 01-1520 OFF, no QSW-044 measurement made
01-1520		0.00		Turn-out OFF for haying
QSW-046	**21.92**		24.25	Measurement rated as "Good"
01-1530		0.00		Turn-out OFF for haying
01-1550		-0.13		Weir washed out, estimated flow
01-1580		-0.37		2.0 feet width (No Suggestions) weir, 1.75 inches depth
01-1590		-0.46		2.0 feet width (No Suggestions) weir, 2.00 inches depth
01-1600		-0.24		Weir washed out, taking 80% allotment, estimated flow
01-1610		-0.59		2.0 feet width (No Suggestions) weir, 2.375 inches depth
QSW-048	**17.32**		26.05	Measurement rated as "Fair"
01-1620		0.00		Pump OFF
01-1625		-0.04		1.0 feet width (No Suggestions) weir, 0.625 inches depth
01-1630		-1.75		Adjust-a-Flume flow measurement
01-1650		-2.24		2.5 feet width (No Suggestions) weir with 5.0 inches
QSW-050	**14.32**		30.08	Measurement not rated
Mickelson Lateral		-3.91		2.5 feet width (No Suggestions) weir, 7.25 inches depth
Main Canal Weir	**9.14**		33.99	6 feet width (No Suggestions) weir, 7.175 inches depth at
01-1720		-0.26		2 feet width (No Suggestions) weir, 1.375 inches depth at
QSW-052	**9.55**		34.25	Measurement rated as "Poor"
01-1730		-0.50		Flume washed out - estimated flow

Main Canal

Over-all Swalley Discharge Measurements

Sum of Canal Intake in the Study Reaches Sum	=	72.17		
of Irr. Turn-out + Flow Remaining	=	-56.8		
Sum of Losses in the Study Reaches	=	15.40	=	21.34%

INDICATES 78.66% OVERALL EXISTING SYSTEM DELIVERY EFFICIENCY



Total Main Canal Intake to the Study Reach	=	54.75		
Total Main Canal Irr. Turnout + Flow Remaining	=	-42.72		
Total Main Canal Losses in the Study Reach	=	12.03	=	21.98%

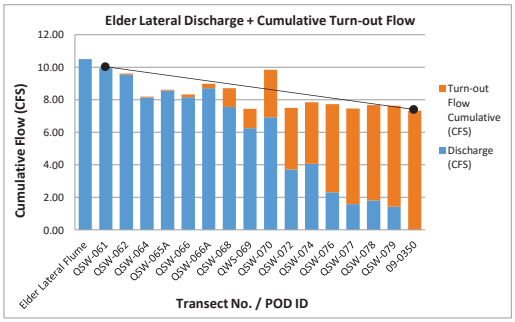
SWALLEY IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

9/16/2016
Final

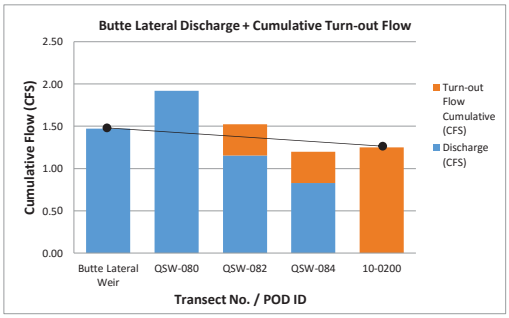
Transect No. Turn-out ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments	
01-1740		0.00		Weir washed out, no turn-out use at time of measure	
QSW-054	**8.76**		34.75	Measurement rated as "Good"	
QSW-056	**8.67**		34.75	Measurement rated as "Good"	
01-1750		-0.46		2 feet width (No Suggestions) weir, 2.0 inches depth at	
01-1760		-0.86		2 feet width (No Suggestions) weir, 3.05 inches depth at	
01-1800		-0.89		2 feet width (No Suggestions) weir, 3.125 inches depth at	
01-1810		-1.41		2 feet width (No Suggestions) weir, 4.25 inches depth at	
Young Ave Weir	**4.19**		38.37	5 feet width (No Suggestions) weir, 0.40 feet depth at	
01-1820		-0.41		2 feet width (No Suggestions) weir, 1.875 inches depth at	
QSW-058	**4.75**		38.78	Measurement rated as "Good"	
01-1830		-0.39		2 feet width (No Suggestions) weir, 1.8 inches depth at	
01-1840		-0.04		6 inch width (No Suggestions) weir, 1.0 inches depth at	
QSW-060	**3.51**		39.21	Measurement rated as "Poor"	
01-1850	**0.00**	-3.51	42.72	Tail end measurement, same as QSW-060	
Main Cnl flow remaining	0.00				
Elder Lateral (Supplemental Measurements 8-25-16)					
Elder Lateral Flume	**10.50**		0.00	Adjust-a-Flume measure, contracted entry, settlement	
QSW-061	**9.94**		0.00	Measurement Rated as "Fair"	
09-0005		-0.07		30 gpm, estimated flow rate, field estimate	
QSW-062	**9.55**		0.07	Measurement Rated as "Good"	
QSW-064	**8.13**		0.07	Measurement Rated as "Fair"	
09-0010		0.00		OFF	
QSW-065A	**8.56**		0.07	Measurement Rated as "Fair"	
09-0020		-0.04		19 gpm, estimated flow rate, field estimate	
09-0030		-0.06		Pump ON, 25 gpm, estimated flow rate, field estimate	
QSW-066	**8.16**		0.16	Measurement Rated as "Fair"	
09-0040		-0.06		25 gpm, estimated flow rate, field estimate	
09-0050		-0.05		24 gpm, estimated flow rate, field estimate	
QSW-066A	**8.71**		0.27	Measurement Rated as "Good"	
09-0060		0.00		Pump OFF, 0 gpm	
09-0070		-0.74		332 gpm, estimated flow rate, field estimate	
09-0080		-0.13		60 gpm, estimated flow rate, field estimate	
QSW-068	**7.57**		1.15	Measurement Rated as "Fair"	
09-0085		-0.03		Pump ON, 15 gpm, estimated flow rate, field estimate	
09-0090		0.00		Pump OFF, 0 gpm	
09-0100		0.00		Pump OFF, 0 gpm	
QWS-069	**6.25**		1.18	Measurement Rated as "Good"	
09-0150		-0.12		1 foot width (No Suggestions) weir, 1.31 inches depth at	
09-0160		0.00		0 gpm, Non-active	
09-0170		-0.08		Pump ON, not measureable, estimate flow 35 gpm	
09-0180		-1.55		2 feet width (No Suggestions), 4.5 inch depth, est. flow	
QSW-070	**6.92**		2.93	Measurement Rated as "Fair"	
09-0200		-0.86		2 feet width (No Suggestions), 3.0 inch depth, est. flow	
QSW-072	**3.71**		3.79	Measurement Rated as "Good"	
QSW-074	**4.07**		3.79	Measurement Rated as "Good"	
09-0210		0.00		Not active turn-out	
09-0220		-0.64		2 feet width Cipolletti, 2.5 inch depth, est. flow 288 gpm	
09-0230		-0.37		2 feet width (No Suggestions), 2.00 inch depth, est. flow	
09-0240		-0.63		2 feet width Cipolletti, 2.5 inch depth, est. flow 285 gpm	
QSW-076	**2.30**		5.44	Measurement Rated as "Good"	
09-0250		-0.35		155 gpm flow est. made in field, weir washed out	
09-0260		-0.09		40 gpm, estimated flow rate, field estimate	
QSW-077	**1.59**		5.87	Measurement Rated as "Fair"	
QSW-078	**1.81**		5.87	Measurement Rated as "Good"	
09-0270		-0.33		2 feet width (No Suggestions), 1.625 inch depth, est. 150	
QSW-079	**1.44**		6.21	Measurement Rated as "Good"	
09-0300		-0.01		6 inch width Cipolletti, plugged, est. flow 6 gpm	
09-0350	**0.00**	-1.11	7.33	2 ft width (No Suggestions), 3.625 in depth, tail water 502	
Elder Lat Flow Remaining	0.00			Tail water use by Turn-out 09-350 patrons	
Butte Lateral					
Butte Lateral Weir	**1.47**		0.00	2 feet width (No Suggestions) weir, 4.375 inches depth	
QSW-080	**1.92**		0.00	Measurement Rated as "Fair"	
10-0130		0.00		Pump 10-0130 OFF	
10-0140		-0.37		2 feet width (No Suggestions) weir, 1.75 inches depth at	
QSW-082	**1.15**		0.37	Measurement Rated as "Fair"	
QSW-084	**0.83**		0.37	Measurement Rated as "Poor"	
10-0150		-0.11		2 feet width (No Suggestions) weir, 0.75 inches depth at	
10-0160		-0.37		2 feet width (No Suggestions) weir, 1.75 inches depth at	
10-0170		0.00		Not active turn-out	
10-0180		0.00		3 inch width (No Suggestions) weir, 0.25 inches depth at	
10-0190		-0.10		Pipe orifice (not measureable) taking water (est. flow)	
10-0200	**0.00**	-0.30	1.25	2 feet width (No Suggestions) weir, 1.5 inches depth, tail	
Butte Lat flow remaining	0.00			Tail water use by Turn-out 10-200 patrons	

Elder Lateral

Butte Lateral



Total Elder Lateral Intake to the Study Reach = 9.94
Total Elder Lateral Irr. Turnout + Flow Remaining = -7.33
Total Elder Lateral Losses in the Study Reach = 2.61 = 26.22%

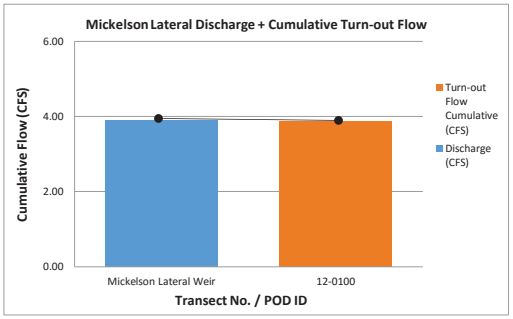


Total Butte Lateral Intake to the Study Reach = 1.47
Total Butte Lateral Irr. Turnout + Flow Remaining = -1.25
Total Butte Lateral Losses in the Study Reach = 0.22 = 14.97%

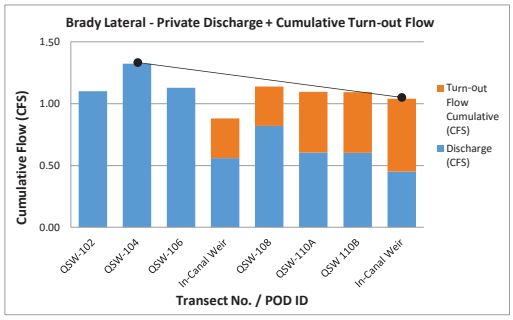
SWALLEY IRRIGATION DISTRICT - DISCHARGE FLOW MEASUREMENTS 2016

9/16/2016
Final

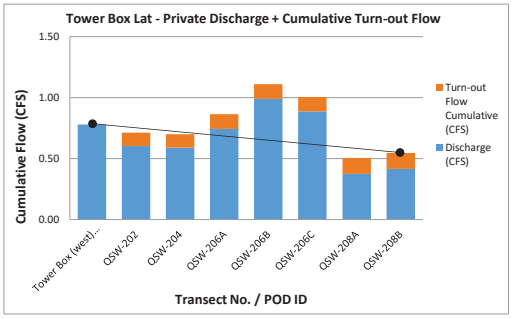
Transect No. Turn-out ID	Discharge (CFS)	Turn-out Flow Rate (CFS)	Turn-out Flow Cumulative (CFS)	Comments	
Mickelson Lateral					
Mickelson Lateral Weir	**3.91**		0.00	2.5 feet width (No Suggestions) weir, 7.25 inches depth	Mickelson Lateral
Return Flow		0.00		Return flow from Hanson, no return flow observed	
12-0050		-0.22		2.0 feet width (No Suggestions) weir, 2.75 inches depth at crest (very leaky)	
12-0100	**0.00**	-3.66	3.88	57.75 inches width (No Suggestions) weir, 4.5 inch depth at crest	
Mickelson Lat remaining	0.00				
Brady Lateral - Private (Supplemental Measurement 8-25-16)					
QSW-102	**1.10**		0.00	Measurement Rated as 'Poor'	Brady Lateral - Private
QSW-104	**1.32**		0.00	Measurement Rated as 'Poor'	
QSW-106	**1.13**		0.00	Measurement Rated as 'Fair'	
Turn-out 01		-0.32		1.0 ft width Cipolletti, 2.5 inch depth, degraded, fair	
In-Canal Weir	**0.56**		0.32	1.8 ft width Rectangular, 2.5 inch depth, degraded, poor	
QSW-108	**0.82**		0.32	Measurement Rated as 'Fair'	
Turn-out 02		-0.17		Calc turn-out flow = 80% QWS 108 minus QWS-110A	
QSW-110A	**0.61**		0.49	Measurement Rated as 'Fair'	
QSW 110B	**0.60**		0.49	Measurement Rated as 'Fair'	
Turn-out 02		-0.10		0.365 ft width Rectangular, 2.375 inch depth, good	
In-Canal Weir	**0.45**		0.59	1.25 ft width Rectangular, 2.75 inch depth, good	
Brady Lat remaining	0.45				
Tower Box Lateral - Private (Supplemental Measurement 8-25-16)					
Tower Box (west) weir	**0.78**		0.00		Tower Box Lateral - Private
Turn-out 01		-0.11		1.0 ft width Cipolletti, 1.25 inch depth, good	
QSW-202	**0.60**		0.11	Measurement Rated as "Poor"	
QSW-204	**0.59**		0.11	Measurement Rated as "Fair"	
Turn-out 02		-0.01		Closed turn-out w/ leakage 5 gpm, estimated flow rate	
Turn-out 03		0.00		Closed turn-out w/o leakage 0 gpm, estimated flow rate	
QSW-206A	**0.74**		0.12	Measurement Rated as "Poor"	
QSW-206B	**0.99**		0.12	Measurement Rated as "Poor"	
QSW-206C	**0.89**		0.12	Measurement Rated as "Poor"	
Turn-out Flood Irr		-0.01		Closed turn-out, bank overtop leakage 5 gpm, est. flow	
QSW-208A	**0.37**		0.13	Measurement Rated as "Fair"	
QSW-208B	**0.42**		0.13	Measurement Rated as "Fair"	
Tower Box remaining	0.42				
	Sum Turn-outs	-55.90			



Total Mickelson Lat Intake to the Study Reach = 3.91
Total Mickelson Lat Irr Turnout + flow remaining = -3.88
Total Mickelson Lat Losses in the Study Reach = 0.03 = 0.77%



Total Brady Lateral Intake to the Study Reach = 1.32
Total Brady Lateral Irr Turnout + Flow Remaining = -1.04
Total Brady Lateral Losses in the Study Reach = 0.28 = 21.26%



Total Tower Box Lat Intake to the Study Reach = 0.78
Total Tower Box Lat Irr Turnout + Flow Remaining = -0.55
Total Tower Box Lat Losses in the Study Reach = 0.23 = 30.03%

ROGERS LATERAL
LOSS MEASUREMENT DATA
18-Sep-12

Measurement Number	Measurement Description	Measurement Type	Measurement	Flow Rate CFS	Re-Measure CFS	Seepage Loss Total Estd CFS
0	7-FT Cipolletti Weir	Weir Stick	7-Inches	10.5		
1	Canal 50-YDS D/S Robal Road	AA/Pygmy		10.3	9.82	0.2
2	Canal Just Above Turnout 04-0120	AA/AA		10.3	10.8	0.2
	Turnout 04-0120	Weir Stick	0.75-Inches	0.11		
3	Canal Just Below Turnout 04-0120	AA/Pygmy		9.38	9.18	1
4	Canal Just Below Cooley Road	AA		9.3		
5	Canal Just Above Rogers Sublateral & Turnout 04-0210	Pygmy		8.96		1.4
	Rogers Sublateral	Weir Stick	5-Inches	1.81		
6	Canal Just Below Rogers Sublateral & Turnout 04-0210	Pygmy		7.24		1.4
7	Canal Above 04-0280	Pygmy		6.52		2.1
8	Canal Just Above Warner Lat 04-0420/25	Pygmy Pygmy		5.31		3.3
	Warner Lateral	2-FT Weir	2-5/8-Inches	0.691		
9	Canal Just Below Warner Lat 04-0420/25	Pygmy		4.48	4.52	3.3
11	Canal Just Below Rogers Road	Pygmy		4.79		3.3
	Turnout 04-0450/60	Weir Stick/Obs	0.75-Inches	0.06		
12	Canal Between Turnout 04-0460/70	Pygmy		4.35		3.4
	Turnout 04-0480	12_Inch Weir	0.75-Inches	0.06		
13	Canal Just Above Turnout 04-0490	Pygmy		4.25	3.96	3.4
14	Canal Just Below Turnout 04-0490	Pygmy		4.19	4.15	3.4
Measurements Performed on Subsequent Day						
1 (same as pt. 14)	Canal Just Below Turnout 04-0490	Pygmy		2.38		3.4
2	Canal at So. Canal Blvd	Pygmy		2.21	2.48	3.4
3	Canal at Jonathan Rd Just Above Turnout 04-0530	Pygmy		2.25		3.4
4	Canal at Jonathan Rd Just Below Turnout 04-0530	Pygmy		2.31		3.4
5	Canal Between Turnout 04-0540/50	Pygmy		1.82		3.9
6	Canal Above Turnout 04-0570	Pygmy		1.7		3.9
7	Canal Below Turnout 04-0570	Pygmy		1.87		3.9
8	Canal at Tail Just U/S Staff Gauge	Pygmy		1.77		3.9
					TOTAL	**3.9**

ROGERS SUBLATERAL
LOSS MEASUREMENT DATA
22-Aug-12 Karl Conklin

Measurement Number	Measurement Description	Measurement Type	Measurement	Flow Rate CFS	Re-Measure CFS	Seepage Loss Total Estd CFS
0	2-FT Cipolletti Weir	Weir Stick	5 3/8-Inches	2.018		
1	Sublateral 775-FT D/S Head	Pygmy		1.96		
	Turnout 05-0010	Weir Stick	2 3/8-Inches	0.59		
2	Sublateral Above 1,490-FT D/S Head	Pygmy		1.4		
3	Sublateral Nearing 1,945-FT D/S Head	Pygmy		1.55		
	Turnout 05-0040	Weir Stick	2-Inches	0.458		
	Turnout 05-0050	Weir Stick	3 1/8-Inches	0.895		0.2
					TOTAL	**0.2**

ROGERS SUBLATERAL
LOSS MEASUREMENT DATA
30-Aug-12 Golden/Bates

Measurement Number	Measurement Description	Measurement Type	Measurement	Flow Rate CFS	Re-Measure CFS	Seepage Loss Total Estd CFS
0	2-FT Cipolletti Weir	Pygmy		2.38		
1	Sublateral 775-FT D/S Head	Pygmy		2.13		0.2
	Turnout 05-0010	Weir Stick	2 1/8-Inches	0.5		
2	Sublateral Above 1,490-FT D/S Head	Pygmy		1.17		
3	Sublateral Nearing 1,945-FT D/S Head	Pygmy		1.48		0.3
	Turnout 05-0040	Weir Stick	2-Inches	0.458		
	Turnout 05-0050	Weir Stick	3 1/8-Inches	0.895		0.4
					TOTAL	**0.4**
					RANGE	**0.2-0.4**

RILEY LATERAL
LOSS MEASUREMENT DATA
24-Oct-12
All Turnouts Off

Measurement Number	Measurement Description	Measurement Type	Measurement	Flow Rate CFS	Re-Measure CFS	Seepage Loss Total Estd
1	Canal Head-End	Pygmy		1.96		
2	Canal Just Above Turnout 06-1031	Pygmy		1.88		
3	Canal Just Below Turnout 06-1070	Pygmy		1.93		0
4	Canal Just Below Turnout 06-1095	Pygmy		1.91		0.04
5	Canal Just South Glen Vista Rd.	Pygmy		1.83		0.1
6	Canal Just Below Turnout 06-1250	Pygmy		1.75	1.76	0.15
7	Canal Tail Just Above Culvert	Pygmy		1.02		0.88
7	Ramp Flume Leaky	Chart		0.7 Read - 1.0	Est'd	0.88
					TOTAL	**0.88**

RILEY SUBLATERAL
LOSS MEASUREMENT DATA
12-Sep-12

Measurement Number	Measurement Description	Measurement Type	Measurement	Flow Rate CFS	Re-Measure CFS	Seepage Loss Total Estd
0	3-FT Cipolletti Weir	Weir Stick	5-Inches	2.71	2.61	
1	Canal 200-YDS D/S of Head End Weir	Pygmy		2.88		
	Turnout 07-2010			0	-0.54	
2	Canal Just Above Turnout 07-2040	Pygmy		2.19	2.07	0-.2
	Turnout 07-2040			Meas Error	Negligible	
3	Canal Just Below Turnout 07-2040	Pygmy		2.5	2.13	0-0.2
4	Canal Just Above Turnout 07-2060	Pygmy		2.64	2.1	0-0.2
	Turnouts 60/70/80			-0.41	-0.35	
5	Canal Just Below Turnout 07-2080	Pygmy		2.23	1.75	0-0.2
6	Canal Just Above Turnout 07-2100	Pygmy		2.02		0.2-0.41
	Turnouts 100/110			-0.33		
7	Canal Just Below Turnout 07-02110	Pygmy		1.69		0.2-0.41
8	Canal at Tail Above Ramp Flume	Pygmy		1.22		0.29-0.88
9	Ramp Flume Chart	Chart	1.6	1.6		0.29-0.88
					TOTAL	**0.29-0.88**

APPENDIX B
EPANET HYDRAULIC MODEL

[TITLE]
Farmers Conservation Alliance (FCA)
Irrigation Modernization Program (IMP)
Hydraulic Modeling
EPANET Input File
SWALLEY IRRIGATION DISTRICT
Demands based on 9 GPM per acre
Version: June 21, 2016

[JUNCTIONS]

;ID	Elev	Demand	Pattern	
07-2010	3509.30	138.60		;
07-2020	3502.06	18.00		;
07-2030	3497.68	9.00		;
07-2040	3491.75	36.00		;
07-2050	3488.99	18.00		;
07-2060	3484.91	76.50		;
07-2090	3481.38	108.00		;
07-2100	3473.84	90.00		;
07-2110	3473.66	72.00		;
07-2120	3472.69	18.00		;
07-2130	3473.42	593.46		;
01-0020	3532.59	24.75		;
01-0050	3510.67	7.92		;
01-0060	3506.69	4.50		;
01-0070	3503.35	4.50		;
01-0080	3502.09	4.50		;
01-0090	3501.38	4.50		;
01-0100	3500.09	49.95		;
01-0140	3500.80	2.70		;
01-0150	3484.55	2.97		;
01-0160	3475.95	4.50		;
01-0210	3474.19	12.60		;
01-0310	3463.43	157.50		;
01-0340	3457.08	13.50		;
01-0350	3456.83	11.70		;
01-0360	3456.94	15.75		;
01-0370	3456.33	9.00		;
01-0380	3456.66	1.80		;
01-0400	3455.66	2.25		;
01-0450	3455.26	4.50		;
01-0470	3453.77	2.25		;
01-0480	3453.15	4.50		;
01-0490	3450.45	4.50		;
01-0520	3449.72	4.50		;
01-0530	3450.74	0.90		;
01-0540	3447.17	4.50		;
01-0560	3445.29	17.10		;
01-0580	3446.77	81.90		;
01-0600	3417.80	9.00		;
01-0610	3417.06	85.50		;
01-0640	3416.84	213.75		;
01-0660	3411.76	9.00		;
01-0670	3412.63	4.50		;
01-0680	3412.93	18.00		;
01-0690	3412.35	433.35		;
01-0700	3412.16	522.45		;
01-0720	3399.58	57.60		;
01-0730	3395.71	5.40		;
01-0750	3385.92	59.40		;
01-0760	3375.06	18.00		;
01-0770	3374.31	49.50		;
01-0780	3373.68	27.00		;
01-0790	3373.65	10.80		;
01-0800	3373.12	18.90		;
01-0810	3372.47	26.10		;
01-0830	3372.42	4.50		;
01-0840	3372.02	2.25		;
01-0850	3366.53	4.50		;
01-0860	3364.92	9.00		;
01-1030	3323.79	684.00		;
01-1040	3322.95	31.50		;
01-1045	3322.97	9.00		;
01-1050	3308.29	109.80		;
01-1060	3303.10	306.00		;
01-1100	3300.37	872.55		;
01-1110	3300.60	74.25		;
01-1150	3299.97	153.00		;
01-1160	3299.97	106.20		;
01-1170	3299.41	234.00		;
01-1220	3298.59	135.00		;
01-1230	3298.50	45.00		;
01-1250	3298.03	220.50		;
01-1270	3298.37	360.00		;
01-1300	3298.04	1130.40		;
01-1320	3298.25	9.00		;
01-1330	3298.20	171.00		;

01-1340	3298.26	216.00	;
01-1410	3297.55	58.50	;
01-1420	3297.46	218.25	;
01-1430	3297.21	54.00	;
01-1440	3296.68	45.00	;
01-1450	3296.79	441.00	;
01-1460	3278.63	211.50	;
01-1470	3277.49	414.00	;
01-1480	3276.51	0.00	;
01-1500	3276.20	234.00	;
01-1520	3275.83	240.75	;
01-1530	3274.30	207.00	;
01-1550	3274.22	72.00	;
01-1580	3272.11	219.60	;
01-1590	3273.44	176.40	;
01-1600	3268.21	162.00	;
01-1610	3268.32	268.20	;
01-1620	3267.08	33.30	;
01-1625	3266.17	63.00	;
01-1630	3265.52	777.60	;
01-1650	3265.72	702.00	;
01-1720	3249.44	184.50	;
01-1730	3246.11	254.70	;
01-1740	3245.72	171.00	;
01-1750	3220.41	246.60	;
01-1760	3220.41	304.20	;
01-1800	3205.89	387.90	;
01-1810	3205.92	516.60	;
01-1820	3205.60	269.10	;
01-1830	3202.67	409.50	;
01-1840	3202.85	32.40	;
01-1850	3202.62	809.10	;
02-0010	3544.80	18.00	;
02-0100	3535.24	1446.93	;
03-0050	3549.22	4.50	;
03-0060	3549.13	105.84	;
03-0070	3547.22	47.25	;
03-0080	3538.84	42.30	;
04-0010	3529.62	31.50	;
04-0030	3527.64	70.20	;
04-0050	3515.61	157.50	;
04-0120	3493.17	253.80	;
04-0150	3491.05	13.50	;
04-0160	3491.09	12.42	;
04-0170	3490.83	152.10	;
04-0180	3489.11	83.97	;
04-0230	3483.15	46.80	;
04-0240	3483.25	48.60	;
04-0250	3477.94	18.00	;
04-0260	3481.24	153.00	;
04-0270	3464.81	13.50	;
04-0280	3461.23	95.67	;
04-0285	3454.74	9.00	;
04-0290	3454.73	36.00	;
04-0300	3446.10	9.00	;
04-0310	3440.38	40.50	;
04-0320	3440.34	18.00	;
04-0330	3439.52	36.00	;
04-0340	3439.52	100.71	;
04-0350	3439.81	184.50	;
04-0360	3437.64	27.00	;
04-0370	3437.45	46.80	;
04-0380	3437.77	27.00	;
04-0390	3432.84	9.00	;
04-0420	3432.76	607.50	;
04-0425	3432.56	21.06	;
04-0430	3416.62	9.00	;
04-0440	3418.20	18.00	;
04-0450	3415.53	104.40	;
04-0460	3415.30	76.50	;
04-0470	3412.96	553.50	;
04-0480	3412.96	36.00	;
04-0490	3408.80	31.50	;
04-0500	3398.59	31.50	;
04-0505	3393.06	45.00	;
04-0507	3393.53	44.10	;
04-0510	3393.22	60.84	;
04-0520	3367.08	63.00	;
04-0530	3362.88	63.00	;
04-0535	3362.47	48.96	;
04-0540	3361.52	74.70	;
04-0550	3352.88	99.00	;
04-0560	3347.01	9.00	;
04-0570	3339.30	60.75	;
04-0580	3338.01	135.00	;
04-0590	3337.07	76.50	;
04-0610	3337.07	789.75	;

05-0010	3472.29	275.40	;
05-0040	3459.96	252.00	;
05-0041	3459.96	27.90	;
05-0050	3459.93	448.65	;
06-0010	3518.36	67.50	;
06-0020	3512.00	9.00	;
06-0040	3511.15	4.50	;
06-1010	3511.29	4.50	;
06-1015	3509.50	9.00	;
06-1020	3511.44	25.20	;
06-1030	3509.24	22.50	;
06-1040	3509.34	75.60	;
06-1050	3509.21	50.40	;
06-1060	3508.26	36.00	;
06-1065	3508.83	15.30	;
06-1070	3508.51	9.00	;
06-1080	3507.26	65.25	;
06-1090	3507.19	5.40	;
06-1095	3507.71	30.60	;
06-1100	3507.61	31.50	;
06-1110	3507.18	32.40	;
06-1130	3506.78	27.00	;
06-1140	3506.78	9.00	;
06-1150	3506.63	18.00	;
06-1160	3506.84	36.00	;
06-1210	3507.23	18.18	;
06-1230	3506.92	18.00	;
06-1250	3506.34	15.75	;
06-1255	3507.41	4.50	;
06-1260	3506.43	18.00	;
06-1270	3506.49	9.00	;
06-1280	3506.40	9.00	;
06-1290	3505.78	54.00	;
06-1300	3505.81	1637.10	;
08-0020	3295.63	536.85	;
08-0040	3288.30	515.34	;
09-0005	3318.71	36.00	;
09-0010	3313.28	33.75	;
09-0020	3311.32	18.00	;
09-0030	3309.78	9.00	;
09-0040	3310.27	27.00	;
09-0050	3310.15	27.00	;
09-0060	3308.35	45.00	;
09-0070	3306.63	443.70	;
09-0080	3306.22	45.00	;
09-0085	3304.09	15.75	;
09-0090	3304.92	13.50	;
09-0100	3304.74	22.50	;
09-0150	3303.51	81.00	;
09-0170	3302.88	45.00	;
09-0180	3302.88	852.30	;
09-0200	3302.88	162.00	;
09-0210	3299.84	126.00	;
09-0220	3301.14	306.00	;
09-0230	3296.55	301.95	;
09-0240	3296.17	356.85	;
09-0250	3295.48	153.00	;
09-0260	3295.13	117.45	;
09-0270	3295.23	162.00	;
09-0300	3292.84	82.80	;
09-0350	3291.54	765.54	;
10-0130	3298.46	18.00	;
10-0140	3297.86	148.50	;
10-0150	3286.62	60.30	;
10-0160	3285.85	244.44	;
10-0170	3284.68	5.40	;
10-0180	3276.77	4.50	;
10-0190	3270.22	18.00	;
10-0200	3270.33	226.80	;
11-0010	3284.46	225.00	;
11-0020	3283.80	81.00	;
11-0030	3283.27	74.25	;
11-0040	3283.65	447.75	;
11-0050	3283.46	73.80	;
11-0060	3282.57	63.00	;
11-0065	3282.53	83.70	;
11-0070	3282.48	432.00	;
11-0080	3267.34	76.50	;
11-0090	3258.49	72.00	;
11-0100	3250.89	295.20	;
12-0050	3253.22	49.50	;
12-0100	3251.05	1431.90	;
BUTTE_HG	3299.48	0.00	;
DESCHUTES_HG	3332.96	0.00	;
ELDER_HG	3319.51	0.00	;
FRAKES_HG	3298.37	0.00	;
KOTZMAN	3545.73	0.00	;

MICKELSON_HG	3252.89	0.00	;					
N-1	3473.73	0.00	;					
N-10	3521.00	0.00	;					
N-11	3517.66	0.00	;					
N-12	3521.07	0.00	;					
N-13	3518.19	0.00	;					
N-14	3517.43	0.00	;					
N-15	3524.89	0.00	;					
N-16	3519.14	0.00	;					
N-17	3524.76	0.00	;					
N-19	3501.43	0.00	;					
N-2	3473.49	0.00	;					
N-20	3501.02	0.00	;					
N-21	3498.72	0.00	;					
N-22	3510.61	0.00	;					
N-23	3341.20	0.00	;					
N-24	3282.91	837	;					
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N-26	3416.92	0.00	;					
N-27	3424.86	0.00	;					
N-28	3503.28	0.00	;					
N-29	3513.69	0.00	;					
N-3	3486.37	0.00	;					
N-30	3514.22	0.00	;					
N-31	3516.88	0.00	;					
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N-33	3471.70	0.00	;					
N-34	3521.90	0.00	;					
N-4	3487.77	0.00	;					
N-5	3512.67	0.00	;					
N-6	3508.80	0.00	;					
N-7	3505.90	0.00	;					
N-8	3513.11	0.00	;					
N-9	3515.93	0.00	;					
NC-1_HG	3545.02	0.00	;					
RILEY_HG	3516.03	0.00	;					
RILEY_SUB_HG	3510.69	0.00	;					
ROGERS_HG	3533.77	0.00	;					
ROGERS_SUB_Tee	3484.54	0.00	;					
1	3534	0	;54"" to dual 36"""					
2	3527	0	;Dual 36"" to 54"""					
3	3466	0	;Transisition from 48"" DR 32.5 to 48"" DR21"					
4	3362	0	;					
5	3341.20	0	;					
6	3537	0	;					
8	3535	0	;					
9	3545.02	0	;NC-1 Booster Pump					
10	3536	0	;End of existing 2006 piping project					
11	3341.2	0	;					

[RESERVOIRS]

;ID	Head	Pattern	
7	3564.04		;

[TANKS]

;ID	Elevation	InitLevel	MinLevel	MaxLevel	Diameter	MinVol	VolCurve	

[PIPES]

;ID	Node1	Node2	Length	Diameter	Roughness	MinorLoss	Status	
MAIN-58	11	DESCHUTES_HG	2094.13	44.869	135	0	Open	;Proposed 48in DR32.5
MAIN-59	DESCHUTES_HG	01-1030	1857.86	39.261	135	0	Open	;Proposed 42in DR32.5
MAIN-60	01-1030	01-1040	1999.50	39.261	135	0	Open	;Proposed 42in DR32.5
MAIN-63	ELDER_HG	01-1050	1030.14	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-62	01-1045	ELDER_HG	697.80	39.261	135	0	Open	;Proposed 42in DR32.5
MAIN-61	01-1040	01-1045	4.76	39.261	135	0	Open	;Proposed 42in DR32.5
MAIN-64	01-1050	01-1060	1698.94	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-65	01-1060	01-1100	1025.72	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-67	01-1110	01-1150	855.59	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-66	01-1100	01-1110	690.32	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-69	01-1160	01-1170	1391.37	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-68	01-1150	01-1160	0.42	33.651	135	0	Open	;Existing 36in DR32.5
MAIN-71	BUTTE_HG	01-1220	901.12	31.78	135	0	Open	;Proposed 34in DR32.5
MAIN-73	01-1230	01-1250	722.58	31.78	135	0	Open	;Proposed 34in DR32.5
MAIN-72	01-1220	01-1230	193.39	31.78	135	0	Open	;Proposed 34in DR32.5
MAIN-70	01-1170	BUTTE_HG	16.62	33.651	135	0	Open	;Proposed 36in DR32.5
MAIN-77	01-1320	01-1330	436.39	29.91	135	0	Open	;Proposed 32in DR32.5
MAIN-76	01-1300	01-1320	171.77	29.91	135	0	Open	;Proposed 32in DR32.5
MAIN-75	01-1270	01-1300	207.70	29.91	135	0	Open	;Proposed 32in DR32.5
MAIN-74	01-1250	01-1270	115.16	31.78	135	0	Open	;Proposed 34in DR32.5
MAIN-80	01-1340	01-1410	339.08	26.17	135	0	Open	;Proposed 28in DR32.5
MAIN-79	FRAKES_HG	01-1340	666.09	26.17	135	0	Open	;Proposed 28in DR32.5
MAIN-78	01-1330	FRAKES_HG	14.72	29.91	135	0	Open	;Proposed 32in DR32.5
MAIN-82	01-1420	01-1430	134.57	26.17	135	0	Open	;Proposed 28in DR32.5
MAIN-81	01-1410	01-1420	940.02	26.17	135	0	Open	;Proposed 28in DR32.5
MAIN-85	01-1450	01-1460	561.93	25.72	135	0	Open	;Proposed 28in DR26
MAIN-84	01-1440	01-1450	86.42	26.17	135	0	Open	;Proposed 28in DR32.5
MAIN-83	01-1430	01-1440	919.53	26.17	135	0	Open	;Proposed 28in DR32.5

MAIN-86	01-1460	01-1470	1102.98	25.72	135	0	Open	;Proposed 28in DR26
MAIN-87	01-1470	01-1480	417.49	23.88	135	0	Open	;Proposed 26in DR26
MAIN-88	01-1480	01-1500	491.87	23.88	135	0	Open	;Proposed 26in DR26
MAIN-89	01-1500	01-1520	704.08	23.88	135	0	Open	;Proposed 26in DR26
MAIN-90	01-1520	01-1530	342.85	23.88	135	0	Open	;Proposed 26in DR26
MAIN-91	01-1530	01-1550	339.34	23.88	135	0	Open	;Proposed 26in DR26
MAIN-94	01-1590	01-1600	1068.52	22.04	135	0	Open	;Proposed 24in DR26
MAIN-93	01-1580	01-1590	75.28	23.88	135	0	Open	;Proposed 26in DR26
MAIN-92	01-1550	01-1580	374.72	23.88	135	0	Open	;Proposed 26in DR26
MAIN-96	01-1610	01-1620	446.68	22.04	135	0	Open	;Proposed 24in DR26
MAIN-97	01-1620	01-1625	679.72	22.04	135	0	Open	;Proposed 24in DR26
MAIN-95	01-1600	01-1610	36.75	22.04	135	0	Open	;Proposed 24in DR26
MAIN-98	01-1625	01-1630	281.76	22.04	135	0	Open	;Proposed 24in DR26
MAIN-100	01-1650	MICKELSON_HG	1282.68	18.37	135	0	Open	;Proposed 20in DR26
MAIN-99	01-1630	01-1650	20.08	22.04	135	0	Open	;Proposed 24in DR26
MAIN-101	MICKELSON_HG	01-1720	343.86	16.53	135	0	Open	;Proposed 18in DR26
MAIN-104	01-1740	01-1750	3030.91	14.38	135	0	Open	;Proposed 16in DR21
MAIN-103	01-1730	01-1740	7.58	14.38	135	0	Open	;Proposed 16in DR21
MAIN-102	01-1720	01-1730	319.85	16.18	135	0	Open	;Proposed 18in DR21
MAIN-106	01-1760	01-1800	1554.70	12.59	135	0	Open	;Proposed 14in DR21
MAIN-105	01-1750	01-1760	0.19	14.38	135	0	Open	;Proposed 16in DR21
MAIN-110	01-1830	01-1840	4.39	7.75	135	0	Open	;Proposed 8in DR21
MAIN-109	01-1820	01-1830	871.86	9.66	135	0	Open	;Proposed 10in DR21
MAIN-108	01-1810	01-1820	65.48	11.46	135	0	Open	;Proposed 12in DR21
MAIN-107	01-1800	01-1810	11.25	12.59	135	0	Open	;Proposed 14in DR21
MAIN-111	01-1840	01-1850	521.57	7.75	135	0	Open	;Proposed 8in DR21
MICKELSON-1	MICKELSON_HG	12-0050	1876.91	9.87	135	0	Open	;Proposed 10in DR26
MICKELSON-2	12-0050	12-0100	4.69	11.71	135	0	Open	;Proposed 12in DR26
ELDER-1	ELDER_HG	09-0005	355.67	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-2	09-0005	09-0010	939.55	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-17	09-0200	09-0210	1280.76	13.09	135	0	Open	;Proposed 14in DR32.5
ELDER-16	09-0180	09-0200	0.65	13.09	135	0	Open	;Proposed 14in DR32.5
ELDER-15	09-0170	09-0180	0.35	14.96	135	0	Open	;Proposed 16in DR32.5
ELDER-13	09-0100	09-0150	498.16	14.96	135	0	Open	;Proposed 16in DR32.5
ELDER-14	09-0150	09-0170	684.24	14.96	135	0	Open	;Proposed 16in DR32.5
ELDER-11	09-0085	09-0090	19.86	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-12	09-0090	09-0100	313.68	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-10	09-0080	09-0085	656.07	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-9	09-0070	09-0080	4.88	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-8	09-0060	09-0070	428.61	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-4	09-0020	09-0030	317.64	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-3	09-0010	09-0020	325.40	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-6	09-0040	09-0050	84.09	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-5	09-0030	09-0040	335.29	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-7	09-0050	09-0060	524.10	16.83	135	0	Open	;Proposed 18in DR32.5
ELDER-18	09-0210	09-0220	248.49	13.09	135	0	Open	;Proposed 14in DR32.5
ELDER-21	09-0240	09-0250	832.23	10.05	135	0	Open	;Proposed 10in DR32.5
ELDER-19	09-0220	09-0230	598.63	11.92	135	0	Open	;Proposed 12in DR32.5
ELDER-20	09-0230	09-0240	5.13	11.92	135	0	Open	;Proposed 12in DR32.5
ELDER-22	09-0250	09-0260	49.53	10.05	135	0	Open	;Proposed 10in DR32.5
ELDER-23	09-0260	09-0270	872.36	8.06	135	0	Open	;Proposed 8in DR32.5
ELDER-24	09-0270	09-0300	289.83	8.06	135	0	Open	;Proposed 8in DR32.5
ELDER-25	09-0300	09-0350	390.52	8.06	135	0	Open	;Proposed 8in DR32.5
BUTTE-1	BUTTE_HG	10-0130	1462.94	8.06	135	0	Open	;Proposed 8in DR32.5
BUTTE-2	10-0130	10-0140	122.83	8.06	135	0	Open	;Proposed 8in DR32.5
BUTTE-3	10-0140	10-0150	2536.19	8.06	135	0	Open	;Proposed 8in DR32.5
BUTTE-7	10-0170	10-0180	329.65	7.92	135	0	Open	;Proposed 8in DR26
BUTTE-4	10-0150	10-0160	255.62	8.06	135	0	Open	;Proposed 8in DR32.5
BUTTE-5	10-0160	10-0170	436.51	7.92	135	0	Open	;Proposed 8in DR26
BUTTE-9	10-0190	10-0200	6.98	7.92	135	0	Open	;Proposed 8in DR26
BUTTE-8	10-0180	10-0190	282.52	7.92	135	0	Open	;Proposed 8in DR26
KOTZMAN-7	N-19	N-20	103.63	11.92	135	0	Open	;Proposed 12in DR32.5
ROGERS-SUB-1	ROGERS_SUB_Tee	05-0010	1312.78	10.05	135	0	Open	;Proposed 10in DR32.5
ROGERS-SUB-2	05-0010	N-33	180.26	8.06	135	0	Open	;Proposed 8in DR32.5
ROGERS-SUB-4	N-32	05-0040	548.96	8.06	135	0	Open	;Proposed 8in DR32.5
ROGERS-SUB-6	05-0041	05-0050	13.06	8.06	135	0	Open	;Proposed 8in DR32.5
ROGERS-SUB-5	05-0040	05-0041	1.13	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-4	N-8	06-0020	155.92	18.70	135	0	Open	;Proposed 20in DR32.5
RILEY-6	06-0040	N-5	19.59	18.70	135	0	Open	;Proposed 20in DR32.5
RILEY-5	06-0020	06-0040	876.06	18.70	135	0	Open	;Proposed 20in DR32.5
RILEY-19	N-6	06-1080	99.41	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-35	06-1270	06-1280	85.63	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-36	06-1280	06-1290	96.04	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-37	06-1290	06-1300	27.56	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-33	06-1255	06-1260	28.95	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-34	06-1260	06-1270	240.00	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-31	06-1230	06-1250	128.05	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-32	06-1250	06-1255	259.20	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-30	06-1210	06-1230	55.64	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-27	06-1150	06-1160	34.80	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-26	06-1140	06-1150	357.05	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-29	06-1160	06-1210	140.64	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-24	06-1110	06-1130	403.77	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-23	06-1100	06-1110	10.60	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-25	06-1130	06-1140	1.65	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-22	06-1095	06-1100	591.39	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-20	06-1080	06-1090	67.91	13.09	135	0	Open	;Proposed 14in DR32.5

RILEY-21	06-1090	06-1095	104.55	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-8	RILEY_SUB_HG	06-1010	122.83	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-17	06-1070	N-7	176.91	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-13	06-1050	06-1040	5.65	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-15	06-1060	06-1065	54.67	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-14	06-1040	06-1060	309.71	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-16	06-1065	06-1070	205.26	13.09	135	0	Open	;Proposed 14in DR32.5
RILEY-12	06-1030	06-1050	61.48	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-10	06-1015	06-1020	232.29	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-9	06-1010	06-1015	184.30	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-11	06-1020	06-1030	196.25	14.96	135	0	Open	;Proposed 16in DR32.5
RILEY-SUB-1	RILEY_SUB_HG	07-2010	189.30	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-2	07-2010	07-2020	377.06	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-4	07-2030	07-2040	848.81	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-3	07-2020	07-2030	297.22	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-5	07-2040	N-4	1258.23	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-8	N-3	07-2060	206.27	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-9	07-2060	07-2090	1047.00	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-10	07-2090	07-2100	828.31	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-SUB-13	07-2120	N-2	96.07	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-SUB-12	07-2110	07-2120	243.03	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-SUB-11	07-2100	07-2110	192.26	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-SUB-15	N-1	07-2130	14.40	8.06	135	0	Open	;Proposed 8in DR32.5
MAIN-57	01-0860	5	1989.90	42.013	135	0	Open	;Existing 48in DR17
NC1-1	9	03-0050	1368.40	8.06	135	0	Open	;Proposed 8in DR32.5
NC1-3	03-0060	03-0070	609.38	8.06	135	0	Open	;Proposed 8in DR32.5
NC1-2	03-0050	03-0060	549.56	8.06	135	0	Open	;Proposed 8in DR32.5
NC1-5	03-0080	N-22	1849.21	8.06	135	0	Open	;Proposed 8in DR32.5
NC1-4	03-0070	03-0080	674.31	8.06	135	0	Open	;Proposed 8in DR32.5
DESCHUTES-1	DESCHUTES_HG	08-0020	4661.68	12.25	135	0	Open	;Existing 14in DR17
DESCHUTES-2	08-0020	08-0040	1832.51	9.41	135	0	Open	;Existing 10in DR17
DESCHUTES-3	08-0040	N-24	1070.93	9.41	135	0	Open	;Existing 10in DR17
FRAKES-1	FRAKES_HG	11-0010	2456.30	14.96	135	0	Open	;Existing 16in DR32.5
FRAKES-3	11-0020	11-0030	168.81	13.09	135	0	Open	;Existing 14in DR32.5
FRAKES-2	11-0010	11-0020	793.76	13.09	135	0	Open	;Existing 14in DR32.5
FRAKES-11	11-0090	11-0100	604.02	6.19	135	0	Open	;Existing 6in DR32.5
FRAKES-10	11-0080	11-0090	1139.04	6.19	135	0	Open	;Existing 6in DR32.5
FRAKES-8	11-0065	11-0070	46.25	11.92	135	0	Open	;Existing 12in DR32.5
FRAKES-7	11-0060	11-0065	6.79	11.92	135	0	Open	;Existing 12in DR32.5
FRAKES-6	11-0050	11-0060	298.37	11.92	135	0	Open	;Existing 12in DR32.5
FRAKES-5	11-0040	11-0050	22.04	11.92	135	0	Open	;Existing 12in DR32.5
FRAKES-9	11-0070	11-0080	814.12	6.19	135	0	Open	;Existing 6in DR32.5
FRAKES-4	11-0030	11-0040	730.30	13.09	135	0	Open	;Existing 14in DR32.5
KOTZMAN-4	8	10	2490.57	22.44	135	0	Open	;Existing 24in DR32.5
KOTZMAN-6	02-0100	N-19	3226.43	11.92	135	0	Open	;Proposed 12in DR32.5
KOTZMAN-8	N-20	N-21	1693.24	11.92	135	0	Open	;Proposed 12in DR32.5
RILEY-2	N-31	06-0010	661.25	18.70	135	0	Open	;Proposed 20in DR32.5
RILEY-3	06-0010	N-8	658.38	18.70	135	0	Open	;Proposed 20in DR32.5
RILEY-18	N-7	N-6	539.41	13.09	135	0	Open	;Proposed 14in DR32.5
ROGERS-1	ROGERS_HG	04-0010	478.11	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-2	04-0010	04-0030	724.52	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-3	04-0030	N-17	133.70	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-5	N-16	N-15	158.15	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-7	N-14	N-34	94.56	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-12	N-10	N-9	469.93	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-15	04-0050	N-30	569.80	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-17	N-29	N-28	1586.27	22.44	135	0	Open	;Proposed 24in DR32.5
KOTZMAN-1	KOTZMAN	02-0010	53.18	22.44	135	0	Open	;Existing 24in DR32.5
MAIN-1	7	KOTZMAN	3189.25	50.477	135	0	Open	;Existing 54in DR32.5
MAIN-2	KOTZMAN	NC-1_HG	625.96	50.477	135	0	Open	;Existing 54in DR32.5
MAIN-6	2	ROGERS_HG	759.98	50.477	135	0	Open	;Existing 54in DR32.5
MAIN-9	01-0050	01-0060	330.68	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-8	01-0020	01-0050	968.91	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-7	ROGERS_HG	01-0020	56.68	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-10	01-0060	01-0070	283.46	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-18	3	01-0210	1891.66	43.154	135	0	Open	;Existing 48in DR21
MAIN-16	01-0150	01-0160	138.33	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-13	01-0090	01-0140	115.38	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-15	01-0100	01-0150	351.43	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-14	01-0140	01-0100	59.30	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-12	01-0080	01-0090	81.32	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-11	01-0070	01-0080	101.93	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-20	01-0310	01-0340	785.93	43.154	135	0	Open	;Existing 48in DR21
MAIN-19	01-0210	01-0310	892.77	43.154	135	0	Open	;Existing 48in DR21
MAIN-25	01-0380	01-0400	443.27	43.154	135	0	Open	;Existing 48in DR21
MAIN-24	01-0370	01-0380	158.59	43.154	135	0	Open	;Existing 48in DR21
MAIN-23	01-0360	01-0370	216.89	43.154	135	0	Open	;Existing 48in DR21
MAIN-22	01-0350	01-0360	113.02	43.154	135	0	Open	;Existing 48in DR21
MAIN-21	01-0340	01-0350	206.24	43.154	135	0	Open	;Existing 48in DR21
MAIN-30	01-0490	01-0520	453.16	43.154	135	0	Open	;Existing 48in DR21
MAIN-29	01-0480	01-0490	105.63	43.154	135	0	Open	;Existing 48in DR21
MAIN-28	01-0470	01-0480	21.93	43.154	135	0	Open	;Existing 48in DR21
MAIN-26	01-0400	01-0450	212.50	43.154	135	0	Open	;Existing 48in DR21
MAIN-27	01-0450	01-0470	415.54	43.154	135	0	Open	;Existing 48in DR21
MAIN-34	01-0560	01-0580	186.81	43.154	135	0	Open	;Existing 48in DR21
MAIN-31	01-0520	01-0530	119.97	43.154	135	0	Open	;Existing 48in DR21
MAIN-33	01-0540	01-0560	82.25	43.154	135	0	Open	;Existing 48in DR21

MAIN-32	01-0530	01-0540	156.04	43.154	135	0	Open	;Existing 48in DR21
MAIN-35	01-0580	01-0600	1822.55	43.154	135	0	Open	;Existing 48in DR21
MAIN-36	01-0600	01-0610	1079.46	43.154	135	0	Open	;Existing 48in DR21
MAIN-39	01-0660	01-0670	329.58	43.154	135	0	Open	;Existing 48in DR21
MAIN-37	01-0610	01-0640	18.58	43.154	135	0	Open	;Existing 48in DR21
MAIN-38	01-0640	01-0660	481.48	43.154	135	0	Open	;Existing 48in DR21
MAIN-41	01-0680	01-0690	56.55	43.154	135	0	Open	;Existing 48in DR21
MAIN-40	01-0670	01-0680	90.28	43.154	135	0	Open	;Existing 48in DR21
MAIN-45	01-0730	01-0750	560.57	43.154	135	0	Open	;Existing 48in DR21
MAIN-46	01-0750	4	759.28	43.154	135	0	Open	;Existing 48in DR21
MAIN-43	01-0700	01-0720	432.59	43.154	135	0	Open	;Existing 48in DR21
MAIN-42	01-0690	01-0700	7.22	43.154	135	0	Open	;Existing 48in DR21
MAIN-44	01-0720	01-0730	237.13	43.154	135	0	Open	;Existing 48in DR21
MAIN-48	01-0760	01-0770	795.59	42.013	135	0	Open	;Existing 48in DR17
MAIN-49	01-0770	01-0780	678.08	42.013	135	0	Open	;Existing 48in DR17
MAIN-51	01-0790	01-0800	205.36	42.013	135	0	Open	;Existing 48in DR17
MAIN-50	01-0780	01-0790	196.93	42.013	135	0	Open	;Existing 48in DR17
MAIN-55	01-0840	01-0850	450.14	42.013	135	0	Open	;Existing 48in DR17
MAIN-54	01-0830	01-0840	98.42	42.013	135	0	Open	;Existing 48in DR17
MAIN-53	01-0810	01-0830	75.56	42.013	135	0	Open	;Existing 48in DR17
MAIN-56	01-0850	01-0860	156.66	42.013	135	0	Open	;Existing 48in DR17
MAIN-52	01-0800	01-0810	293.33	42.013	135	0	Open	;Existing 48in DR17
ROGERS-45	N-27	N-26	210.11	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-65	N-25	04-0580	5.37	9.66	135	0	Open	;Proposed 10in DR21
ROGERS-66	04-0580	04-0590	54.67	9.66	135	0	Open	;Proposed 10in DR21
ROGERS-67	04-0590	04-0610	0.05	9.66	135	0	Open	;Proposed 10in DR21
ROGERS-10	N-12	N-11	141.15	28.04	135	0	Open	;Proposed 30in DR32.5
RILEY-7	N-5	RILEY_SUB_HG	61.18	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-SUB-3	N-33	N-32	178.00	8.06	135	0	Open	;Proposed 8in DR32.5
RILEY-SUB-6	N-4	07-2050	233.25	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-7	07-2050	N-3	536.79	10.05	135	0	Open	;Proposed 10in DR32.5
RILEY-SUB-14	N-2	N-1	255.06	8.06	135	0	Open	;Proposed 8in DR32.5
ROGERS-4	N-17	N-16	37.87	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-6	N-15	N-14	134.15	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-8	N-34	N-13	0.40	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-9	N-13	N-12	49.88	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-11	N-11	N-10	60.06	28.04	135	0	Open	;Proposed 30in DR32.5
ROGERS-13	N-9	RILEY_HG	76.40	28.04	135	0	Open	;Proposed 30in DR32.5
RILEY-1	RILEY_HG	N-31	16.31	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-14	RILEY_HG	04-0050	26.62	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-16	N-30	N-29	50.68	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-18	N-28	04-0120	931.63	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-19	04-0120	04-0150	1610.96	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-23	04-0180	ROGERS_SUB_Tee	314.15	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-22	04-0170	04-0180	410.74	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-21	04-0160	04-0170	185.91	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-20	04-0150	04-0160	40.73	22.44	135	0	Open	;Proposed 24in DR32.5
ROGERS-28	04-0260	04-0270	737.58	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-25	04-0230	04-0240	95.82	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-27	04-0250	04-0260	9.49	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-26	04-0240	04-0250	326.63	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-24	ROGERS_SUB_Tee	04-0230	830.33	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-31	04-0285	04-0290	62.03	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-32	04-0290	04-0300	588.73	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-30	04-0280	04-0285	308.24	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-29	04-0270	04-0280	373.28	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-33	04-0300	04-0310	149.90	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-35	04-0320	04-0350	320.71	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-39	04-0360	04-0370	138.03	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-36	04-0350	04-0340	3.19	16.53	135	0	Open	;Proposed 18in DR26
ROGERS-37	04-0340	04-0330	0.79	16.53	135	0	Open	;Proposed 18in DR26
ROGERS-38	04-0330	04-0360	424.10	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-34	04-0310	04-0320	99.33	18.70	135	0	Open	;Proposed 20in DR32.5
ROGERS-43	04-0425	04-0420	9.72	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-42	04-0390	04-0425	132.64	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-44	04-0420	N-27	320.55	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-40	04-0370	04-0380	40.64	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-41	04-0380	04-0390	594.86	16.83	135	0	Open	;Proposed 18in DR32.5
ROGERS-46	N-26	04-0430	98.27	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-48	04-0440	04-0450	354.06	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-47	04-0430	04-0440	126.30	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-51	04-0470	04-0480	20.77	12.86	135	0	Open	;Proposed 14in DR26
ROGERS-50	04-0460	04-0470	582.32	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-49	04-0450	04-0460	234.98	14.70	135	0	Open	;Proposed 16in DR26
ROGERS-54	04-0500	04-0507	416.20	11.71	135	0	Open	;Proposed 12in DR26
ROGERS-53	04-0490	04-0500	598.37	12.86	135	0	Open	;Proposed 14in DR26
ROGERS-52	04-0480	04-0490	500.77	12.86	135	0	Open	;Proposed 14in DR26
ROGERS-55	04-0507	04-0505	16.84	11.71	135	0	Open	;Proposed 12in DR26
ROGERS-59	04-0530	04-0535	158.10	11.46	135	0	Open	;Proposed 12in DR21
ROGERS-58	04-0520	04-0530	485.91	11.46	135	0	Open	;Proposed 12in DR21
ROGERS-57	04-0510	04-0520	1005.47	11.46	135	0	Open	;Proposed 12in DR21
ROGERS-60	04-0535	04-0540	375.69	11.46	135	0	Open	;Proposed 12in DR21
ROGERS-56	04-0505	04-0510	1.81	11.71	135	0	Open	;Proposed 12in DR26
ROGERS-63	04-0560	04-0570	559.85	9.66	135	0	Open	;Proposed 10in DR21
ROGERS-62	04-0550	04-0560	482.29	9.66	135	0	Open	;Proposed 10in DR21
ROGERS-61	04-0540	04-0550	346.91	11.46	135	0	Open	;Proposed 12in DR21
ROGERS-64	04-0570	N-25	406.23	9.66	135	0	Open	;Proposed 10in DR21

MAIN-3	NC-1_HG	1	321.37	50.477	135	0	Open	;Existing 54in DR32.5
MAIN-4	1	2	1979.98	33.651	135	0	Open	;Existing 36in DR32.5
MAIN-5	1	2	1978.45	33.651	135	0	Open	;Existing 36in DR32.5
MAIN-17	01-0160	3	49.96	44.869	135	0	Open	;Existing 48in DR32.5
MAIN-47	4	01-0760	99.68	42.013	135	0	Open	;Existing 48in DR17
KOTZMAN-2	02-0010	6	762.82	22.44	135	0	Open	;Existing 24in DR32.5
KOTZMAN-3	6	8	905.46	16.83	135	0	Open	;Existing 18in DR32.5
KOTZMAN-5	10	02-0100	1986.67	11.92	135	0	Open	;Proposed 12in DR32.5

[PUMPS]

;ID	Node1	Node2	Parameters	
297	NC-1_HG	9	HEAD Cu-1	;NC-1 Booster Pump
299	N-23	11	HEAD Cu-2	;Proposed Booster Pump

[VALVES]

;ID	Node1	Node2	Diameter	Type	Setting	MinorLoss	
294	5	N-23	42.013	PRV	1	0	;Hydroelectric Station

[TAGS]

[DEMANDS]

;Junction	Demand	Pattern	Category

[STATUS]

;ID	Status/Setting

[PATTERNS]

;ID	Multipliers

[CURVES]

;ID	X-Value	Y-Value
;PUMP: NC-1 Booster Pump		
Cu-1	155.51	67.6
Cu-1	155.53	67.5
;PUMP: Proposed Booster Pump at Hydro		
Cu-2	18142.73	78.55
Cu-2	18142.75	78.53

[CONTROLS]

[RULES]

[ENERGY]

Global Efficiency	75
Global Price	0
Demand Charge	0

[EMITTERS]

;Junction	Coefficient

[QUALITY]

;Node	InitQual

[SOURCES]

;Node	Type	Quality	Pattern

[REACTIONS]

;Type	Pipe/Tank	Coefficient

[REACTIONS]

Order Bulk	1
Order Tank	1
Order Wall	1
Global Bulk	0
Global Wall	0
Limiting Potential	0
Roughness Correlation	0

[MIXING]

;Tank	Model

[TIMES]

Duration	0:00
Hydraulic Timestep	1:00
Quality Timestep	0:05
Pattern Timestep	1:00
Pattern Start	0:00
Report Timestep	1:00
Report Start	0:00
Start ClockTime	12 am
Statistic	NONE

[REPORT]

Status	No
Summary	No
Page	0

[OPTIONS]

Units	GPM
Headloss	H-W
Specific Gravity	1
Viscosity	1
Trials	40
Accuracy	0.001
CHECKFREQ	2
MAXCHECK	10
DAMPLIMIT	0
Unbalanced	Continue 10
Pattern	1
Demand Multiplier	.778
Emitter Exponent	0.5
Quality	None mg/L
Diffusivity	1
Tolerance	0.01

[COORDINATES]

;Node	X-Coord	Y-Coord
07-2010	4707995.52	888636.34
07-2020	4707802.36	888954.88
07-2030	4707669.62	889219.71
07-2040	4707868.82	889843.45
07-2050	4707735.65	890981.86
07-2060	4707492.63	891472.32
07-2090	4707046.15	892243.34
07-2100	4706933.20	892839.56
07-2110	4706817.96	892973.90
07-2120	4706606.18	892864.07
07-2130	4706333.13	893038.75
01-0020	4711233.51	885461.86
01-0050	4711598.75	886266.50
01-0060	4711815.23	886499.99
01-0070	4711962.52	886729.32
01-0080	4712021.18	886812.64
01-0090	4712063.97	886881.49
01-0100	4712169.96	887014.74
01-0140	4712122.53	886979.36
01-0150	4712463.45	887194.14
01-0160	4712557.00	887292.20
01-0210	4713688.33	888678.16
01-0310	4713776.11	889461.08
01-0340	4713774.52	890228.28
01-0350	4713739.86	890431.01
01-0360	4713692.56	890532.44
01-0370	4713517.78	890659.10
01-0380	4713389.11	890748.16
01-0400	4713430.17	891152.79
01-0450	4713560.07	891309.69
01-0470	4713601.02	891710.23
01-0480	4713605.45	891731.68
01-0490	4713599.63	891836.69
01-0520	4713777.85	892239.76
01-0530	4713846.99	892335.50
01-0540	4713908.17	892477.05
01-0560	4713974.06	892525.23
01-0580	4714129.85	892601.25
01-0600	4714181.73	894104.93
01-0610	4714292.95	894852.48
01-0640	4714274.77	894856.33
01-0660	4714118.21	895289.83
01-0670	4714107.71	895587.01
01-0680	4714137.54	895672.05
01-0690	4714172.39	895716.16
01-0700	4714177.79	895720.94
01-0720	4714557.53	895907.12
01-0730	4714681.91	896104.78
01-0750	4715148.35	896348.49
01-0760	4715620.95	897033.73
01-0770	4716252.01	897323.88
01-0780	4716785.16	897513.46
01-0790	4716691.97	897682.40
01-0800	4716721.92	897883.67
01-0810	4716630.53	898149.18
01-0830	4716635.24	898224.59
01-0840	4716641.09	898322.84
01-0850	4716845.10	898712.21
01-0860	4716872.14	898865.48
01-1030	4714672.77	902856.94
01-1040	4713147.96	903641.83
01-1045	4713144.73	903645.33

01-1050	4712248.73	904909.20
01-1060	4712398.72	906379.13
01-1100	4712274.10	907153.26
01-1110	4712044.44	907672.04
01-1150	4712752.78	908101.91
01-1160	4712752.67	908102.32
01-1170	4712721.47	909367.16
01-1220	4712191.02	910000.68
01-1230	4712038.37	910100.49
01-1250	4711834.27	910781.33
01-1270	4711804.85	910892.57
01-1300	4711743.42	911090.85
01-1320	4711685.47	911252.13
01-1330	4711660.02	911686.51
01-1340	4711556.88	912353.22
01-1410	4711451.04	912672.49
01-1420	4711267.92	913590.78
01-1430	4711242.87	913722.91
01-1440	4711146.90	914622.60
01-1450	4711112.81	914701.92
01-1460	4710998.38	915219.34
01-1470	4711610.42	916070.86
01-1480	4711975.61	916271.90
01-1500	4712456.53	916294.74
01-1520	4712858.92	916830.15
01-1530	4713053.86	917110.88
01-1550	4713270.32	917367.72
01-1580	4713542.11	917623.87
01-1590	4713576.06	917689.85
01-1600	4714174.49	918563.73
01-1610	4714188.10	918597.66
01-1620	4714494.34	918905.37
01-1625	4714764.74	919526.58
01-1630	4714855.80	919792.77
01-1650	4714862.99	919811.48
01-1720	4715402.12	921285.95
01-1730	4715499.07	921587.84
01-1740	4715502.51	921594.53
01-1750	4718212.57	922632.51
01-1760	4718212.76	922632.47
01-1800	4719624.19	922826.66
01-1810	4719631.85	922834.90
01-1820	4719659.55	922893.30
01-1830	4719792.26	923715.82
01-1840	4719789.69	923719.37
01-1850	4719688.80	924189.76
02-0010	4710298.64	882330.13
02-0100	4713967.46	883629.34
03-0050	4709687.45	883678.24
03-0060	4709317.59	884038.54
03-0070	4709226.99	884591.07
03-0080	4708625.29	884696.29
04-0010	4710908.75	885748.98
04-0030	4710698.16	886438.61
04-0050	4709789.20	887261.30
04-0120	4709824.39	890165.85
04-0150	4709797.24	891359.95
04-0160	4709776.36	891394.66
04-0170	4709811.46	891565.52
04-0180	4709885.29	891957.94
04-0230	4709198.69	892740.80
04-0240	4709111.04	892773.49
04-0250	4708901.68	893007.94
04-0260	4708895.08	893014.76
04-0270	4708486.25	893544.39
04-0280	4708496.57	893850.62
04-0285	4708564.24	894132.46
04-0290	4708532.84	894184.33
04-0300	4708701.01	894680.17
04-0310	4708831.43	894730.49
04-0320	4708881.76	894810.16
04-0330	4708912.12	895097.43
04-0340	4708912.48	895096.72
04-0350	4708913.82	895093.82
04-0360	4708984.95	895420.64
04-0370	4708865.69	895489.17
04-0380	4708835.93	895516.74
04-0390	4708456.04	895937.77
04-0420	4708443.47	896073.59
04-0425	4708441.54	896064.06
04-0430	4708353.88	896653.35
04-0440	4708421.20	896747.29
04-0450	4708318.52	897067.67
04-0460	4708189.40	897244.71
04-0470	4708211.79	897758.41
04-0480	4708221.00	897776.96
04-0490	4708115.47	898233.68

04-0500	4708302.89	898785.27
04-0505	4708357.08	899193.00
04-0507	4708366.30	899181.56
04-0510	4708355.32	899193.42
04-0520	4707430.22	899295.09
04-0530	4707462.65	899745.10
04-0535	4707568.82	899837.69
04-0540	4707681.76	900155.44
04-0550	4707618.61	900462.98
04-0560	4707672.74	900892.72
04-0570	4707632.34	901331.02
04-0580	4707625.53	901721.11
04-0590	4707574.25	901734.92
04-0610	4707574.21	901734.95
05-0010	4710361.20	893276.77
05-0040	4710838.45	893892.95
05-0041	4710839.08	893893.89
05-0050	4710845.64	893905.16
06-0010	4709297.50	887641.10
06-0020	4708914.33	888217.19
06-0040	4708111.30	888444.74
06-1010	4707908.96	888463.24
06-1015	4707726.60	888483.30
06-1020	4707504.59	888485.13
06-1030	4707337.95	888587.42
06-1040	4707292.40	888635.91
06-1050	4707295.50	888631.22
06-1060	4706993.12	888591.26
06-1065	4706948.47	888560.33
06-1070	4706871.63	888375.46
06-1080	4706517.16	888333.29
06-1090	4706472.37	888382.25
06-1095	4706375.16	888416.61
06-1100	4705814.44	888366.27
06-1110	4705806.60	888359.15
06-1130	4705790.62	887966.59
06-1140	4705790.59	887964.94
06-1150	4705626.34	887655.16
06-1160	4705600.04	887632.70
06-1210	4705462.41	887613.43
06-1230	4705407.00	887610.34
06-1250	4705289.13	887573.97
06-1255	4705108.33	887424.32
06-1260	4705079.95	887420.57
06-1270	4704870.87	887317.16
06-1280	4704785.47	887316.92
06-1290	4704691.35	887333.78
06-1300	4704664.27	887338.34
08-0020	4717066.01	905696.44
08-0040	4718535.84	906455.09
09-0005	4712347.49	904158.67
09-0010	4711783.75	904867.33
09-0020	4711780.76	905164.60
09-0030	4711556.00	905315.73
09-0040	4711245.37	905237.68
09-0050	4711167.32	905266.87
09-0060	4710734.11	905539.49
09-0070	4710336.00	905651.44
09-0080	4710331.52	905653.38
09-0085	4709754.51	905530.67
09-0090	4709736.17	905535.11
09-0100	4709472.94	905482.21
09-0150	4708991.05	905536.47
09-0170	4708385.09	905663.21
09-0180	4708384.79	905663.42
09-0200	4708384.42	905663.96
09-0210	4708467.33	906834.09
09-0220	4708293.27	907002.64
09-0230	4708210.26	907580.45
09-0240	4708210.04	907585.57
09-0250	4707978.56	908375.98
09-0260	4707962.57	908422.51
09-0270	4707906.42	909269.11
09-0300	4707682.70	909434.17
09-0350	4707640.73	909819.27
10-0130	4714155.53	909514.59
10-0140	4714278.01	909518.81
10-0150	4716649.89	909366.55
10-0160	4716902.05	909405.27
10-0170	4717319.22	909494.96
10-0180	4717632.90	909521.52
10-0190	4717896.80	909616.39
10-0200	4717902.79	909619.98
11-0010	4710237.11	912974.64
11-0020	4710158.01	913706.75
11-0030	4709994.63	913744.85
11-0040	4709327.74	913832.30

11-0050	4709307.53	913826.53
11-0060	4709021.82	913771.54
11-0065	4709015.45	913769.56
11-0070	4708978.72	913741.77
11-0080	4708169.03	913737.81
11-0090	4707738.39	914430.93
11-0100	4707743.01	915034.94
12-0050	4715447.65	922604.83
12-0100	4715452.07	922606.39
BUTTE_HG	4712715.02	909382.48
DESCHUTES_HG	4716032.16	901988.79
ELDER_HG	4712669.51	904066.81
FRAKES_HG	4711659.01	911701.19
KOTZMAN	4710276.46	882295.15
MICKELSON_HG	4715345.32	920949.92
N-1	4706344.65	893030.10
N-10	4710151.87	886932.91
N-11	4710201.27	886911.15
N-12	4710277.44	886792.31
N-13	4710305.79	886751.27
N-14	4710350.31	886667.40
N-15	4710393.37	886547.95
N-16	4710536.67	886481.03
N-17	4710565.69	886456.71
N-19	4716471.82	882718.18
N-2	4706535.49	892890.06
N-20	4716565.83	882675.73
N-21	4717975.37	882634.97
N-22	4707492.77	885499.48
N-23	4717017.08	900695.20
N-24	4719500.01	906856.56
N-25	4707630.89	901721.07
N-26	4708364.38	896556.17
N-27	4708351.71	896362.42
N-28	4709846.78	889251.83
N-29	4709916.51	887800.99
N-3	4707483.42	891271.19
N-30	4709928.27	887751.83
N-31	4709762.03	887252.90
N-32	4710564.12	893476.03
N-33	4710533.52	893305.42
N-34	4710306.01	886750.94
N-4	4707820.20	890802.03
N-5	4708091.88	888447.29
N-6	4706523.67	888236.93
N-7	4706872.83	888219.27
N-8	4709026.91	888113.83
N-9	4709795.28	887172.11
NC-1_HG	4710265.80	882911.08
RILEY_HG	4709773.58	887241.56
RILEY_SUB_HG	4708031.01	888453.44
ROGERS_HG	4711222.07	885406.35
ROGERS_SUB_Tee	4709750.40	892229.54
1	4710325.63	883207.52
2	4711052.82	884673.36
3	4712578.25	887337.35
4	4715537.54	896979.75
5	4717022.77	900675.11
6	4710686.72	882761.10
8	4711079.93	883312.99
9	4710240.40	882910.72
10	4712852.48	884773.13
11	4717008.85	900711.92
7	4709511.51	879386.95

APPENDIX C
PIPE BUDGET ESTIMATES FROM VENDORS

From: **Theetge, Mark A** <Mark.Theetge@hdsupply.com>
Date: Thu, Sep 15, 2016 at 8:55 AM
Subject: RE: Swalley Pipe Lengths
To: Kevin Crew <blackrockci@gmail.com>

Great to hear! I have attached basic pricing that I may end up refining for my own interest and share that later. The cost that I have used is based on actual footage which could include partial loads. The freight cost I have included is for the furthest distance which would be Kingman AZ. I have also included cost for a tech and equipment to weld the material. I used current project pricing levels and a conservative mark up about 12%. All of this could change with the market so for basic estimation only!!

If it was my district I might want to include cost for fusion equipment purchase in the cost of the project. For material 24" and down or possibly 18" and down based on the cooperation of other districts. Given Marc has a 36" machine and since there is not a whole lot of larger pipe it would make sense to rent possibly. Just a thought?

Thanks,

Mark A. Theetge

Fusible Plastics Specialist

HD Supply WaterWorks

M 503 341 3614

F 855 222-0361

	Proposed DR32.5		Proposed DR26		Proposed DR21	
54in	0.00		0.00		0.00	
48in	2,094.13	$105.50	0.00		0.00	
42in	4,559.92	$81.92	0.00		0.00	
36in	6,708.70	$62.89	0.00		0.00	
34in	1,932.25	$54.73	0.00		0.00	
32in	830.58	$4,703	0.00		0.00	
30in	2,558.88	$42.15	0.00		0.00	
28in	3,085.71	$37.05	1,664.91	$44.98	0.00	
26in	0.00	$0.00	2,745.63	$39.95	0.00	
24in	5,727.49	$26.86	2,533.51	$32.98	0.00	
22in	0.00	$0.00	0.00		0.00	
20in	6,350.76	$19.45	1,282.68	$24.15	0.00	
18in	5,644.83	$15.41	347.84	$23.97	319.85	$28.14
16in	2,295.26	$15.27	1,926.59	$15.61	3,038.68	$22.13
14in	9,163.29	$9.48	1,119.91	$12.78	1,565.95	$13.77
12in	8,351.11	$7.81	4,588.71	$9.56	2,437.56	$11.35
10in	9,020.98	$5.82	2,197.32	$7.23	2,380.32	$8.75
8in	13,531.69	$3.93	4,736.81	$4.68	525.96	$10.16