The City of Penticton

City of Penticton
IRRIGATION MASTER PLAN

Final Report

SEPTEMBER 2009

USL Reference No. 1017.0055.01

URBANSYSTEMS.

2353 - 13353 Commerce Parkway, Richmond, BC V6V 3A1
Telephone: 604-273-8700 Fax: 604-273-8752

URBANSYSTEMS.

September 29, 2009 File: 1017.0055.01-C1

City of Penticton
171 Main Street
Penticton, BC V2A 5A9

VIA EMAIL: ian.chapman@penticton.ca

Attention: Ian Chapman, P.Eng.

RE: Irrigation Master Plan Final Report

Enclosed please find a copy of the Irrigation Master Plan Final Draft Report. We have incorporated comments received from the City and from Ted van der Gulik. We have also included additional text on the source water capacity for these two systems. It is noted that there is no current information that can be used to assess the storage capacity of either system. In our report we have recommended that this assessment be completed and that continuous monitoring equipment be installed on the City reservoirs in order to gain a better understanding on the response of these reservoirs to changing climatic conditions.

Yours truly,

URBAN SYSTEMS LTD.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S. D. BRUBACHER #27232

Jun 30, 2014

Jonathan Lowe, EIT
Water & Wastewater Engineer
/sb

Steve Brubacher, P.Eng.
Principal

cc. Carolyn Stewart – City of Penticton
Ted van der Gulik – Sustainable Agriculture Management Branch
Ron Fretwell – RHF Systems Ltd.

U:\Projects_VAN\1017\0055\01\C-Correspondence\C1-Client\2009-09-29 Ltr to City.doc

EXECUTIVE SUMMARY

The City of Penticton currently operates and maintains two dedicated irrigation systems that provide water to agricultural uses within the City. The purpose of this plan is to evaluate and identify and long term strategy for the operation and maintenance of these systems and to help the City understand the impacts that changes in crops and climate may have on this important utility.

Both of these systems were constructed in the late 1960's under funding provided by the federal government through the Agriculture and Rural Development Act. The provision of irrigation water is distributed through allotments assigned to each parcel connected to the system. The following table summarizes the characteristics of both systems.

	North System	South System
Irrigable Area (Roll)	1,508 Acres	303 Acres
2006 Active Irrigated Area	551 Acres	157 Acres
Parcels Serviced	308	84
Water License	5,412 ML/year	2,558 ML/year

A water requirement analysis was conducted utilizing the water/climate model developed for the Okanagan Basin Water Board. Scenarios were evaluated to determine if changing all crops to high water use crops and climatic changes anticipated over the next 100 years would result in water shortages for the irrigation users. It was also evaluated to see if additional land could be added to the irrigation role. In conjunction with the water requirement analysis a hydraulic model was created of the distribution system to determine if the existing system has capacity to support irrigating all parcels simultaneously and also to determine the ability to service new lands.

Both of these models confirmed that adequate source and hydraulic conveyance capacity exists to support the existing users under all scenarios up to a 1:10 year drought for the North System and greater than a 1:200 drought for the South System. However, there may not be sufficient source capacity in the North System to meet the needs of the full irrigation roll and growth under the combination of both crop change to 100% apples and climate change. Our assessment on source capacity has been limited to considering the annual volumes and has not included an evaluation of existing storage volumes to meet variations in demands over the growing season.

A financial analysis was completed to determine the capital and operating costs of the irrigation water systems over the next 50 years. Based on this review it was determined that within the next 25 years approximately $9.1 Million will need to be spent on capital improvements to the existing system. This primarily includes replacing aging infrastructure but also includes $1.4 Million for the installation of universal water metering and $0.6 Million for the meter maintenance and replacement needs over the next 25 years. Annual operating costs are estimated at $400,000/year. This brings the average annual funding requirement to $764,000/year (excluding any borrowing costs). Based on a roll of 1,811 acres this correlates to $422/acre/year. Current water rates are set at $133/acre/year.

Nine Okanagan based communities who operate and maintain irrigation water systems were contacted to determine how they handle irrigation pricing and metering. Eight of the nine communities meter their irrigation customers with a primary purpose of providing information to the farmers in making their agricultural practices more water efficient. All of the communities recognize that they subsidize the cost of providing water to irrigation users on the premise that agriculture is a benefit to the community.

Community	Flat Rate ($/acre/year)
Penticton (2009)	$133.00
RDOS (2008)	$240.00
Kaleden I.D. (2008)	$139.40
SEKID (2009)	$63.00
Glenmore/Ellison (2009)	$43.00-54.80
Westbank (2009)	$63.94
Summerland (2009)	$84.70-128.84 $278.18 (greenhouse)
Black Mountain (2009)	$51.00-68.00
Peachland (2009)	$95.27
Lake Country (2009)	$73.50
Greater Vernon (2009)	$85.21

Two approaches to funding the irrigation water systems are presented which range from a subsidy approach similar to that used today through to full cost recovery where the irrigation users pay the full cost of the services that they receive.

It is recommended that the City evaluate the alternatives presented for funding the shortfall and in consultation with the irrigation users adopt a funding policy that will ensure the long term viability of the irrigation water systems. It is also recommended that the City proceed with installing water meters so as to provide a tool to assist the farmers in optimizing their farming practices to help ensure efficiency in the amount of water extracted from the Ellis and Penticton Creeks. Finally it is recommended that the City review the runoff projections and storage capacity on both systems, in consultation with the Okanagan Basin Water Board to confirm that adequate storage exists to meet the future flow requirements and that the City install continuous flow monitoring equipment on all of its reservoirs in order to improve water management capabilities.

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

The City of Penticton currently operates and maintains three distinct water systems in order to satisfy the water requirements of the residents of the City. The treated water system obtains water from Penticton Creek and Okanagan Lake and following treatment provides water for domestic uses in the City as well as commercial, industrial and institutional uses. The City also operates two dedicated irrigation systems that provide water to the agricultural uses within the City. The North Penticton Irrigation System obtains water from Penticton Creek while the South Penticton Irrigation System obtains water from Ellis Creek. Neither of these systems have any form of treatment or disinfection since water is not intended for human consumption.

This plan is focused on evaluating and identifying a long term strategy for the operation and maintenance of the two dedicated irrigation systems and to provide the City with a better understanding on how changes in agricultural crops and practices combined with climate change may impact this important utility.

The preparation of the plan could not be possible without the contributions of the following individuals from the provincial and federal governments:

Ted van der Gulik, P.Eng.
Sustainable Agriculture Management Branch, BC Ministry of Agriculture and Lands

Denise Neilsen, Ph.D.
Agriculture and Agri-Food Canada

Scott Smith, M.Sc.
Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada

2.0 BACKGROUND

2.1 Watershed Context

PENTICTON CREEK

The Penticton Creek watershed reaches a maximum elevation of 2,130m with its headwaters located to the east/northeast of Penticton. Flowing though a broad forested valley in the upper reaches, Penticton Creek enters the Greyback Reservoir, 10km east of Penticton, at an elevation of approximately 1,650m. Over the next 16 km the valley gradually narrows into a deep canyon until an elevation of 670m where untreated water from Penticton Creek is diverted to Campbell Mountain Diversion Dam, the source of the North Penticton Irrigation System. Penticton Creek continues and flows southward through a narrow canyon and into Penticton #2 Dam on the eastern city limits at an elevation of 470m where there is an intake to the City's Water Treatment Plant. Leaving the dam, the creek enters an open sloping hillside and continues down through the City of Penticton.

Annual rainfall in the region between 1994 and 2004 ranged between 580mm to 840mm with approximately half falling as snow[1]. The watershed covers an area of 17,391 hectares. Historical flow records from 2006 show the flow in Penticton Creek to range from an average of 370L/s in October to 2,025L/s in May. The total allotment for the North System is 533L/s. This flow would only be realized if all farmers were to irrigate all of their allotted land at the same time. Typically irrigation systems are designed to extract the allotted application rate whenever they are turned on. However, for an area of this size the total peak demand would likely only be realized if a single crop type was grown. Different crops require water at different times of the growing season and different irrigation methods are more or less efficient thereby requiring a greater duration of watering. The peak daily demand on this system during 2004-2006 was 317 L/s.

The City's water licenses for irrigation purposes allow for a maximum withdrawal of 5,412 ML/year from Penticton Creek. The average annual usage from 2004 to 2006 was just 37% of this at 1,980 ML/year.

ELLIS CREEK

Located at the south end of Okanagan Lake, to the east of Penticton, the Ellis Creek watershed extends up to an elevation of approximately 1,980m. Passing down through broad forested valleys it narrows in its lower reaches and flows through the City of Penticton before discharging into Okanagan River located between Okanagan and Skaha Lakes. A series of dams are located within the watershed – Ellis Dam #2 is located on South Ellis Creek at an approximate elevation of 1,490m, Ellis Dam #4 is located on the

[1] Wrinkler R. et al, (2004) *Upper Penticton Creek: How Forest Harvesting Affects Water Quantity and Quality.* Steamline: Watershed Management Bulletin. Vol. 8/No. 1. Fall Issue.

main stem of Ellis Creek at an approximate elevation of 1,335m while Ellis Creek Diversion Dam, the source of the South Penticton Irrigation System, is located downstream of the Ellis/South Ellis confluence at an approximate location of 465m.

The watershed covers an area of 15,292 hectares. The total allotment for the South Penticton Irrigation System based upon connected parcel allotments is 107L/s. The peak daily demand on this system during 2004-2006 was 126 L/s. Through discussions with the City is has been confirmed that historically portions of Skaha Park have been irrigated with water from the Irrigation Systems. This area is currently not included in the agricultural role allotment and may have attributed to the elevated recorded flows. The City is presently working on irrigating this park with treated effluent from the waste water treatment plant and as such future irrigation from the irrigation system will not be required. Other possible factors which may have contributed to the peak flows include:

- Leaks in the South Penticton Irrigation System;
- Farmers using more than their allotment; or
- Inaccurate meter readings.

The City's water licenses for irrigation purposes allow for a maximum withdrawal of 2,558 ML/year from Ellis Creek. The average annual usage from 2004 to 2006 was just 19% of this at 491 ML/year.

2.2 Design and Construction of the Irrigation Systems

NORTH PENTICTON IRRIGATION SYSTEM

The Campbell Mountain Diversion was constructed between 1966 and 1967 and consists of a 3km tunnel through which a 915mm steel pipe transports water to a 31 ML diversion reservoir. The Penticton Reservoir at an elevation of 584m provides sufficient head to supply the demands of the North Penticton Irrigation System. The irrigation system pipework is constructed of a variety of materials; asbestos cement, cast iron, galvanized iron, PVC and steel with asbestos cement and PVC serving areas with pressures less than approximately 1,030 kPa (150psi).

Each lot connected to the north irrigation system is also allocated a unit application rate based upon the soil types within the property and range from 0.13 to 0.18 L/s/hectare (5 to 7 USGPM/acre) for the defined irrigable area. There are 4 pressure reducing stations; Lochore Road (50mm), Three Mile Road (50mm), Lower Bench Road (100mm) and Pearson Road (100mm).

All cast iron, asbestos cement, and galvanized iron pipes are approaching the end of their useful life with replacement scheduled to begin in 2020. Steel pipework was installed in 1967 and is understood to be in satisfactory condition. Replacement, particularly of the transmission line linking the source to the distribution system, will take place between 2020 and 2060 and is assumed to be completed by slip lining the existing 900mm steel pipe (located within the Campbell Mountain tunnel) with 750mm DR17 HDPE pipe. The PVC mains have been installed within the last 10 years (averaging a 5 year life) and have been estimated to have an average remaining useful life of 70 years. **Table 1** presents the assumed installation life for the various pipe materials installed along the irrigation systems. These have been established in consultation with the City.

Table 1: Pipe Replacement Schedule

Pipe Material	Life Expectancy (Average)
Asbestos Cement	65
Cast Iron	65
Galvanized Iron	65
PVC	75
Steel	75

SOUTH PENTICTON IRRIGATION SYSTEM

Ellis Creek Diversion Dam is an earth fill dam constructed in 1966 and commissioned in 1967. A concrete spillway holds back the 6.2 ML diversion pond covering an area of 0.3 ha. Water is gravity fed to the irrigation system below via a combination of cast iron and PVC pipe. The irrigation system pipework is constructed of a variety of materials; asbestos cement, cast iron, galvanized iron and PVC with asbestos cement and PVC serving areas with pressures less than approximately 1,030 kPa (150psi).

Each lot connected to the irrigation system is allocated a unit application rate based upon the soil types within the property and range from 0.13 to 0.18 L/s/hectare (5 to 7 USGPM/acre) for the defined irrigable area. There is one pressure reducing station located near the end of Brantford Ave.
All cast iron, asbestos cement, and galvanized iron pipes are approaching the end of their useful life with replacement scheduled to begin in 2020. The PVC mains have been installed within the last 10 years (averaging a 5 year life) and have a remaining useful life of 70 years. Replacement schedule for the various pipe materials installed along the irrigation systems will be the same as that presented in the above table.

2.3 Policies and Bylaws

The City has established Bylaw 2005-02 Irrigation, Sewer and Water Bylaw to govern the provision of all municipal water services including services provided by the North and South Irrigation Systems. Within this bylaw (and amendments to this bylaw) the service area of the irrigation water systems is established. According to this bylaw the irrigation systems are only to be used to supply untreated irrigation water for the purposes of irrigation, for the purposes of fire protection and when supply conditions permit for the filling of the water storage systems.

It is our understanding that the provision of water for fire protection is a service that the City has added to the irrigation system to supplement water that can be provided by the treated water system. The irrigation system has not been designed to provide a defined level of fire protection coverage and it is our understanding that no upgrading will be done to the irrigation system in order to meet fire protection standards.

According to the bylaw, water is only permitted to be supplied to properties that are within the irrigation water area and are on the City Irrigation Roll unless otherwise approved by the City. The bylaw prohibits individual users from selling, giving or distributing irrigation water to any other person.

The City explicitly does not guarantee irrigation water pressure or continuous supply. Furthermore the bylaw gives the City the ability to impose water conservation restrictions. The City commits to distributing the water as equitably as possible and is authorized to rotate the delivery of the irrigation water as necessary. No new connections are permitted to the Irrigation Water System that prejudicially affects the prior rights of any parties to the use of the water.

The bylaw permits the City to charge customers of the irrigation water system on three mechanisms: a per hectare charge for the irrigable area shown on the irrigation role; and/or a volumetric charge based on the volume of water used; and/or a standalone negotiated agreement. It is our understanding that all customers are currently charged on the basis of a flat rate per hectare of irrigable area.

At the present time the City of Penticton operates its irrigation and treated water systems administratively as a single utility. While separate annual operating budgets are established for the irrigations systems and the treated water system, all revenues are collected and pooled. A single capital reserve fund has been established to fund capital upgrades and repairs in both the irrigation and treated water systems. In other words this system provides the City with the ability to subsidize the rates of the irrigation system with revenues from the treated water system users. We are not aware of any City policy that requires the irrigation user rates to fully cover the costs of the service provided by the irrigation systems. This is discussed in further detail later in the report.

3.0 OBJECTIVES OF THE MASTER PLAN

There are a number of key objectives that this master plan is intended to address:

1) To confirm service level objectives for the existing Irrigation Systems;

2) To evaluate the performance of the existing systems today and identify gaps in meeting the service level objectives;

3) To evaluate the potential source and distribution system impacts of agricultural practices and climate change on the ability to service the existing users;

4) To evaluate the capacity of the source and distribution systems to service expanded irrigated agricultural lands within the City;

5) To provide recommendations on improving the effectiveness of governance and financial sustainability of the irrigation water systems; and

6) To provide a list of recommended capital projects together with recommended financial cost recovery strategy to cover both anticipated capital and operating costs.

4.0 SERVICE LEVEL OBJECTIVES

The following level of service commitments form the basis of the assessments of the existing irrigation systems and provide a context for determining what gaps exist and what improvements are required to eliminate these gaps. The National Guide to Sustainable Municipal Infrastructure Best Practice titled "Developing Levels of Service" provides the following definition for levels of service:

Levels of service reflect social and economic goals of the community and may include any of the following parameters: safety, customer satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost, and availability. The defined levels of service are any combination of the above parameters deemed important by the municipality.

WATER QUANTITY

a. Under normal supply conditions adequate water will be supplied to meet the allotment of each property.

b. Under drought conditions priority will be given to meeting the indoor domestic needs of the City residents first.

c. Adequate water is defined as sufficient water to meet the reasonable needs of each user. Water wastage will not be encouraged or supported.

d. Water will be supplied at appropriate pressures for the above uses.

SYSTEM RELIABILITY

a. All systems will be designed and operated to account for predicable failure events with minimal interruption to water service delivery.

b. Systems will be operated and maintained in accordance with condition levels established in the City's asset management program.

5.0 METHODOLOGY

5.1 Distribution System Model Compilation

Computer models for each of the north and south irrigation systems were created using WaterCAD Version 8 based upon an as-built drawing provided by the City of Penticton on July 5th, 2007. This drawing was also used to extract pipe materials, pipe sizes and demand allocations using ArcGIS software.

Parcels were grouped into "Demand Areas" with the total irrigable demand from each area assigned to a common node on the irrigation system network within the model. The elevations for each of the nodes were assigned based upon the surface elevations within the Digital Elevation Model (DEM) for the City of Penticton using tools in ArcGIS.

Both irrigation systems contain PRVs and the settings for each within the model were as presented in **Table 2** below according to the information provided by the City of Penticton.

Table 2: PRV Settings as of July 10, 2007

PRV	Outlet Pressure (psi)
Hickory	50
Lower Bench Rd	115
Benchland Rd	72
Lochore Rd	65
Pearson Rd	95
1024 Three Mile	90

The full water level of 584m and 534m were used for the water level elevations at the Campbell Mountain Diversion Dam and Ellis Creek Diversion Dam respectively. The minimum desired operating pressure for both systems is understood to be 480 kPa (70 psi) at the property line and 415 kPa (60 psi) at the highest point in the property. For the purpose of this analysis we evaluated the criteria at the property line for satisfactory performance of the system.

Maps 1 and 2 respectively illustrate the Pipe Material and Pipe Size for the North System while Maps 3 and 4 respectively illustrate the Pipe Materials and Pipe Sizes for the South System.

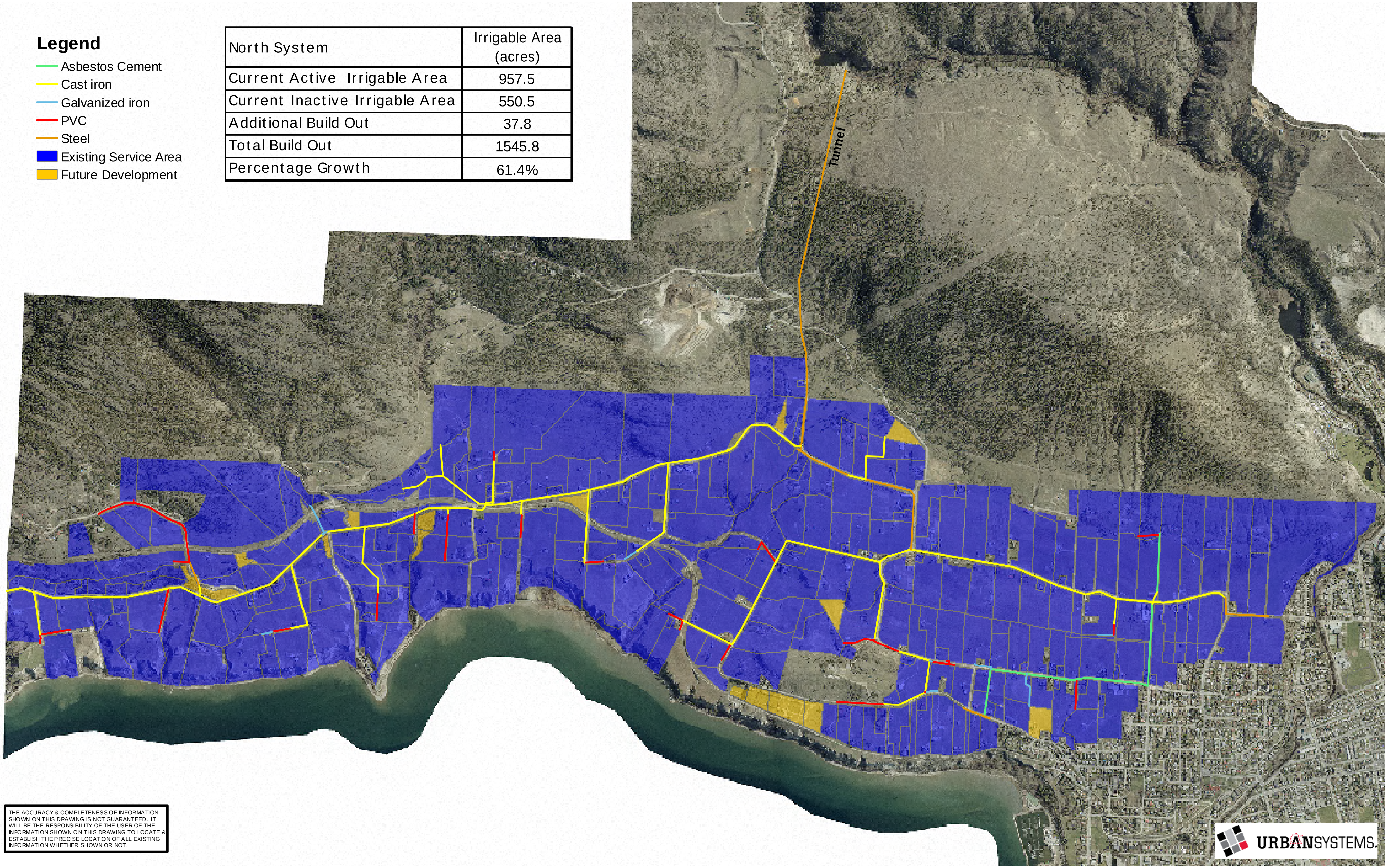
DATE: AUGUST 20, 2009

NORTH IRRIGATION SYSTEM BUILD OUT MAP
PIPE MATERIAL

Legend

- Asbestos Cement
- Cast iron
- Galvanized iron
- PVC
- Steel
- Existing Service Area
- Future Development

North System	Irrigable Area (acres)
Current Active Irrigable Area	957.5
Current Inactive Irrigable Area	550.5
Additional Build Out	37.8
Total Build Out	1545.8
Percentage Growth	61.4%



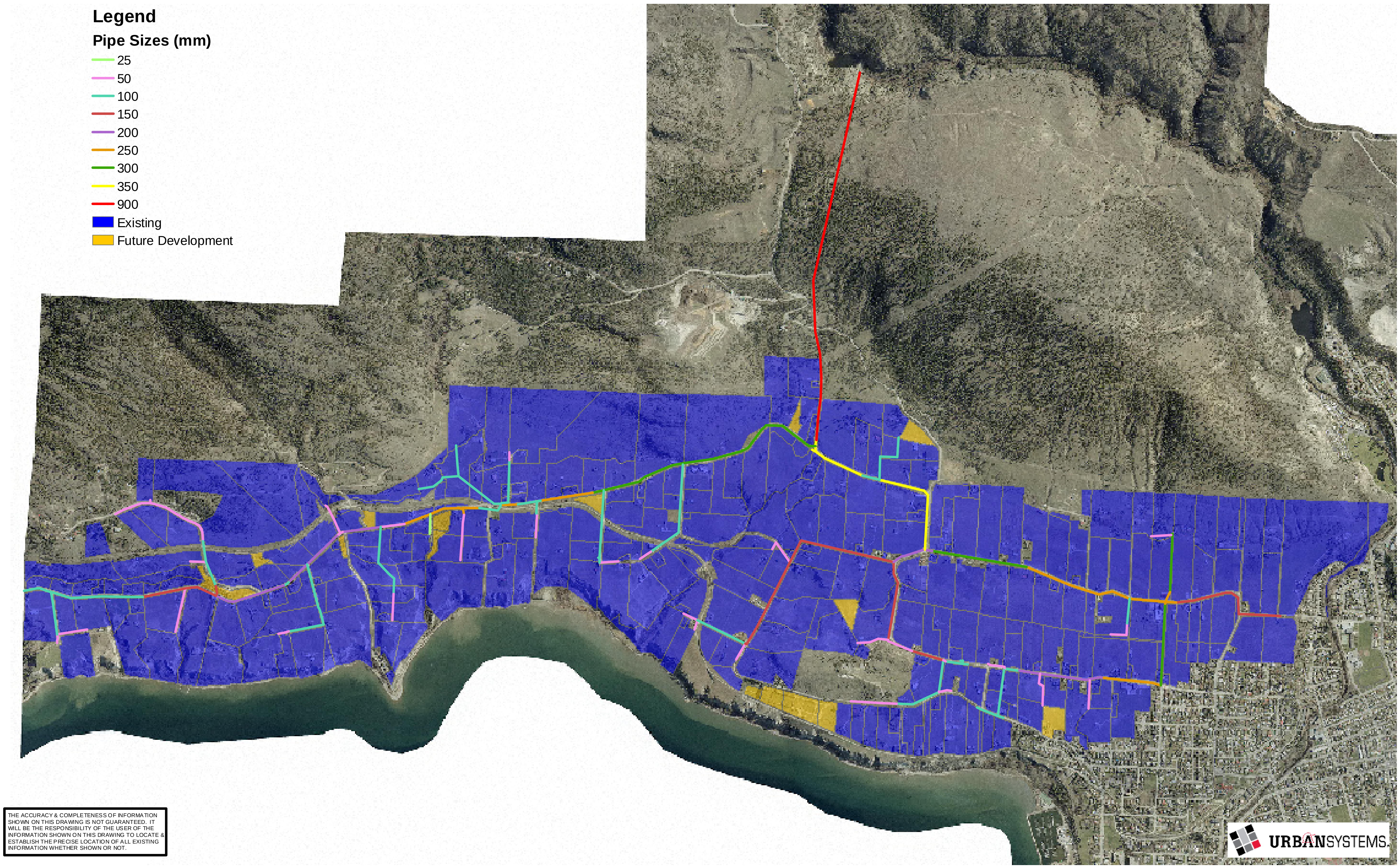
THE ACCURACY & COMPLETENESS OF INFORMATION SHOWN ON THIS DRAWING IS NOT GUARANTEED. IT WILL BE THE RESPONSIBILITY OF THE USER OF THE INFORMATION SHOWN ON THIS DRAWING TO LOCATE & ESTABLISH THE PRECISE LOCATION OF ALL EXISTING INFORMATION WHETHER SHOWN OR NOT.

URBANSYSTEMS.

MAP 1

DATE: AUGUST 20, 2009

NORTH IRRIGATION SYSTEM BUILD OUT MAP
PIPE SIZES



THE ACCURACY & COMPLETENESS OF INFORMATION SHOWN ON THIS DRAWING IS NOT GUARANTEED. IT WILL BE THE RESPONSIBILITY OF THE USER OF THE INFORMATION SHOWN ON THIS DRAWING TO LOCATE & ESTABLISH THE PRECISE LOCATION OF ALL EXISTING INFORMATION WHETHER SHOWN OR NOT.

File Path: U:\Projects_VAN\1017\0055\01\D-Drafting-Design-Analysis\GIS\Projects

URBANSYSTEMS.

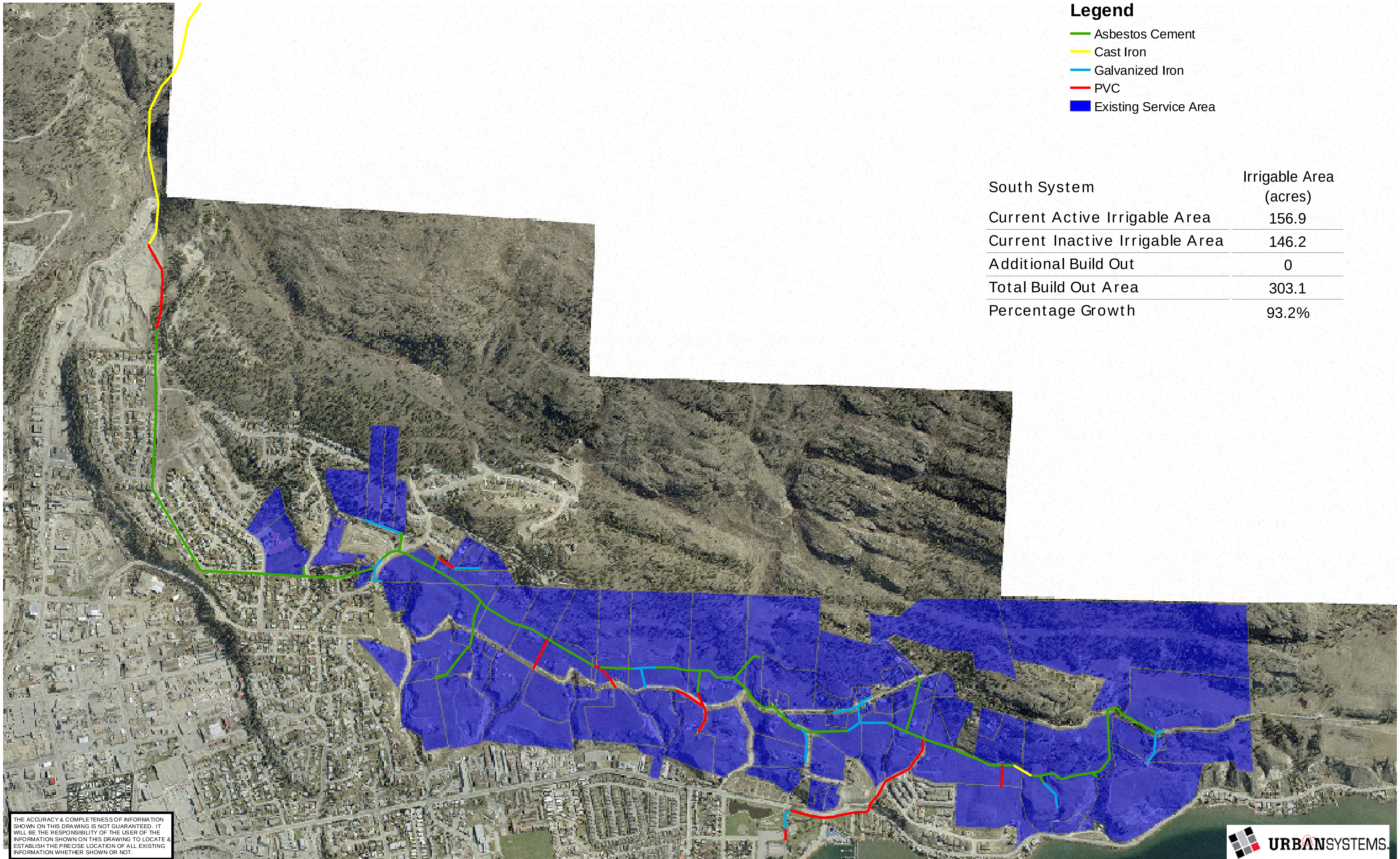
MAP

2

DATE: AUGUST 20, 2009

SOUTH IRRIGATION SYSTEM BUILD OUT MAP
PIPE MATERIAL

MAP 3



South System	Irrigable Area (acres)
Current Active Irrigable Area	156.9
Current Inactive Irrigable Area	146.2
Additional Build Out	0
Total Build Out Area	303.1
Percentage Growth	93.2%

THE CITY OF Penticton

PENTICTON IRRIGATION MASTER PLAN

DATE: AUGUST 20, 2009

SOUTH IRRIGATION SYSTEM BUILD OUT MAP PIPE SIZES

MAP

4

5.2 Assumptions

The predictive nature and long term projection of this investigation requires a number of assumptions to be made. The following presents the key assumptions which were made through the various stages in this investigation. The existing irrigation systems also contain fire hydrants in select areas. However, it is our understanding as stated previously that these are for supplemental fire protection only. As such we have not evaluated the capacity of the irrigation system to deliver fire protection water.

IRRIGATION SYSTEM USE ASSUMPTIONS

- There is currently one truck fill station on the North Irrigation System fed by the irrigation system, but since it is not metered its demand is not known, it is our understanding that there are no plans to have any more connected to the irrigation system in the foreseeable future.
- Agricultural irrigation (both current and future) is limited to spray or drip irrigation and does not include water for post processing facilities or wineries.
- Residential irrigation use is assumed to remain connected to the treated water system

SOURCE WATER AVAILABILITY

The most current source water availability analysis was completed by D.B. Letvak of the Ministry of Environment in 1988. While this data is quite dated, and may not accurately reflect current hydrology, it is the only information that we are aware of that can be used as a basis for flow predictions for Penticton or Ellis Creeks. Average yearly values represent those outlined in the City of Penticton 2005 Water Study. **Table 3** is a summary of this data. Within the 2005 Water Study similar information from Letvak is referenced however, it is based on his earlier work of 1985.

Table 3: Source capacities during various drought conditions

Frequency	% of Average	Penticton Creek (ML/year)	Ellis Creek (ML/year)
Average Year		23,250	17,340
1:10 year drought	59%	13,718	10,231
1:20 year drought	51%	11,858	8,843
1:50 year drought	43%	9,998	7,456
1:100 year drought	38%	8,835	6,589
1:200 year drought	34%	7,905	5,896

It is our understanding that while the City holds licenses on Penticton Creek for both irrigation and domestic water use that the Okanagan Lake license is more than sufficient to meet all of the domestic use requirements under all drought conditions. Unfortunately there is no documentation on the minimum required flows in order to satisfy environmental obligations.

If we consider the need to meet the annual irrigation requirements, without consideration for environmental flows, then sufficient capacity exists in both systems under the 1:200 year drought.

However, the critical requirement is typically not only the annual flows but rather also satisfying the peak flows. These are met through a combination of runoff and storage. We do not have sufficient information to evaluate if the storage within either system is sufficient to meet allotted demands under a 1:200 year drought.

From a hydraulic conveyance perspective with a full reservoir at Penticton Creek the spillway has a peak capacity of 86 ML/day and the tunnel through Campbell Mountain has a capacity greater than that of the spillway. This compares to a peak flow requirement of 46 ML/day if all users irrigated their allotted land at the same time. The Ellis Creek Reservoir at full level has a spillway capacity of 7,300 ML/day which is significantly greater than the irrigation allotment of 9.2 ML/day.

There is currently little information regarding the impacts on the capacity of supply for either water system as a result of future climate change. The Okanagan Basin Water Board is currently looking at the sustainability of the region and once completed may have additional information to aid the City in determining if there will be any long term threats to the availability of water.

It is recommended that the City complete a study to determine, in consultation with the OBWB, that adequate storage exists in both systems to meet the needs of both irrigation systems under future climate and crop scenarios. It is also recommended that the City look to install continuous monitoring on its reservoirs to monitor levels and release rates to improve the water management capabilities of the City.

5.3 Build Out Condition

To help estimate the extent of agricultural development and growth for each of the systems, the Pacific Agri-Food Research Centre in Summerland performed an analysis to identify areas for future growth. The criteria used for identifying parcels were:

- currently within ALR land with preferable soil type
- slopes of less than 30% and
- No crops currently listed (based on agricultural land use study completed in 2005).

The results were placed digitally over orthophotos of the area and through visual inspection by the City of Penticton, the build out areas were selected. No future build out areas were identified in the South System. The build out areas for the North System are illustrated in Map 1.

5.4 Development of Climate & Irrigation Demand Scenarios

A climate and irrigation demand model for both systems was prepared by the provincial and federal government in conjunction with the Okanagan Basin Water Board and is maintained by RHF Systems Ltd. This model is just completing the final stages of development and has not yet been formally released. Permission was granted to the City to utilize the model on a pilot basis for the purposes of this irrigation master plan. Details of this model are documented in the report titled Irrigation Water Demand Model, April 2009 as prepared by RHF Systems Ltd.

The climate and irrigation demand model takes into account a number of inputs relating to water demand and use, such as soil and crop type, irrigation systems, soil moisture balance and of course climate conditions. For detailed descriptions of model assumptions and inputs please refer to **Appendix A**. Some key variables of interest in this model are:

Climate — There are an array of climate change predictions, with differences in rainfall intensity, duration, frequency, time of year and differences in temperature fluctuations and humidity. For scenarios where current climate conditions are modeled, historical records from 2006 are used.

Crop Type — Each crop type has different irrigation requirements in terms of duration, volume and time of year.

Irrigation Practices — This relates to the farmer's ability to match the water requirements of the crops. Over watering results in loss of soil moisture to deep percolation and hence reduced efficiency, in the same way under watering limits crop growth and reduces yield.

Growing Season Overrides — The Water Demand Model establishes a growing season for each crop using characteristics such as the last and first frosts, accumulations of growing degree days and temperature sums, etc. However, there can be anomalous climate situations where the rules as implemented result in a crop season extending beyond its reasonable bounds. An override table can be used to limit the start and end of each crop's season to avoid these anomalies however, since changes in climate could obviously alter those season lengths the override table was not used.

Evaluating the impacts of climate change is still a relatively new science and as such there are a number of models that exist. In many cases more than one model is used in order to understand the variability associated with each model. In order to select models for this assignment the City contacted the Okanagan Basin Water Board and selected models consistent with those being used for evaluating the basin. These two models are referred to as CGCM2.A2 and CGCM2.B2.

In order to understand the potential increase in water use requirements associated with crop types, medium density apples were modeled on all agricultural lots. Apples were chosen because they demand large quantities of water typically near the end of the irrigation season when the area is the driest. It was also conservatively assumed that the apples would be irrigated using solid set under tree irrigation. This method of irrigation is one of the least efficient methods of irrigating apples but is still in common use today. If farmers were to convert to drip irrigation systems than efficiencies of at least 35% could be achieved.

Five scenarios were developed to gain and understanding of impacts caused by changes in both crop types and climate.

Scenario 1a - Existing System
Under this scenario the model represents the irrigation demands under 2006 climatic conditions and crop types. Historical data and anecdotal information were used to setup and calibrate the model. This creates the initial condition to which all the other scenarios are compared.

Scenario 1b - Existing System with Future Climate
Provides insight into the current systems abilities to meet demands in the situation where everything stayed the same into the future except the climate. To distinguish between the two climate models, Scenario 1bA2 will be used to represent climate model CGCM2.A2 and Scenario 1bB2 for the CGCM2.B2 climate model.

Scenario 2a - Existing System with Current Climate and Medium Density Apples
Represents the condition where no additional irrigable area is added to the irrigation system, all agricultural lots have been changed to medium density apples and the current climate conditions remain. This provides an indication of how the current systems will respond to growth within the existing service areas.

Scenario 2b - Existing Area with Future Climate and Medium Density Apples
Assuming no expansion of either system this scenario presents what the anticipated demands may be from the systems should the climate change and all agricultural areas grow medium density apples with solid set under tree irrigation. This provides a measure of what the highest demands might be for the current systems. As with Scenario 1b, Scenario 2bA2 will be used to represent climate model CGCM2.A2 and Scenario 2bB2 for the CGCM2.B2 climate model.

Scenario 2d - Build Out Condition with Future Climate and Medium Density Apples Throughout

The ultimate scenario where the system has reached build out, the future anticipated climate is in effect and all agricultural lots have medium density apples with under tree irrigation implemented.

The model produces the data on a daily basis and then summarizes it upwards, allowing analysis of a wide range of time periods (daily, weekly, monthly and annual are standard products).

There are a small number of parcels connected to the systems identified as "Domestic Outdoor". These were assumed to be lawn or other residential landscaping with sprinkler irrigation and left unchanged in the future high use scenarios (2a, 2b, 2d).

Only those areas with an irrigation system designated as "in use" were modified under the high use scenarios 2a and 2b. Properties with an identified irrigation system flagged as *not in use* (abandoned, unusable, etc.) were excluded from the models representing the current water service area but were included for the build out scenario 2d.

There were a few minor anomalies encountered in the development of the climate model that pertain to the parcels of land that were included. In the North System there were 2 parcels where the folio ID numbers were not able to be matched between the City and provincial data base. The total area of these parcels is 7.9 hectares (3.2 acres) and represents 1.0 % of the total area and as such will not have any appreciable impact on the results of this analysis. In addition there were 2 parcels in the North System which do not have any irrigation allotment assigned to them but appear to be growing crops. These parcels were assumed to be irrigated under the build out scenario at irrigable areas consistent with surrounding properties but were not included in the existing scenario.

6.0 SYSTEM PERFORMANCE

6.1 Current System Performance

This section discusses the performance of each of the systems over 2004 to 2006 together with the results from the WaterCAD model. A set of the output results from the model are attached in **Appendix B**.

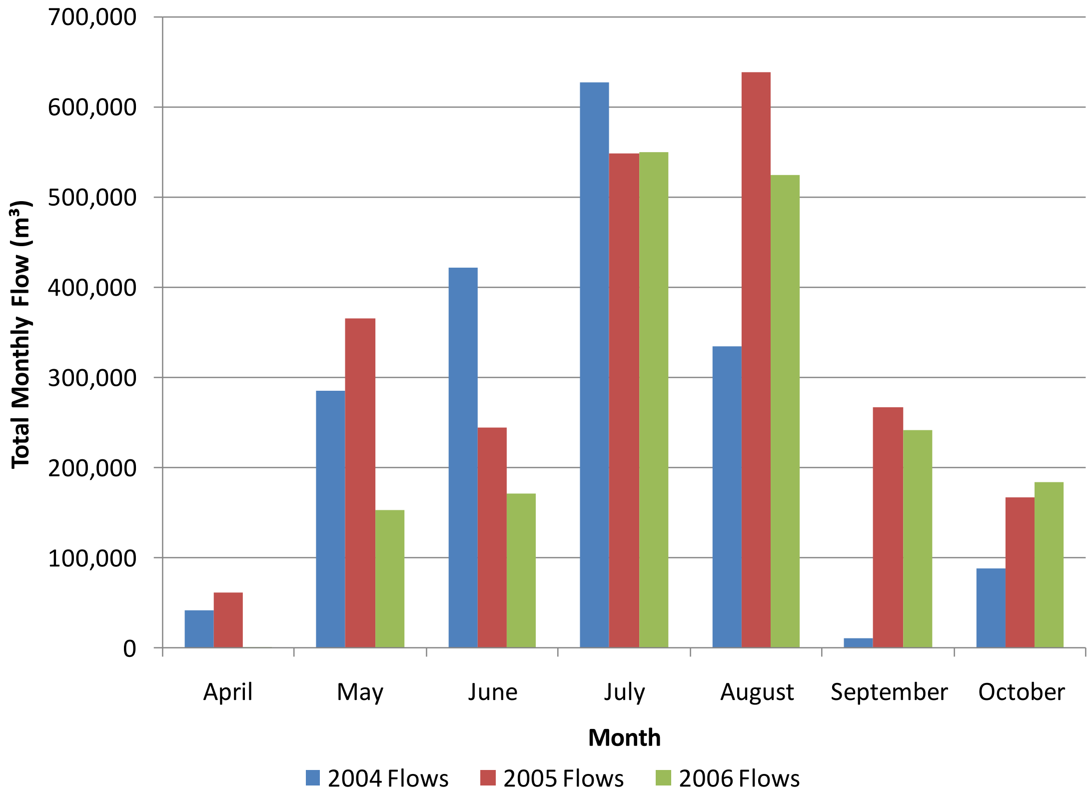
NORTH SYSTEM

The North System is currently comprised of 308 serviced lots which comprise a total allotted irrigable area of approximately 610.4 hectares (1508 acres) and total allotted peak flow of 533 L/s.

Historical flow monitoring records for the north system from 2004 to 2006 are presented in **Figure 1**. The WaterCAD model results (show that during peak flows the pressures along North Naramata Road north of Pearson Road intersection drop to as low as 345 kPa (50psi). The model represents the situation whereby all lots are irrigating simultaneously, demanding the maximum flow from the system and hence resulting in the lowest pressures. Since this is not a common occurrence in operation these pressures are not likely experienced in practice.

The WaterCAD model results and operational records show that two services extending up Sutherland Road fail to provide sufficient quantity of water and pressure during peak flow periods. This is due to a combination of the sharp increase in elevation along Sutherland Road and the length of the service connections to reach the properties. It is our understanding that the owners agreed to these reduced service levels when they requested an extension of service.

Figure 1: Actual flow monitoring results for the North Penticton Irrigation System from 2004 to 2006.



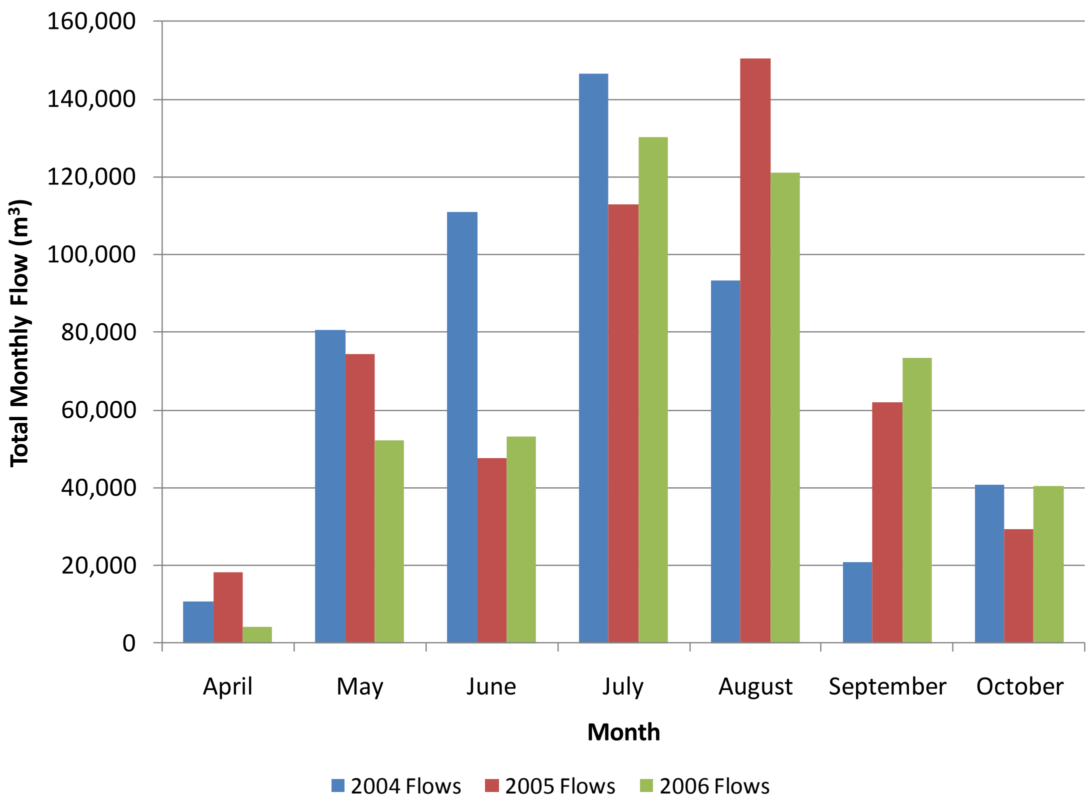
The peak instantaneous flow over the 2004 to 2006 period was 27.4ML/d (317L/s); significantly less than the allotted peak flow of 533L/s. The maximum total annual water use over this period was 2,295,536 m^3 in 2005 which represents 42.4% of the 5,412,000 m^3 license.

SOUTH SYSTEM

The South System is currently comprised of 84 serviced lots which comprise a total allotted irrigable area of approximately 122.5 hectares (303 acres) and total allotted peak flow of 107 L/s.

Historical flow monitoring records for the south system from 2004 to 2006 are presented in **Figure 2** below. The WaterCAD model results indicated there were two areas with insufficient pressures during peak flows. The first is a collection of lots to the north and south of Pineview Road where the pressures drop to below 60 psi and the second area is a group of serviced but undeveloped lots to the east of Valleyview Rd where the pressures are approximately 65 psi. Again, as with the north system model, the WaterCAD model represents a peak flow situation where all lots are irrigating simultaneously. Since this is a low probability event and the pressures are not significantly lower than the required 70 psi, these are not considered a significant concern.

Figure 2: Actual flow monitoring results for the South Penticton Irrigation System from 2004 to 2006.



The peak instantaneous flow over the 2004 to 2006 period was 10.9ML/d (126L/s), which is greater than the allotted peak flow of 107L/s. The maximum total annual water use over this period was 504,170 m^3 in 2004 which represents 19.7% of the 2,558,000 m^3 license.

6.2 Climate & Irrigation Model Results

The following sections present the results from the climate and irrigation demand model and provide comment on how these results relate to the performance of the current systems under existing climate and crop conditions.

EXISTING SYSTEM

The model results for Scenario 1a together with the actual recorded flows in 2006 for the North and South system are presented in **Figure 3** and **Figure 4** respectively. The model results for the north system predict a later start to the irrigation season and increased water usage over the summer months. The results from the south system model also show a later start to the irrigation season however under predict the water usage for most of the summer months. Both model results indicate significantly lower water usage in October than the recorded values. This difference may be due in part to the farmers irrigating the soils after the harvest to restore any deficit in soil moisture or due to modified irrigation practices associated with wine grapes as there is no mechanism in the model to account for this. In addition as already discussed for the South System the irrigation of Skaha Lake Park is likely contributing to the actual flows exceeding the modeled flows.

A summary of the annual water usages is presented in **Table 4**.

Table 4: Annual Flow Comparisons between Recorded and Modeled Values

System	2006 Flows (m^3/yr)	2006 Model Results (m^3/yr)	Variation of Model
North	1,830,200	2,181,448	+19%
South	474,348	390,224	-17%

Fluctuations of the magnitude shown in **Table 3** are not uncommon for modeling of this magnitude and complexity. Inputs like soils are from fairly broad-scale classifications, with defaults in place for areas where mapped data is lacking. The climate surfaces are interpolated from discrete station values around the Okanagan Valley and generalized to 500m x 500m cells - there could definitely be pockets where the reported temperatures and precipitations differ from what actually happened. The model assumes an average irrigation management practice, which controls the amount of overwatering taking place, where in reality some of the properties could have been managed poorly or exceptionally well. There are also irrigable parcels where the irrigation system on record is flagged as "not in use", and therefore didn't create a water demand in the model, where in reality irrigation may have been taking place.

With these factors and assumptions in mind the model is considered to be producing results that match well with the known or estimated values on an overall Okanagan Valley basis and within some of the purveyor areas that were previously use for comparison. For all remaining scenarios it will be the results from Scenario 1a which will be used as the basis for comparison since the interest of this investigation lies more towards the relative differences and changes rather than actual numbers.

Figure 3: North System - Actual 2006 Flows compared to Scenario 1a Model Results

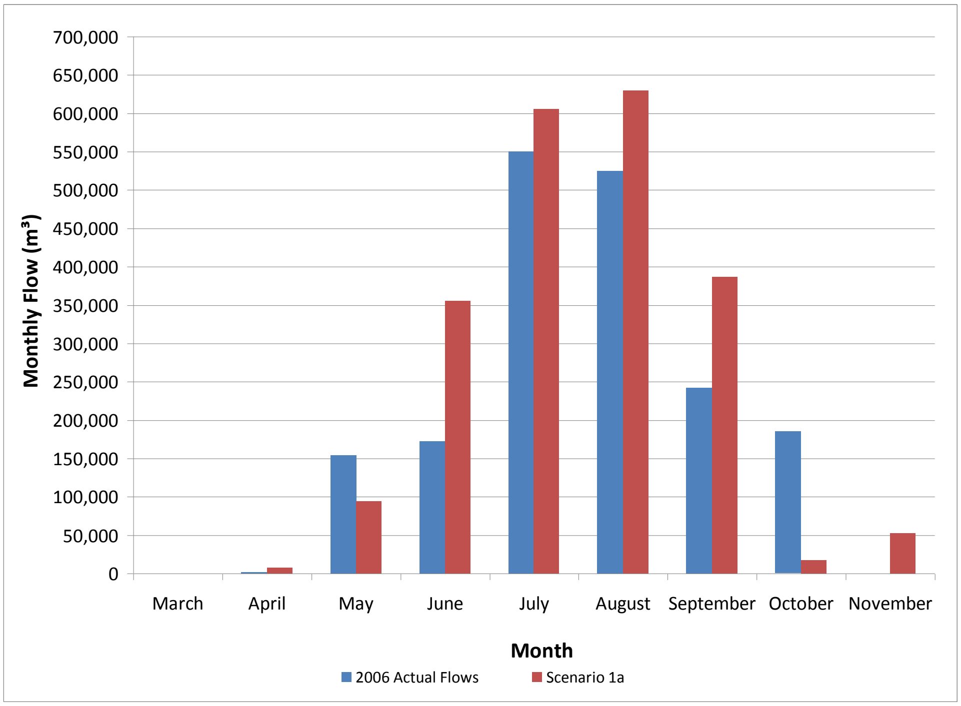
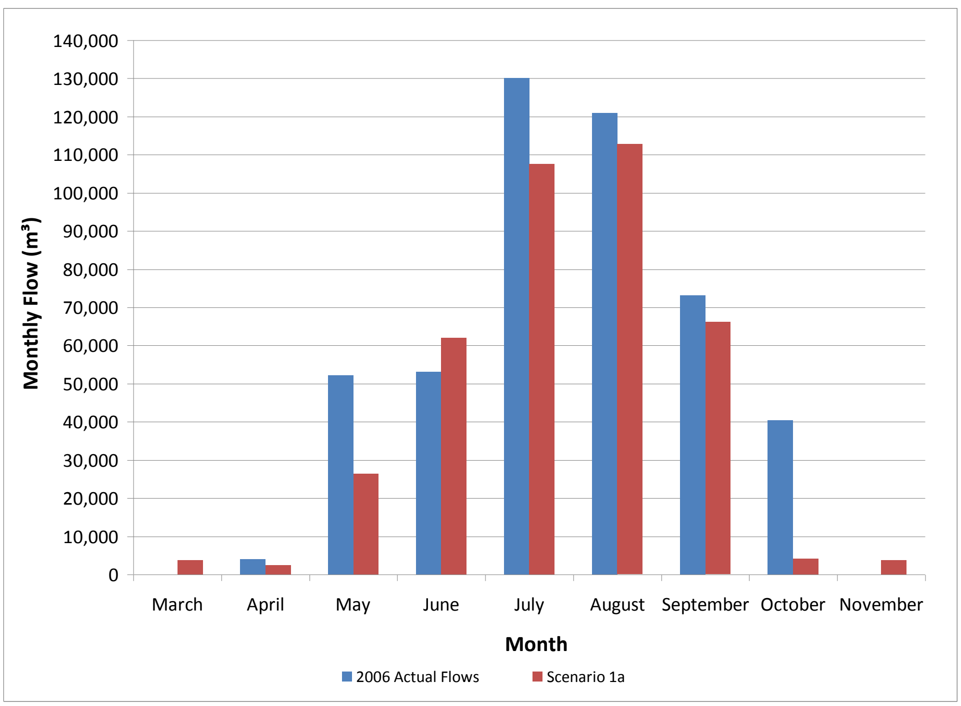


Figure 4: South System - Actual 2006 Flows compared to Scenario 1a Model Results



EXISTING SYSTEM WITH FUTURE CLIMATE

The model results for Scenario 1a together with the results for Scenario 1b for the North and South system are presented in **Figure 5** and **Figure 6** respectively. These figures show that both systems under each of the climate models are anticipated to experience increased irrigation demands over the entire irrigation season, particularly during May and October. This is a result of the model predicting an extended growing season due to longer and drier summer conditions.

These results also indicate that the crops under climate model CGCM2.A2 (Scenario 1bA2) require a greater amount of water, particularly earlier in the season than that of model CGCM2.B2 (Scenario 1bB2). The total irrigation demands for both of these scenarios are illustrated below.

Table 5: Demand Comparisons between Scenario 1a and 1b.

System	Annual Irrigation Demands (m^3/yr)				
	Scenario 1a	Scenario 1bA2	Scenario 1bB2	Average	Change from 1a to 1b
North	2,236,300	3,175,500	2,898,200	3,036,900	+36%
South	399,900	587,200	503,000	545,100	+36%

System	Peak Monthly Irrigation Demands ($m^3/month$)				
	Scenario 1a	Scenario 1bA2	Scenario 1bB2	Average	Change from 1a to 1b
North	630,000	791,500	735,500	763,500	+21%
South	112,800	143,800	134,400	139,100	+23%

Table 6: Comparison of Scenario 2b Results to Annual Water License Allotment

System	License (m^3/yr)	Scenario 1b Average Annual Demand (m^3/yr)	Percentage of License Usage
North	5,412,000	3,036,900	56%
South	2,558,000	545,100	21%

Figure 5: North System - Scenario 1a vs. Scenario 1b - Impact of Climate Change on the Existing System

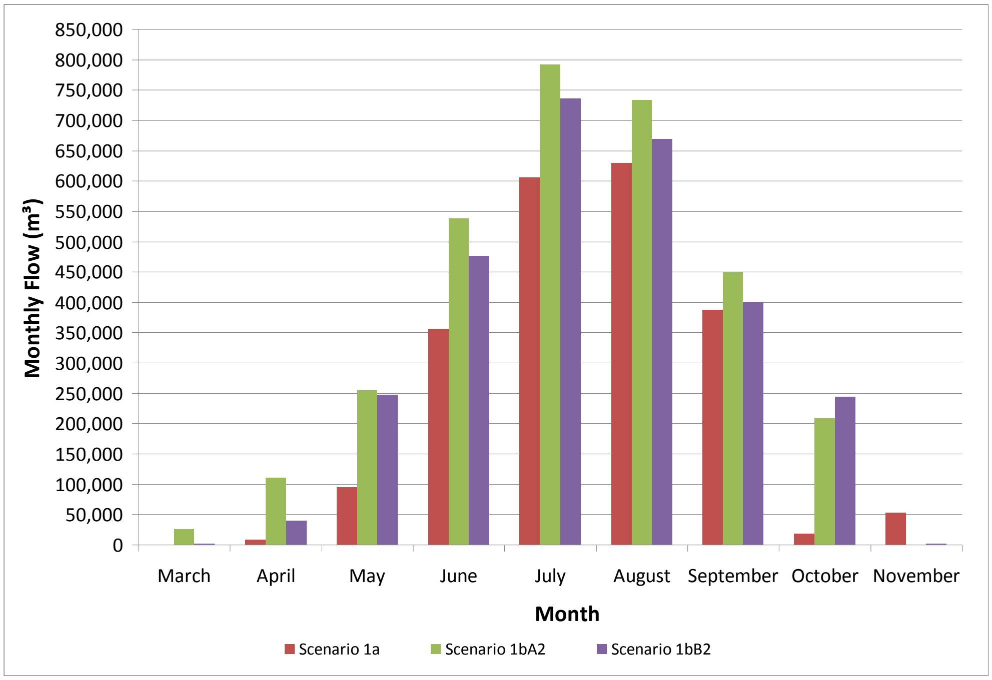
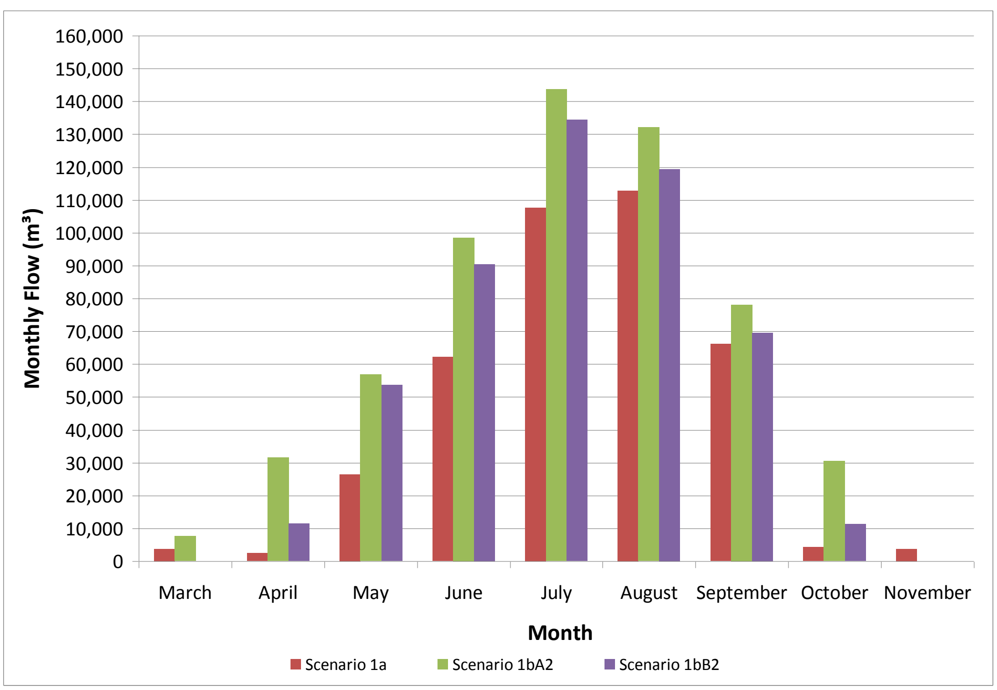


Figure 6: South System - Scenario 1a vs. Scenario 1b - Impact of Climate Change on the Existing System



CROP CHANGES AND THE INFLUENCE OF FUTURE CLIMATE

The model results for Scenario 1a together with the results for Scenarios 2a and 2b for the North and South system are presented in **Figure 7** and **Figure 8** respectively. Firstly, looking at the effect of crop type on irrigation use from the results of Scenario 2a, both the North and South system appear to respond in a very similar manner, with irrigation starting and peaking later in the season typical for apple crops.

Combining a change in crop with the change in climate results in substantial increases in irrigation demand for both systems with the months of June and July seeing an increase of close to 100%. Moreover, the shoulder months of May and October require substantial increases in comparison to both Scenarios 1a and 2a. Longer, drier summers and increased demands for water later in the apple growing season are possible factors for these trends.

The more significant comparison is that of the annual demands as this is the condition to which the water licenses are governed. **Table 7** summarizes the annual demands and their differences between the scenario results. Firstly, the results for Scenario 2a show that the annual irrigation demand could increase by as much as 44% and 31% for the North and South system respectively, should all the crops be changed to medium density apples with solid set under tree irrigation and the climate remain as it is today. Despite this significant increase both systems continue to remain below the annual water license limits.

Table 7: Demand Comparisons between Scenario 1a, 2a and 2b

System	Annual Irrigation Demands (m^3/yr)						
	Scenario 1a	Scenario 2a	Change from 1a to 2a	Scenario 2bA2	Scenario 2bB2	Average	Change from 1a to 2b
North	2,236,300	3,173,200	+42%	4,658,400	4,205,800	4,432,100	+98%
South	399,900	503,200	+26%	760,900	639,400	700,150	+75%

System	Peak Monthly Irrigation Demands (m^3/month)						
	Scenario 1a	Scenario 2a	Change from 1a to 2a	Scenario 2bA2	Scenario 2bB2	Average	Change from 1a to 2b
North	630,000	943,700	+50%	1,180,700	1,078,700	1,129,700	+80%
South	112,800	150,500	+33%	191,200	174,900	183,100	+62%

Secondly and more significantly, the Scenario 2b results indicate that the existing North and South system could see as much as a 98% and 75% increase in annual irrigation volumes respectively should both crops and climate change in the future. Once again both systems are able to remain below current license limits as presented in **Table 8** therefore implying that the sources have sufficient capacity to satisfy these projected demands providing that climate change does not cause the need to reduce water license amounts.

Table 8: Comparison of Scenario 2b Results to Annual Water License Allotment

System	License (m^3/yr)	Scenario 2b Average Annual Demand (m^3/yr)	Percentage of License Usage
North	5,412,000	4,432,100	82%
South	2,558,000	700,150	27%

Figure 7: North System - Scenario 1a vs. Scenario 2a & 2b - Influence of Crop Type and Climate Change on Existing System

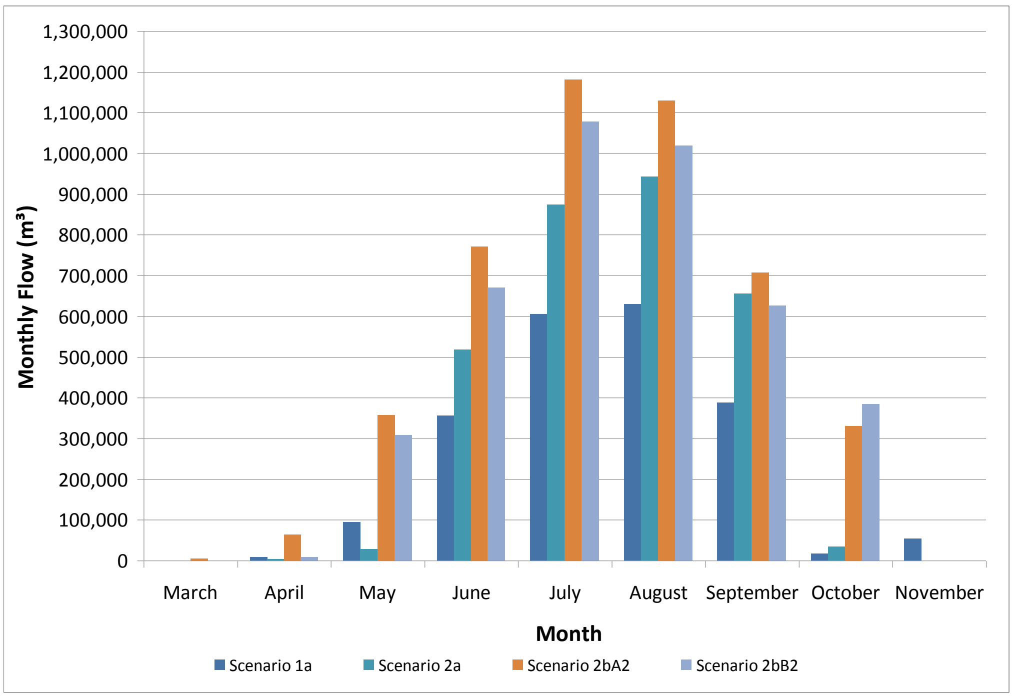
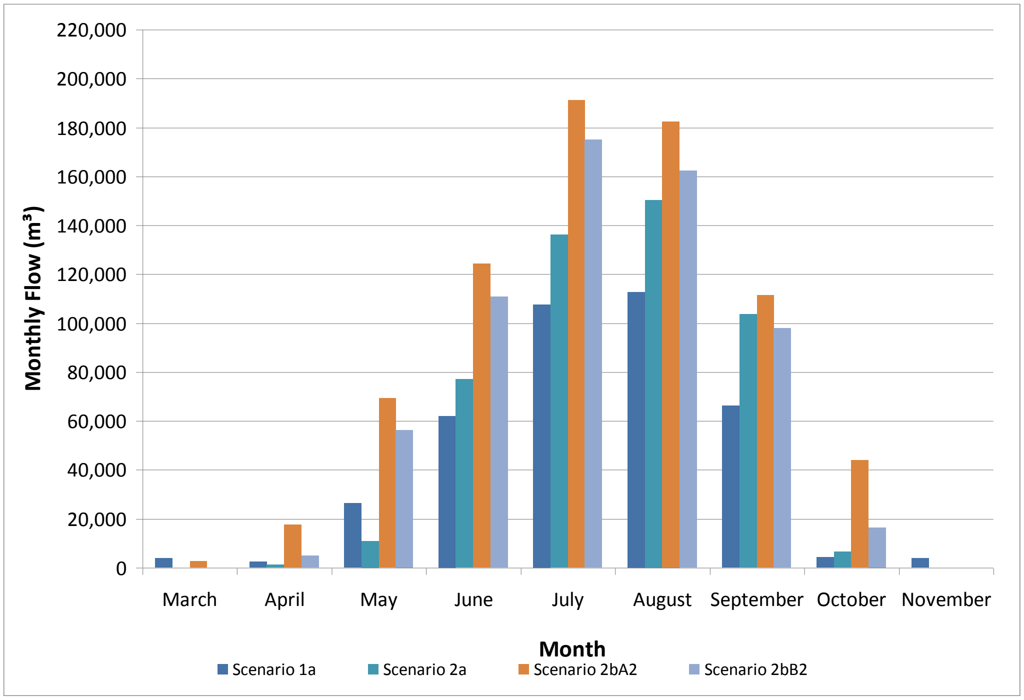


Figure 8: South System - Scenario 1a vs. Scenario 2a & 2b - Influence of Crop Type and Climate Change on Existing System



BUILD OUT WITH FUTURE CLIMATE

The model results for Scenario 1a together with the results for Scenario 2d for the North and South system are presented in **Figure 9** and **Figure 10** respectively.

Under the build out with future climate change scenario one of the significant impacts is the inclusion of land within the irrigable roll that is presently not understood to be drawing water from the irrigation system. In the North System this represents an increase of 57.5% and in the South System, 93.2%. In addition to these areas, service area growth has been established as 3.9% for the North System and 0% for the South System. The following tables summarize the performance of the system.

Table 9: Demand Comparisons between Scenario 1a and 2d.

System	Annual Irrigation Demands (m^3/yr)				
	Scenario 1a	Scenario 2dA2	Scenario 2dB2	Average	Change from 1a to 2d
North	2,236,300	5,568,200	5,093,600	5,330,900	+138%
South	399,900	1,416,700	1,159,700	1,288,200	+207%

System	Peak Monthly Irrigation Demands (m^3/month)				
	Scenario 1a	Scenario 2dA2	Scenario 2dB2	Average	Change from 1a to 2d
North	630,000	1,480,100	1,347,500	1,413,800	+124%
South	112,800	359,600	327,300	343,450	+204%

Table 10: Comparison of Scenario 2d Results to Annual Water License Allotment

System	License (m^3/yr)	Scenario 2d Average Annual Demand (m^3/yr)	Percentage of License Usage
North	5,412,000	5,330,900	98.5%
South	2,558,000	1,288,200	48%

As illustrated above the impacts of this growth indicate that both systems are capable of supplying and delivering this demand under either the crop change or the climate change scenario, however, the combination of both the crop change and climate change in the North System has the potential of exceeding its current license capacity.

Figure 9: North System - Scenario 1a vs. Scenario 2d - Comparison of Current and Ultimate Water Use

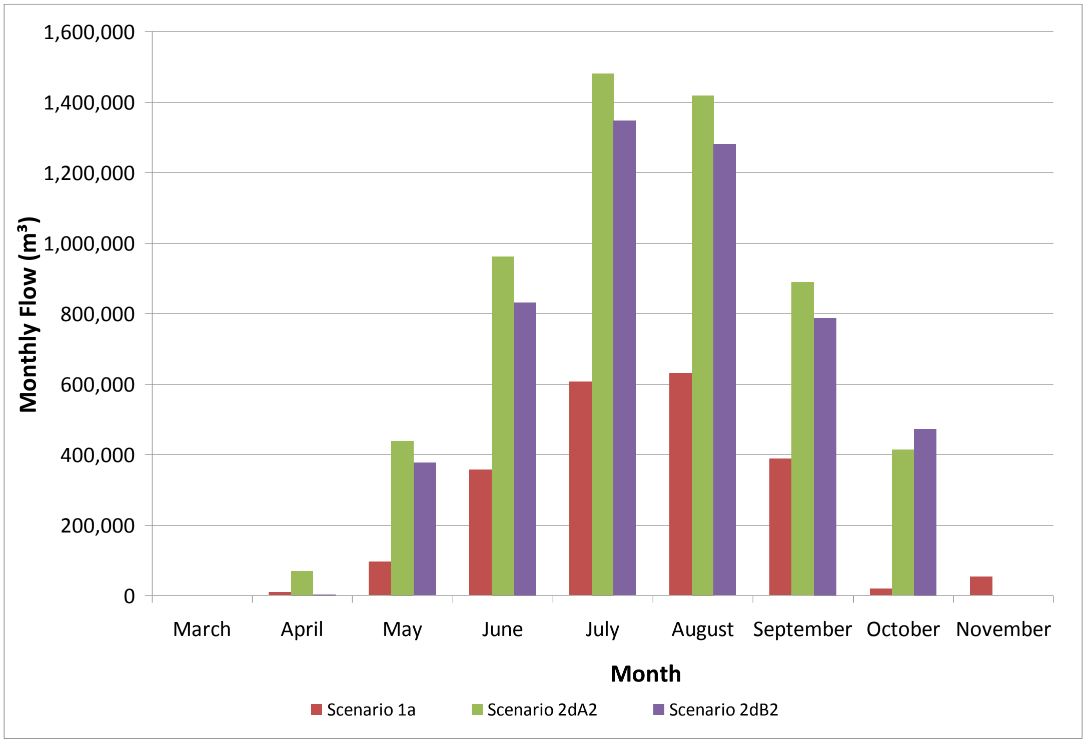
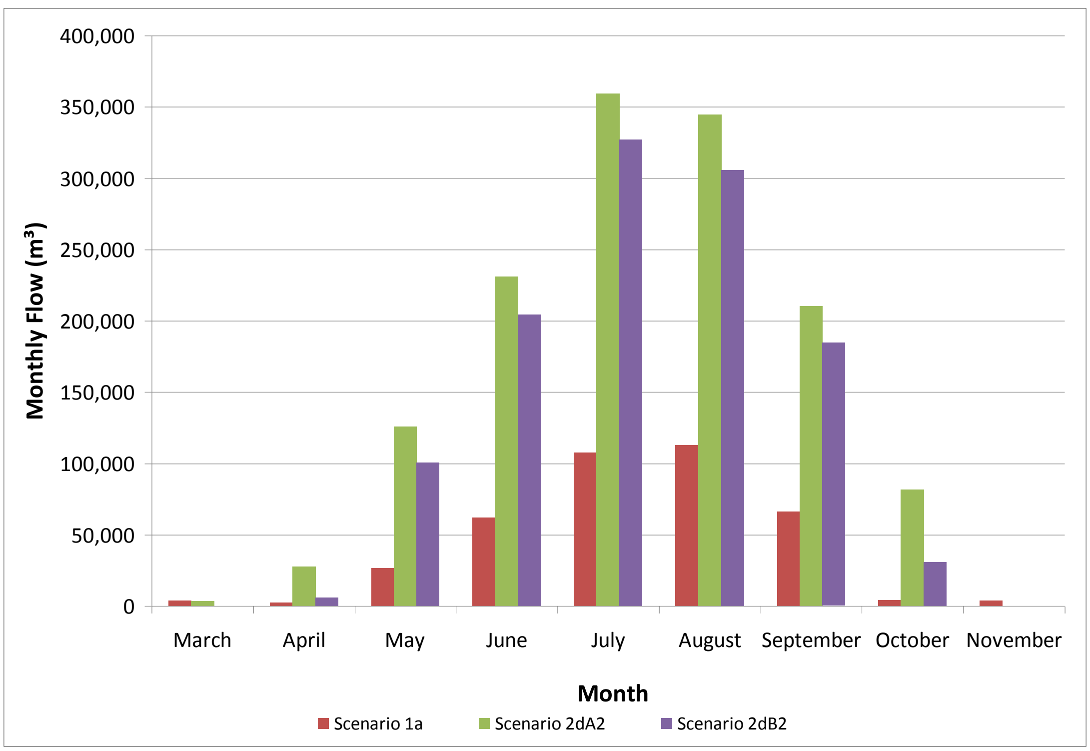


Figure 10: South System - Scenario 1a vs. Scenario 2d - Comparison of Current and Ultimate Water Use



ANNUAL RESULTS SUMMARY

A summary of the annual flow results from the model are presented alongside the actual 2006 recorded flows for the North and South system in **Figure 11** and **Figure 12** respectively. These provide a visual representation of the model results and a quick reference on how crop type and climate change influence the irrigation demand for the two irrigation systems Located in the City of Penticton, BC.

Figure 11: North System - Summary of Annual Flow Results from Climate and Irrigation Model

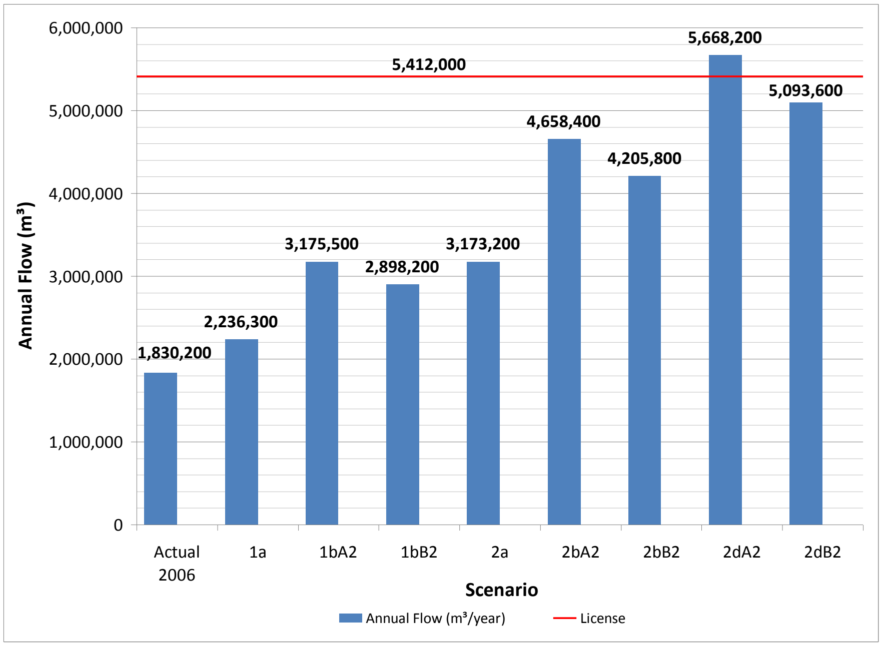
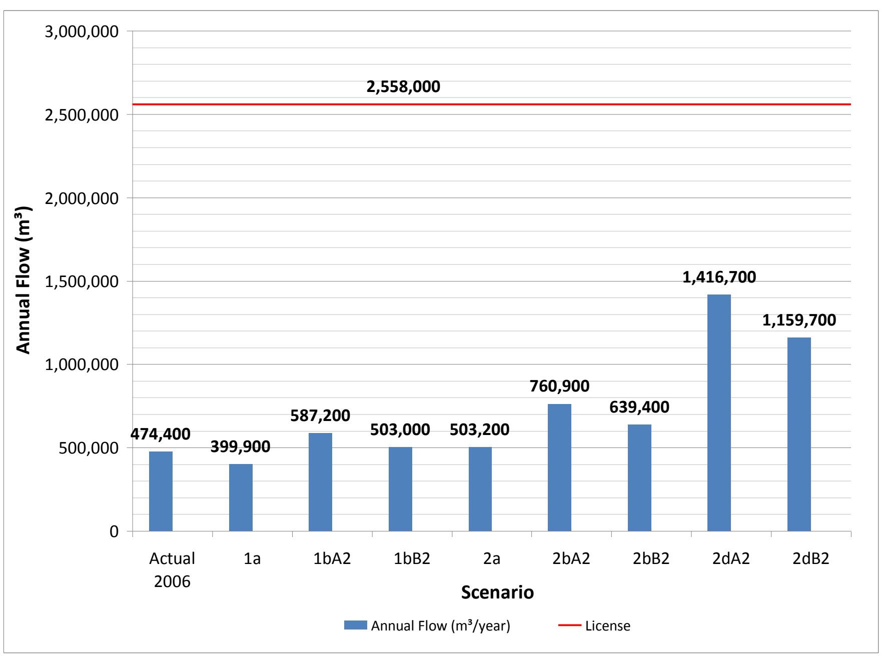


Figure 12: South System - Summary of Annual Flow Results from Climate and Irrigation Model



6.3 Upgrading and Replacement Requirements

Based on our evaluation of the capacity of the existing systems there are no known distribution system upgrade requirements required to deal with a deficiency in service levels. The only upgrading improvement that has been identified is the addition of water meters. This is discussed in further detail in the following sections of the report. A detailed breakdown of the costs associated with each project can be found in **Appendix C**.

However, due to the age of the system there is a need to plan for the replacement of existing infrastructure as it reaches the end of its useful life. We have developed a plan based on the types of materials and anticipated ages presented in **Table 11**.

Table 11: Infrastructure Replacement

Pipe Material	Year of Initial Installation	Begin Replacement	End Replacement
AC	1965	2020	2040
GI	1965	2020	2040
CI	1965	2020	2040
PVC	2005	2060	2100
Steel	1965	2020	2060
Intake Structure	1965	2030	2030
Water Meter	2012	2022	2027

All non-steel pipes with an operating pressure less than 1,034 kPa (150psi) will be replaced with PVC. Steel piping will be replaced with steel piping and any non-steel pipework over 1,034 kPa (150psi) will be replaced with ductile iron. Work previously completed on the irrigation system has indicated that the existing pipework is in good condition and there is no need for replacement in the immediate future. No information was made available regarding the replacement value or condition of the intake structures for either system built in 1965. It is assumed that each has an installation life of 65 years, therefore making replacement necessary in 2030. The estimated replacement cost has been established at $725,000 per system. This value should be reviewed and confirmed by the City.

For the purposes of estimating costs it has been assumed that all water meters will be installed above ground. Installation of water meters on all lots connected to the irrigation systems is anticipated to begin in 2012 and if funds permit be completed within 1 year. It has been assumed that 50mm positive displacement meters will be installed throughout. These have a maximum flow capacity of 10L/s (160 USGPM). For smaller lots, or those requiring lower flows, it may be possible to downsize the meter. The operational life of the meters has been estimated to be an average of 12 years with replacement beginning after 10 years and ending before the meters reach an age of 15 years. All water meters include radio transmitters, allowing for the meter reading to be picked up remotely by operations staff while driving by.

The pipe material or intake structure in each system constitutes a replacement project. Each system has been separated into two categories: Distribution – pipes with service connections and Transmission – pipes located between the source and the first user. The North System has a total of seven distribution projects and two transmission projects while the South System has six distribution and three transmission projects. Due to the lack of available edge of pavement information, pipes located under asphalt were determined visually by placing the system pipework over orthophotos of the area using GIS software and flagging those which appeared on the edge of or under roads.

A summary of the Class D replacement cost estimates for the transmission and distribution sections of each system and the costs associated with the implementation and replacement of water meters are presented in **Table 12**. These costs include an engineering and contingency allowance of 45% for pipe replacement projects and 20% for water meter projects. Included within this table is both the total project cost as well as the portion of the project cost that is projected to be spent within the next 25 years.

Table 12: Summary of Project Replacement Costs

	Total Project Cost	25 Year Project Cost
North System Distribution	$6,116,600	$3,589,500
North System Transmission	$3,071,400	$1,583,400
South System Distribution	$2,006,500	$1,195,000
South System Transmission	$1,226,100	$1,012,100
Water Meters Initial Installation	$1,411,200	$1,411,200
Water Meters – First Replacement	$470,400	$470,400
Water Meters – Second Replacement	$470,400	$128,300
TOTAL IRRIGATION REPLACEMENT COST	**$14,302,200**	**$9,389,900**

OPERATIONS AND MAINTENANCE COSTS

The City has supplied a copy of the current operations and maintenance budget for the irrigation water systems. The breakdown of the budget is contained in **Appendix D**. Within the current budget there are three main categories: General, Operational Costs, and Capital Upgrades. In order to avoid duplicating costs with the replacement projects outlined in the previous section we have removed the costs associated with capital upgrades. We have however, kept the costs for studies within the budget that are not attributed to a single capital upgrade project. Since costs can vary quite significantly from one year to the next we have utilized an average of the 2006-2008 actual and 2009 budget values.

With the installation of water meters will come the operational costs associated with meter reading, billing and meter maintenance. We have assumed that this would constitute a cost in the order of $75,000 per year. However, we recommend that the City review and confirm that this value is appropriate.

The annual budget for operations and maintenance has been established at $400,000.

7.0 AGRICULTURAL IRRIGATION PRICING AND METERING PRACTISES OF OTHER BC COMMUNITIES

To understand the agricultural irrigation pricing and metering practices in the Central Okanagan we contacted nine communities that currently provide irrigation water for agricultural land use. The communities we investigated include; South East Kelowna Irrigation District (SEKID), Glenmore/ Ellison, Westbank, Summerland, Black Mountain, Peachland, Lake Country, Greater Vernon Services and Penticton. The intent was to both understand what are the common irrigation water pricing and metering practices and policies and also reach some conclusions as to what approach Penticton might take for future irrigation water pricing, metering and water policies. The following sections summaries our research to date and conclusions. A detailed summary of the responses received is contained in **Appendix E** (to come in final report).

7.1 Irrigation Water Allotment

There are two main tools that are used by suppliers of irrigation water to allocate water resources. The first and most common way is to allocate a peak flow rate to each parcel on the basis of the proposed land to be irrigated. The unit flow rate is established based on the soil type of the land. The farmer is free to utilize this connection for as many hours as he or she sees fit over the duration of the irrigation season. This is how the City allocates water. The water allotments in the Okanagan are not surprisingly consistent with the City's rates of 5-7 USgpm/acre.

The second control used by some local governments is an annual water allotment based on the volume of water supplied to the parcel determined by the size of the parcel. Some organizations such as the South East Kelowna Irrigation District (SEKID) allocate water on a volume of acre feet/ acre. For example in non drought conditions the SEKID allotment is 2.25 acre feet/ acre, in a drought year like 2009 the allotment is reduced to 1.8 acre feet/ acre. By providing farmers with an annual allotment it provides an incentive for them to plan out how they will use their water over the growing season.

7.2 Water Metering

Water meters have been installed in eight of the nine communities we interviewed. SEKID started a water meter program in 1994 for all irrigation connections in their district. Today all SEKID irrigation connections are metered. Water meters are installed in the Glenmore/ Ellison, Westbank, Summerland, Black Mountain, Greater Vernon and water meters continue to be installed in Peachland. The majority of these meters are equipped with a radio read device rather than a touchpad or fixed station meter reading system.

FUNDING OF WATER METERS

Many of the water meters purchased and installed in the Central Okanagan were funded through provincial and federal grant programs such as the Canada-BC Green Plan for Agriculture (concluded in 2000) and the Municipal Rural Infrastructure Fund. At this time there are no funding programs specifically for water meter installations. Municipalities can apply to the federal/ provincial Infrastructure Canada program for assistance in funding the purchase and installation costs of water meters for any land use. Funding is limited in the Infrastructure Canada program and it may be difficult to get funding approved from this program given the competition for the available resources for "shovel ready" projects. It should be noted that the provincial and federal governments typically fund the initial capital and not replacement funding. The implication of this action is that the repair and replacement costs of water meters are the responsibility of each community. Water meter repair and replacement costs are typically included in the cost of operating and maintaining the water systems and costs are recovered through water utility rates.

REASONS FOR INSTALLING WATER METERS

Metering the consumption of water use is often a cornerstone of any water conservation program. Through the BC Governments Living Water Smart Document the province has committed to increasing water use efficiency in BC by 33%. Communities that switch from being a non water metered community be having water meters for all land uses typically report a 10% to 20% reduction in overall water consumption. Water meters combined with a well designed water rate schedule can also assist in recovering funds in a more equitable manner than through a rate schedule based on a flat rate without water meters. Water meters can also allow individual users the opportunity to monitor their water consumption and adjust their water use to meet their allocation and needs.

At this time irrigation water meters in the Central Okanagan are used for the following purposes:

1. To help encourage water conservation.
2. Monitoring water consumption of individual parcels by either the municipality or farmer or both.
3. Notification of the consumer of their consumption to date and the percentage or amount of their annual allotment remaining.
4. Assisting the municipality in projecting annual water consumption for future years and under various climatic scenarios.
5. Collecting data on consumers using an excessive amount of irrigation water as defined in their water use bylaw.

6. For a mock water meter bill to inform the consumer of their water use and cost of the water service.

7. To help determine the total system water consumption in relationship to the water license.

8. To help understand the actual water demands of agriculture in the Central Okanagan.

9. To be able to identify and react quickly to overuse issues during drought years.

It is important to note that at this time in the Central Okanagan area the agriculture irrigation water consumer is being charged for water consumption based on a flat rate even though most farms are now metered. The one exception is a metered charge for excessive water consumption in the SEKID community. Many communities are considering charging irrigation water use by metered consumption but none have implemented such a program to date. It would be simple to establish a water rate for irrigation water consumption in the Central Okanagan but the implications may not warrant the change.

There are both positives and negatives to both a flat rate and metered water system. **Table 13** summarizes some of pros and cons for each approach. At this time the irrigation rate charged by the communities surveyed does not reflect the full cost of providing water for these users. We will discuss this issue later in this report.

Table 13: Metered Water Rate Structures

Rate	Pro	Con
Flat Rate	• Consistent revenue • Simple to understand and administer • Treats everyone the same • Can use as much water as required if no restrictions in place • Simple billing process	• Does not promote water conservation • Does not reflect different water demands by different consumers • Cost burden is often shifted to other types of consumers
Metered Rate	• Promote water conservation • Can be used to reflect actual cost of service • Users who consume less pay less	• Requires more administration • Billing more complex • Revenue varies by water consumed • May encourage farmers to not irrigate even when necessary • May influence crops changes to reflect lower use and as such lower water cost crops

7.3 Agricultural Irrigation Water Rates

The agriculture irrigation water rates established by the nine communities we interviewed range from $63/acre/year to $129/acre/year for most irrigation water users for what is typically classed as Grade water. Grade water is typically defined as water with a guarantee of a certain level of pressure, a consistent supply of water and in some cases also chlorinated water. Greenhouse operations in one community are charged $278/acre/year. Water in most of the communities is treated because the water supplied is also used for domestic consumption. As a point of comparison the City of Penticton currently charges a rate of $133/acre/year.

The American Water Works Association (AWWA) recommends the use of a cost of service analysis to determine the appropriate water rate and rate structure. Typically the community water system supplies water to a variety of users including residential, commercial, industrial, and institutional and sometimes water for agriculture irrigation. Many communities supply potable water to agriculture users for domestic use and may or may not supply water for agricultural irrigation.

The cost of water typically includes capital costs for both annual repair and replacement and expansion or capital for improvements, operation and maintenance costs, reserve requirements, debt servicing costs and other cash requirements to deliver the water service. These costs are used to calculate the cost of providing water to the community. These costs are then used to determine the revenue requirements on an annual and longer term projection. Communities will then consider the question of what is the best rate structure to implement to recover the required revenue. Rate structures such as flat rates, seasonal rates, inclined blocks and off-peak rates are considered and a rate structure is implemented.

The initial capital investment to construct many of the water intake facilities, distribution mains, pumps and connections were funded from government programs to assist agriculture. The works directly benefitted agriculture and the community as a whole. Some of the irrigation water infrastructure is now reaching the point of requiring repair or replacement. Some systems have been previously expanded or are being expanded to meet the needs of non agriculture growth. Overall there appears to be interest in assessing the true cost of providing water to all consumers and determining a fair water pricing structure. It is not easy to define what is fair and to whom. The communities we interviewed expressed that agriculture is an important industry to the community and has been supported over many years through a "subsidy" for the agriculture irrigation water consumer.

To ensure that the end users of the irrigation water is an active agriculture operation the Greater Vernon Services (GVS) requires the property to have "Farm Status" as defined by the BC Assessment Authority (BCAA) to receive the agriculture water rate. Farms without this designation may either apply to BCAA for farm status or appeal to the GVS for the agriculture water rate. The conditions for the appeal are detailed on the GVS web site. We believe this is an attempt to ensure that the individuals that benefit from the farm irrigation rate are active agriculture producers.

From discussions we had with staff from the Ministry of Agriculture and Lands, irrigation districts and municipal staff it would appear that moderately priced water for agriculture is a key component to a thriving agricultural industry and the long term viability of agriculture in the Central Okanagan. Farm operations are very sensitive to the cost of water. A significant increase in water supply costs could affect the success of a farm under certain market conditions.

It was felt by many of the people we talked to that agriculture could afford some increase in the cost of water but what the tipping point between success and hardship depends on many variables not the least of which was the type of crop being grown and the market from year to year. It may be true that a grape farm using trickle irrigation, producing fine wine may be more tolerant to an increase in the price of water than a fruit tree farmer with an over head irrigation system. We did not find any community that has done a price sensitivity analysis for irrigation water supply for agricultural use in the Okanagan.

One scenario that the agriculture industry would not like to see is that the price of water becomes so expensive that farms are sold or used for non agriculture purposes and the water allocation is not used for the original intent of agriculture. Should this happen it may be very difficult to bring the allocation back into the agriculture industry if other land uses can afford the higher cost of water. Residential development on farm land not in the ALR could place such pressure on agriculture.

In all of the communities we interviewed the water rate for agriculture reflects a subsidy to the agricultural consumer by the other water consumers in the community. Typically the irrigation water rate is not set to recover the cost of service for the water system used by the farmer. The water system costs are placed in one pot and shared amongst the users. The costs appear to be shared based on historical rates and possibly the perceived ability of the farmers to pay. The irrigation rates do appear to help conserve water when rates are applied for excessive water use. The basic flat rate does not appear to change people's behavior based on our interviews. Installing water meters and many of the agriculture industry's irrigation efficiency initiatives have been noted as helping with water conservation by irrigation users.

There are numerous principles used to help guide communities on how they will establish their water rates. Two common principles are 1) user pay principle and 2) consumers ability to pay. The user pay principle is often applied where the actual use of some tangible asset can be measured and the consumer has some control on their amount of consumption. Electricity and natural gas are often based on the basic user pay principle. This is sometimes refined for bulk users or off peak use period users.

The consumer's ability to pay principle is applied to provide some assistance to a specific group of users such as a senior citizens rate for programs and resources. Many water rate schedules are based on the consumer's ability to pay principle. For example a community may subsidize a specific group of people based on their income. Individuals below a certain income level may be given a special rate based on income tax data. The following section will provide a simplified estimate of two possible irrigation rates based on the user pay and ability to pay principles.

Possible Irrigation Water Rates for Penticton

Penticton is in a desirable position to reap the experience and knowledge of other irrigation districts and municipalities who have also have struggled with providing irrigation water at a reasonable rate. Penticton is also in the unique position that the North and South systems supply water exclusively for agriculture.

The need to set irrigation rates to help reduce water consumption is most important when there is a limited supply of water or the cost to provide water is very expensive. Based on the data presented earlier in this report it was noted that the annual water license for both the North and South water systems at least meets the projected demand under all the various climate and crop scenarios. This would imply that providing the source water supply capacity does not change, water is not likely a scarce resource under the various water demand models investigated. Therefore the cost to provide water is not significantly affected by the amount of water consumed. The water is not treated and water is supplied by gravity flow without the costs of chemicals or electrical power consumption. There will likely be no need to set excessive water penalties to protect the water resource if water supply costs are the deciding factor.

SIMPLE USER PAY IRRIGATION WATER RATE

For discussion purposes a simple way to determine the irrigation water rate would be to use the cost of providing the water including all the components identified earlier and sharing these costs equally amongst the irrigation water users and not including any funding from the other non agriculture water consumers or from any grant programs. If the amount of water used is not an issue it would not matter if the user had an allocation of 5, 6 or 7 USGPM. Therefore for simplicity the costs could be shared equally solely based on the size of the irrigable area of the parcel.

Table 14: Irrigation Water Rate Example Including Infrastructure Replacement

	North System and South Water Systems
Total acreage	1,811 acres
Annual cost to supply water*	$9.1 million/ 25 years = $364,000 (capital) $400,000 (O&M) Total = $764,000
Average annual cost per acre	$764,000/ 1811 acres = **$422/acre/year**
Current annual cost per acre	$133/acre/year

*Notes: The annual cost to supply water does not include debt servicing, non-capital reserve requirements and any capital expansion costs. Water meters are included within the next 25 years. Capital costs are included to reflect cash flow requirements over the next 25 years.

SIMPLE CONSUMERS ABILITY TO PAY IRRIGATION WATER RATE

If we were to assume that the that the farming community has a limited ability to pay we could for discussion purposes allocate a certain amount of the water system costs to the irrigation users and recover the remaining costs from the treated water Penticton water consumer or seek government grants. As discussed earlier in this report it is difficult to determine what an acceptable water rate is for the agriculture community. It is also not accurate to conclude that all farmers have the same ability to pay.

One option is to recover the annual operating cost of the irrigation water system from the farming community. Based on the information we have collected the annual operating cost of the North and South irrigation water system is $400,000 (which includes a $75,000/year allowance for water meter reading and billing). With the addition of funding the capital costs of water meters the operating cost increases to $480,000.

It is interesting to note that the current rate is only covering 60% of the average operating costs of the irrigation systems.

The following table summarizes a simple calculation for a possible irrigation water rate based on the farmer only contributing to the annual operation and maintenance costs. There are many combinations of costs scenarios that could be explored to try and establish what an acceptable irrigation water rate is.

Table 15: Irrigation Water Rate Example Excluding Infrastructure Replacement

	North System and South Water Systems
Total acreage	1,811 acres
Annual operation and maintenance cost to supply water*	$2,000,000/25 years = $80,000 (Water meters) $400,000 (O&M) (Including meter reading) Total = $480,000
Average annual cost per acre	$480,000/ 1811 acres = **$265/acre/year**
Current annual cost per acre	$133/acre/year

*Notes: The annual cost only includes O&M costs and meters costs for 25 years. Debt servicing, capital costs beyond the water meters, reserve requirements and any capital expansion costs are not included.

If the City was able to get a 66% grant for the initial installation of the water meters then the annual cost for this approach would drop to $245/acre/year.

If these rates are considered to still be excessively high for agriculture the City could establish a policy that a percentage of operating costs will be covered by the treated water rates. Alternatively the City could create two rates classes within the irrigation water systems. Farm status land would receive the lower rate while non-farm status land would be required to pay a premium to help keep the farm status

costs lower. We do not have the statistics to know what percentage of the irrigable area would be considered non-farm status at this time to calculate what impact this would have on the rates.
Once meters are installed the City would also be in a position to allot a certain annual amount of water to each property and charge a consumption rate for excessive use over and above the allotment. This revenue could also be used to either provide a grant to farmers toward improvements to irrigation practices or could be used to reduce the subsidy amounts. The only caution with this amount is that the income from this category will not be able to be predicted ahead of time. Once meters are installed it will likely be the area that the greatest water use reduction will be realized due to the penalty of over use.

In pursuing government grants the City may attempt to use grants to pay for at least a portion of the replacement costs of the infrastructure. Of course with this comes the risk that if this money is not available when the infrastructure is required to be replaced that extensive borrowing may be required.

The City is already charging the highest rates for water when compared to the 9 local governments we contacted. Two neighbouring irrigation systems run by the Regional District of the Okanagan Similkameen and the Kaleden Irrigation District charge rates higher than the City. So there will likely be the need for consultation prior to introducing any significant increases to the water rates.

8.0 CONCLUSIONS AND RECOMMENDATIONS

As outlined in this report we have concluded that the existing irrigation systems are able to supply adequate water at adequate pressures to meet the needs of today's users with consideration for climate change and potential changes to crop types. However, with the addition of unirrigated area there is the potential that adequate source licensed water may not exist on an annual basis to meet both crop change and climate change for the North System. In addition, the current funding collected through user rates is not sufficient to cover operating costs let alone capital replacement costs without significant increases in funding.

It is therefore recommended that the City evaluate the alternatives presented for funding the shortfall and in consultation with the irrigation users adopt a funding policy that will ensure the long term viability of the irrigation water systems. It is also recommended that the City proceed with installing water meters, with a priority for the truck fill station on the North System, so as to provide a tool to the farmers to assist them in optimizing their farming practices so as to reduce the amount of water extracted from the Ellis and Penticton Creeks. Finally it is recommended that the City review the runoff projections and storage capacity on both systems, in consultation with the Okanagan Basin Water Board to confirm that adequate storage exists to meet the future flow requirements and that the City install continuous flow monitoring equipment on all of its reservoirs in order to improve water management capabilities.

APPENDIX A

CLIMATE AND IRRIGATION MODEL TECHNICAL DESCRIPTION

City of Penticton Irrigation District
Initial Data for Scenarios 1a and 2a

This describes 4 datasets representing an initial pass at scenarios 1a and 2a.

Datasets

There are 2 pairs of tables in the package, one corresponding to the current crop and irrigation systems (*_current*) and one to a higher water use scenario (*_high_use*) where all crops in the ALR that are currently classified as having an active irrigation system have been changed to medium density apples (AppleMD) using solid state undertree irrigation (Ssundertree).

Each of the pairs has both an annual and monthly component. The Irrigation Water Demand model produces the data on a daily basis and then summarizes it upwards, so any time period between daily and yearly is easily achievable (daily, weekly, monthly and annual are standard products). Daily data would be quite large, and probably not very useful, particularly given the discussion with Ted van der Gulik about the *peak demand* not being a realistic product from the Irrigation Water Demand model.

In the monthly tables, *month 0* refers to the annual soil moisture deficit – it's the amount of water that the farmer needs to replenish prior to the start of the growing season to begin with a full soil moisture "tank".

There are 2 forms of the data: tables in an MS Access 2002 database and individual Excel spreadsheets. The monthly Excel files have approx. 60,000 rows, so they have to be used with newer versions of Excel.

The data could also be exported as something like a comma-delimited text file if that's easier to handle.

Crop and Irrigation System Modifications

For the high use scenario, all crops within the ALR whose irrigations systems are classified as in use (*irrigUsed='Y'*) were converted to medium density apples using solid state undertree irrigation. All crops outside of the ALR were left unmodified, which means that non-ALR areas like sports fields, golf courses, domestic yards, etc. remain constant across the two scenarios.

Issues and Questions

The lookup tables provided by MAL to translate the Irrigation Water Demand model property keys into BCAA folio numbers don't provide a match in all cases. Some of the rows in the conversion table have the correct IWD key (*mallotslnk*), but a blank folio number, while in other cases keys in the IWD database don't appear in the conversion table. I will discuss this with MAL, but it's likely that the overall effect on this analysis would not be large since:

- Some of the missing values are for areas such as the Penticton Airport that would never be changed to a high water use crop
- These omissions will remain constant across different scenarios and will therefore cancel themselves out in terms of comparisons

All irrigated crops in the ALR were converted under the high water use scenario, and none outside of the ALR. Is this the best set for modification under this scenario? Should we instead identify agricultural crops and convert only those regardless of their inclusion within the ALR? We don't want to convert the Domestic crop (residential yards) and perhaps others such as golf courses and landscape turf, but we may want to convert areas of grape and forage outside of the ALR.

The Irrigation Management Practices classification, which affects the amount of water lost to deep percolation through over watering, has been left at the *average* setting for both scenarios. Should it be switched to *poor* for the high use scenario? It's probably safer to leave that variable alone for these comparisons, and perhaps change it to *good* if we ever get into looking at how water use could be reduced through better practices.

City of Penticton Irrigation District
Scenario Results II

This describes a series of datasets representing scenarios 1a, 1b, 2a and 2b from the modeling task list for the Penticton Irrigation area. These runs include a further set of crop modifications for scenarios 2a and 2b to pick up fields that do not have an irrigation system in place, or that do have a system but it isn't currently being used.

Selected Parcels
The Water Demand Model stores a unique identifier for each cadastral property in the source database, but this identifier does not match the descriptors used by the City of Penticton. In order to make that correlation, the Ministry of Agriculture and Lands provided a translation table containing the internal identifiers, the BCAA folio number, and a key specific to Penticton's GIS environment (PENTID).

For this round of modeling, Penticton provided a list of the specific parcels that they wanted included in the process; this table also included the unique Penticton-specific key (PENT_ID). Selecting the parcels in the Water Demand Model, therefore, required matching the PENT_ID values from the selection list to the equivalent PENTID keys in the Ministry's lookup table. The following parcels from the selection list did not match rows in the Ministry's lookup table and were therefore omitted from the modeling processes:

pent_id	folio	roll_no
13363	2100061010000	07354-050
13368	5730062047000	07389-510
13262	2805251155000	07311-000
13266	2606191109000	07182-005
13353	5253300134000	07082-002
12677	4506231395000	09552-000
13354	5753500127000	07091-002
13255	5926010583000	08102-010

Crop Modifications
Some of the scenarios are based on a modified crop and irrigation system conversion to medium density apples using solid state undertree irrigation. In an earlier round of modeling, the conversion was made only for land within the Agricultural Land Reserve; everything outside the ALR retained its current crop and irrigation system.

For these scenarios, the conversions have not been restricted to ALR areas since a set of parcels being modeled has been explicitly identified by the city as being supplied by the water systems of interest.

There is a small amount of area showing up as a Domestic Outdoor "crop" in the results. These are areas assumed to be lawn or other residential landscaping, and they are restricted to properties within Residential or Rural Residential zoning where the land use survey did not identify an agricultural crop. They were classified in terms of their irrigated areas through an image analysis process in a separate step from the original land use survey.

This domestic outdoor use has been left in its current state (a grass crop using a landscape sprinkler system) rather than modifying it to the higher use Apple/Ssundertree combination.

Finally, only those areas with an irrigation system designated as "in use" have been modified to the higher use scenario. Properties with an identified irrigation system flagged as *not in use* (abandoned, unusable, etc.) have been left that way; these don't generate a water demand. These areas should likely be included as irrigated under the build-out scenarios, since that is what the Okanagan Basin Water Board is doing in their future expansion models.

August 4, 2009
A second set of modeling runs has been completed in which those fields that have a crop listed but not an irrigation system, or with an unused irrigation system (irrigUsed = N) have also been modified to the higher use Apple/Ssundertree combination. In the earlier runs of 2a and 2b, the distinct combinations of crop, irrigation system and irrigation used flag were:

cropId	irrigId	irrigUsed	hectares
AppleMD	Ssundertree	Y	487.685014280162
Blank	Blank	N	380.339814592261
CherryLD	Blank	N	0.50959140625
Domestic	Landscapesprinkler	Y	9.7872225049026
Grass	Blank	N	5.9310499664414
Inactive	Blank	N	29.4231651678529
Inactive	Sprinkler	N	2.311458610914
Inactive	Ssovertree	N	0.892781807315
Inactive	Ssundertree	N	1.645433847117
Pear	Blank	N	0.205412993002
TurfPark	Blank	N	28.3825745974168
Vegetable	Blank	N	1.4396437499986
Yard	Blank	N	10.9882166266744

Those crop combinations above other than the AppleMD and Domestic were not generating a water demand.

Under the new modifications, the final combination areas are:

cropId	irrigId	irrigUsed	hectares
AppleMD	Ssundertree	Y	558.42612642647
Blank	Blank	N	380.339814592261
Domestic	Landscapesprinkler	Y	9.7872225049026
Yard	Landscapesprinkler	Y	10.9882166266744

Climate Models and Years
Two climate models (CGCM2.A2 and CGCM2.B2) have been selected by the OBWB for their initial future scenario modeling, and these were used for Penticton's scenarios as well. Rather than running the models for all years between now and 2100, a single year was selected for each model – this was based on the maximum potential evapotranspiration (ET0) for each model.

For the CGCM2.A2 model, the maximum predicted ET0 fell in the year 2100, while the CGCM2.B2 model showed its maximum in year 2091.

Note that the selection of years was based entirely on the annual ET0 calculation; it's possible that high precipitations for those years could offset the actual water use and that these may not be maximum use years.

Growing Season Overrides
The Water Demand Model establishes a growing season for each crop using characteristics such as the last and first frosts, accumulations of growing degree days and temperature sums, etc. However, there can be anomalous climate situations where the rules as implemented result in a crop season extending beyond its reasonable bounds. There is an override table that can be used to limit the start and end of each crop's season to avoid these anomalies. The override table can't generally be used with future scenarios, however, since changes in climate could obviously alter those season lengths.

For the future climate scenarios, the use of the overrides table was turned off.

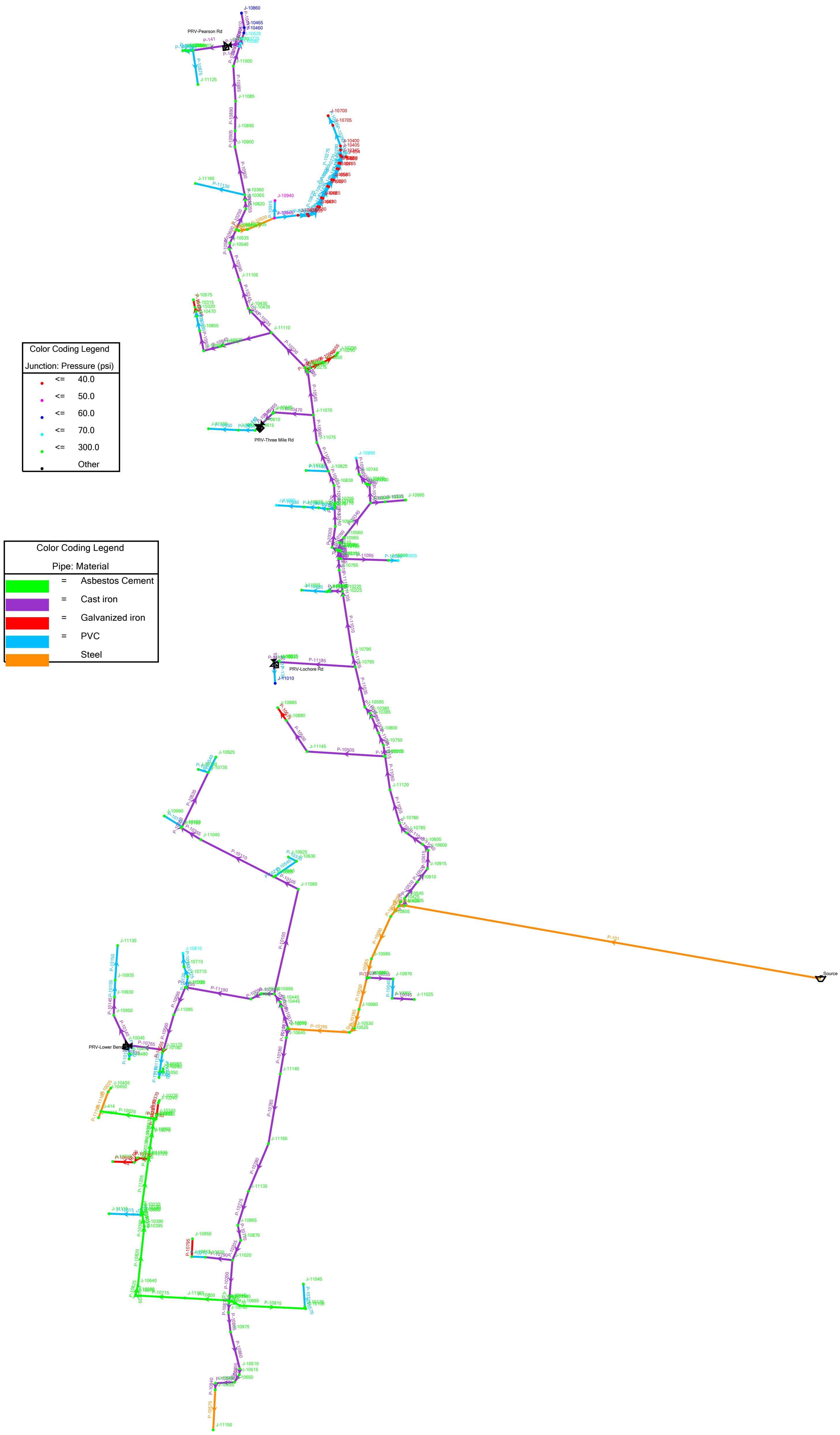
Irrigation Efficiency Factors Used in Climate and Irrigation Demand Model

Irrigation ID	Irrigation Efficiency	Comments
Blank	0.72	Unknown system - use Sprinkler parameters
Drip	0.92	
Gun	0.55	
Handline	0.7	
Microspray	0.88	
Microsprinkler	0.82	
Overtreedrip	0.92	
Overtreemicro	0.78	
Pivot	0.72	
PivotLP	0.8	
SDI	0.95	
Sprinkler	0.72	
Ssgun	0.62	
Ssovertree	0.7	
Sssprinkler	0.72	
Ssundertree	0.74	
Subirrig	0.9	
Travgun	0.65	
Wheelline	0.72	
Flood	0.4	
Landscapesprinkler	0.7	
Landscapespray	0.75	
Landscapedrip	0.95	
Golfsprinkler	0.72	

APPENDIX B

WATERCAD MODEL RESULTS

Print Preview



FlexTable: Pipe Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-30	69.02	J-1360	PRV-1	200.0	PVC	150.0	0.95	0.03
P-31	1.13	PRV-1	J-1290	200.0	PVC	150.0	0.95	0.03
P-1005	32.57	J-1380	J-1385	150.0	Asbestos Cement	140.0	19.76	1.12
P-1010	35.00	J-1385	J-1210	150.0	Asbestos Cement	140.0	19.13	1.08
P-1015	79.18	J-1710	J-1370	200.0	Asbestos Cement	140.0	33.30	1.06
P-1020	29.90	J-1370	J-1375	200.0	Asbestos Cement	140.0	28.37	0.90
P-1025	25.17	J-1305	J-1310	100.0	Asbestos Cement	140.0	0.00	0.00
P-1030	110.29	J-1260	J-1305	100.0	Asbestos Cement	140.0	2.46	0.31
P-1035	78.94	J-1795	J-1675	50.0	Galvanized iron	120.0	-1.89	0.96
P-1040	55.04	J-1675	J-1325	50.0	Galvanized iron	120.0	-1.89	0.96
P-1045	48.76	J-1135	J-1650	25.0	Galvanized iron	120.0	0.00	0.00
P-1050	13.28	J-1130	J-1135	25.0	Galvanized iron	120.0	0.00	0.00
P-1055	52.88	J-1195	J-1690	25.0	Galvanized iron	120.0	0.00	0.00
P-1060	16.83	J-1190	J-1195	25.0	Galvanized iron	120.0	0.00	0.00
P-1065	61.29	J-1570	J-1725	50.0	Galvanized iron	120.0	0.38	0.19
P-1070	44.56	J-1570	J-1575	200.0	Asbestos Cement	140.0	42.26	1.35
P-1075	54.68	J-1695	J-1570	200.0	Asbestos Cement	140.0	42.64	1.36
P-1080	150.32	J-1330	J-1695	200.0	Asbestos Cement	140.0	42.64	1.36
P-1085	42.49	J-1560	J-1325	200.0	Asbestos Cement	140.0	44.53	1.42
P-1090	27.53	J-1325	J-1330	200.0	Asbestos Cement	140.0	42.64	1.36
P-1095	93.83	J-1550	J-1560	200.0	Asbestos Cement	140.0	45.36	1.44
P-1100	41.42	J-1545	J-1550	200.0	Asbestos Cement	140.0	45.36	1.44
P-1105	64.64	J-1405	J-1545	200.0	Asbestos Cement	140.0	45.36	1.44
P-1110	31.85	J-1400	J-1405	200.0	Asbestos Cement	140.0	45.36	1.44
P-1115	60.01	J-1260	J-1400	200.0	Asbestos Cement	140.0	49.14	1.56
P-1120	135.71	J-1745	J-1170	100.0	Asbestos Cement	140.0	4.93	0.63
P-1125	64.85	J-1370	J-1745	100.0	Asbestos Cement	140.0	4.93	0.63
P-1130	79.11	J-1530	J-1380	150.0	Cast iron	130.0	19.76	1.12
P-1135	50.41	J-1660	J-1665	25.0	Galvanized iron	120.0	0.63	1.29
P-1140	60.64	J-1420	J-1660	25.0	Galvanized iron	120.0	0.63	1.29
P-1145	31.93	J-1385	J-1420	25.0	Galvanized iron	120.0	0.63	1.29
P-1150	27.03	J-1335	J-1340	100.0	Asbestos Cement	140.0	0.00	0.00
P-1155	32.00	J-1250	J-1430	75.0	Galvanized iron	120.0	7.40	1.67
P-1160	58.75	J-1640	J-1245	50.0	Galvanized iron	120.0	-3.90	1.99
P-1165	48.31	J-1635	J-1640	50.0	Galvanized iron	120.0	-3.90	1.99
P-1170	148.15	J-1350	J-1250	150.0	Asbestos Cement	140.0	12.79	0.72
P-1175	27.44	J-1345	J-1350	150.0	Asbestos Cement	140.0	12.79	0.72
P-1180	38.33	J-1490	J-1345	150.0	Asbestos Cement	140.0	15.31	0.87
P-1185	186.24	J-1740	J-1490	150.0	Asbestos Cement	140.0	15.31	0.87
P-1190	60.78	J-1365	J-1740	150.0	Asbestos Cement	140.0	15.31	0.87
P-1195	29.26	J-1340	J-1365	150.0	Asbestos Cement	140.0	15.31	0.87
P-1200	70.81	J-1655	J-1340	150.0	Asbestos Cement	140.0	15.31	0.87
P-1205	49.68	J-1465	J-1655	150.0	Asbestos Cement	140.0	19.13	1.08
P-1210	35.68	J-1215	J-1465	150.0	Asbestos Cement	140.0	19.13	1.08
P-1215	18.42	J-1210	J-1215	150.0	Asbestos Cement	140.0	19.13	1.08
P-1220	40.12	J-1525	J-1530	150.0	Asbestos Cement	140.0	19.76	1.12
P-1225	48.48	J-1540	J-1525	150.0	Asbestos Cement	140.0	22.60	1.28
P-1230	40.77	J-1535	J-1540	150.0	Asbestos Cement	140.0	22.60	1.28
P-1235	88.40	J-1300	J-1535	150.0	Asbestos Cement	140.0	27.42	1.55
P-1240	48.16	J-1460	J-1255	250.0	Asbestos Cement	140.0	51.60	1.05
P-1245	35.25	J-1095	J-1460	250.0	Asbestos Cement	140.0	51.60	1.05
P-1250	9.97	J-1090	J-1095	250.0	Asbestos Cement	140.0	51.60	1.05
P-1255	23.73	J-1285	J-1290	200.0	PVC	150.0	-0.95	0.03

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-1260	98.60	J-1715	J-1285	200.0	PVC	150.0	-0.95	0.03
P-1265	58.38	J-1590	J-1715	200.0	PVC	150.0	-0.95	0.03
P-1270	44.96	J-1240	J-1590	200.0	PVC	150.0	-0.95	0.03
P-1275	20.59	J-1115	J-1240	200.0	PVC	150.0	-0.95	0.03
P-1280	13.15	J-1110	J-1115	200.0	PVC	150.0	-0.95	0.03
P-1285	18.15	J-1205	J-1110	200.0	PVC	150.0	-0.95	0.03
P-1290	18.92	J-1220	J-1205	200.0	PVC	150.0	-0.95	0.03
P-1295	147.29	J-1845	J-1760	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1300	170.47	J-1860	J-1845	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1305	236.24	J-1685	J-1860	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1310	6.85	J-1015	J-1020	300.0	PVC	150.0	-106.81	1.51
P-1315	103.10	J-1085	J-1015	300.0	PVC	150.0	-106.81	1.51
P-1320	9.70	J-1080	J-1085	300.0	PVC	150.0	-106.81	1.51
P-1325	46.32	J-1105	J-1595	200.0	Asbestos Cement	140.0	27.42	0.87
P-1330	25.93	J-1295	J-1300	200.0	Asbestos Cement	140.0	27.42	0.87
P-1335	72.94	J-1595	J-1295	200.0	Asbestos Cement	140.0	27.42	0.87
P-1340	38.40	J-1375	J-1105	200.0	Asbestos Cement	140.0	28.37	0.90
P-1345	58.03	J-1575	J-1710	200.0	Asbestos Cement	140.0	42.26	1.35
P-1350	126.66	J-1835	J-1840	300.0	Asbestos Cement	140.0	102.96	1.46
P-1355	8.00	J-1065	J-1070	300.0	Asbestos Cement	140.0	102.96	1.46
P-1360	142.03	J-1840	J-1065	300.0	Asbestos Cement	140.0	102.96	1.46
P-1365	161.46	J-1850	J-1835	300.0	Asbestos Cement	140.0	106.81	1.51
P-1370	61.57	J-1440	J-1700	300.0	Asbestos Cement	140.0	93.51	1.32
P-1375	13.28	J-1045	J-1050	300.0	Asbestos Cement	140.0	100.44	1.42
P-1380	26.20	J-1050	J-1440	300.0	Asbestos Cement	140.0	93.51	1.32
P-1385	62.35	J-1045	J-1515	300.0	Asbestos Cement	140.0	-100.44	1.42
P-1390	39.28	J-1070	J-1515	300.0	Asbestos Cement	140.0	100.44	1.42
P-1395	46.39	J-1605	J-1610	100.0	Asbestos Cement	140.0	1.14	0.14
P-1400	5.63	J-1035	J-1040	50.0	Galvanized iron	120.0	0.00	0.00
P-1405	144.05	J-1125	J-1035	50.0	Galvanized iron	120.0	0.00	0.00
P-1410	13.26	J-1120	J-1125	100.0	Asbestos Cement	140.0	0.00	0.00
P-1415	72.10	J-1780	J-1610	50.0	PVC	150.0	-1.14	0.58
P-1420	47.54	J-1625	J-1630	300.0	Asbestos Cement	140.0	85.43	1.21
P-1425	53.68	J-1700	J-1605	300.0	Asbestos Cement	140.0	93.51	1.32
P-1430	65.61	J-1605	J-1625	300.0	Asbestos Cement	140.0	92.37	1.31
P-1435	100.28	J-1810	J-1780	50.0	Galvanized iron	120.0	0.00	0.00
P-1440	52.56	J-1680	J-1685	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1445	359.06	J-1865	J-1680	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1450	230.57	J-1850	J-1865	300.0	Asbestos Cement	140.0	-106.81	1.51
P-1455	51.44	J-1070	J-1025	50.0	Galvanized iron	120.0	0.32	0.16
P-1460	5.50	J-1025	J-1030	50.0	Galvanized iron	120.0	0.00	0.00
P-1465	26.14	J-1315	J-1320	250.0	Asbestos Cement	140.0	56.52	1.15
P-1470	31.25	J-1390	J-1395	250.0	Asbestos Cement	140.0	61.42	1.25
P-1475	59.01	J-1395	J-1315	250.0	Asbestos Cement	140.0	56.52	1.15
P-1480	23.91	J-1275	J-1280	250.0	Asbestos Cement	140.0	66.26	1.35
P-1485	123.73	J-1280	J-1390	250.0	Asbestos Cement	140.0	61.42	1.25
P-1490	200.71	J-1775	J-1275	250.0	Asbestos Cement	140.0	66.26	1.35
P-1495	71.26	J-1770	J-1775	300.0	Asbestos Cement	140.0	76.40	1.08
P-1500	43.96	J-1185	J-1520	300.0	Asbestos Cement	140.0	-85.43	1.21
P-1505	16.76	J-1165	J-1185	300.0	Asbestos Cement	140.0	-76.40	1.08
P-1510	15.79	J-1160	J-1165	300.0	Asbestos Cement	140.0	-76.40	1.08
P-1515	69.32	J-1500	J-1160	300.0	Asbestos Cement	140.0	-76.40	1.08
P-1520	38.99	J-1495	J-1500	300.0	Asbestos Cement	140.0	-76.40	1.08

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-1525	83.37	J-1770	J-1495	300.0	Asbestos Cement	140.0	-76.40	1.08
P-1530	27.62	J-1355	J-1090	250.0	Asbestos Cement	140.0	51.60	1.05
P-1535	64.45	J-1475	J-1355	250.0	Asbestos Cement	140.0	56.52	1.15
P-1540	36.37	J-1470	J-1475	250.0	Asbestos Cement	140.0	56.52	1.15
P-1545	37.22	J-1320	J-1470	250.0	Asbestos Cement	140.0	56.52	1.15
P-1550	21.92	J-1255	J-1260	250.0	Asbestos Cement	140.0	51.60	1.05
P-1555	34.00	J-1025	J-1435	25.0	Galvanized iron	120.0	0.32	0.64
P-1560	16.72	J-1120	J-1180	100.0	Asbestos Cement	140.0	6.93	0.88
P-1565	9.00	J-1075	J-1080	300.0	PVC	150.0	-106.81	1.51
P-1570	48.52	J-1645	Source	300.0	Cast iron	130.0	-106.81	1.51
P-1575	63.00	J-1755	J-1645	300.0	Cast iron	130.0	-106.81	1.51
P-1580	119.57	J-1585	J-1755	300.0	Cast iron	130.0	-106.81	1.51
P-1585	51.87	J-1020	J-1670	300.0	Cast iron	130.0	-106.81	1.51
P-1590	17.50	J-1200	J-1075	300.0	PVC	150.0	-106.81	1.51
P-1595	66.31	J-1760	J-1765	300.0	PVC	150.0	-106.81	1.51
P-1600	121.42	J-1765	J-1200	300.0	PVC	150.0	-106.81	1.51
P-1605	15.26	J-1150	J-1155	50.0	PVC	150.0	4.61	2.35
P-1610	31.93	J-1145	J-1150	50.0	PVC	150.0	4.61	2.35
P-1615	57.58	J-1705	J-1140	100.0	Asbestos Cement	140.0	4.92	0.63
P-1620	85.76	J-1355	J-1705	100.0	Asbestos Cement	140.0	4.92	0.63
P-1625	5.08	J-1005	J-1010	100.0	Asbestos Cement	140.0	0.00	0.00
P-1630	120.71	J-1270	J-1615	100.0	Asbestos Cement	140.0	7.83	1.00
P-1635	22.03	J-1265	J-1270	100.0	Asbestos Cement	140.0	7.83	1.00
P-1640	45.67	J-1600	J-1265	100.0	Asbestos Cement	140.0	9.03	1.15
P-1645	62.36	J-1750	J-1600	100.0	Asbestos Cement	140.0	9.03	1.15
P-1650	65.96	J-1185	J-1750	100.0	Asbestos Cement	140.0	9.03	1.15
P-1655	125.68	J-1775	J-1830	50.0	PVC	150.0	4.56	2.32
P-1660	62.93	J-1520	J-1630	300.0	Asbestos Cement	140.0	-85.43	1.21
P-1665	65.07	J-1415	J-1280	50.0	PVC	150.0	-4.83	2.46
P-1670	31.88	J-1410	J-1415	50.0	PVC	150.0	-4.83	2.46
P-1675	78.62	J-1395	J-1790	50.0	Galvanized iron	120.0	0.00	0.00
P-1680	86.82	J-1485	J-1140	18.0	PVC	150.0	-0.32	1.24
P-1685	37.44	J-1060	J-1485	18.0	PVC	150.0	-0.32	1.24
P-1690	7.88	J-1055	J-1060	18.0	PVC	150.0	-0.32	1.24
P-1695	39.01	J-1155	J-1505	50.0	PVC	150.0	4.61	2.35
P-1700	16.63	J-1170	J-1175	100.0	Asbestos Cement	140.0	4.93	0.63
P-1705	20.73	J-1245	J-1250	50.0	Galvanized iron	120.0	-5.39	2.75
P-1710	14.23	J-1140	J-1145	50.0	PVC	150.0	4.61	2.35
P-1715	12.65	J-1100	J-1105	200.0	PVC	150.0	-0.95	0.03
P-1720	28.60	J-1360	J-1100	200.0	PVC	150.0	-0.95	0.03
P-1730	87.41	J-1805	J-1525	50.0	PVC	150.0	-2.84	1.45
P-1735	44.65	J-1580	J-1585	300.0	Cast iron	130.0	-106.81	1.51
P-1740	80.25	J-1800	J-1580	300.0	Cast iron	130.0	-106.81	1.51
P-1745	102.93	J-1820	J-1800	300.0	Cast iron	130.0	-106.81	1.51
P-1750	134.36	J-1735	J-1820	300.0	Cast iron	130.0	-106.81	1.51
P-1755	60.62	J-1730	J-1735	300.0	Cast iron	130.0	-106.81	1.51
P-1760	76.38	J-1785	J-1730	300.0	Cast iron	130.0	-106.81	1.51
P-1765	99.97	J-1815	J-1785	300.0	Cast iron	130.0	-106.81	1.51
P-1770	162.43	J-1855	J-1815	300.0	Cast iron	130.0	-106.81	1.51
P-1775	193.70	J-1825	J-1855	300.0	Cast iron	130.0	-106.81	1.51
P-1780	112.56	J-1670	J-1825	300.0	Cast iron	130.0	-106.81	1.51
P-1785	39.06	J-1510	J-1225	200.0	PVC	150.0	0.00	0.00
P-1790	43.58	J-1565	J-1510	200.0	PVC	150.0	0.00	0.00

FlexTable: Pipe Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-1795	20.47	J-1235	J-1230	200.0	PVC	150.0	0.00	0.00
P-1800	20.13	J-1225	J-1230	200.0	PVC	150.0	0.00	0.00
P-1805	33.96	J-1445	J-1235	200.0	PVC	150.0	0.00	0.00
P-1810	37.25	J-1445	J-1480	200.0	PVC	150.0	0.00	0.00
P-1815	41.82	J-1480	J-1555	200.0	PVC	150.0	0.00	0.00
P-1820	67.21	J-1555	J-1455	200.0	PVC	150.0	0.00	0.00
P-1825	34.96	J-1450	J-1455	200.0	PVC	150.0	0.95	0.03
P-1830	44.41	J-1450	J-1220	200.0	PVC	150.0	-0.95	0.03
P-1835	27.72	J-1690	J-1725	25.0	Galvanized iron	120.0	0.00	0.00
P-1840	6.12	J-1725	J-1130	25.0	Galvanized iron	120.0	0.00	0.00
P-1845	26.24	J-1130	J-1720	25.0	Galvanized iron	120.0	0.00	0.00
P-1850	40.63	J-1620	J-1010	100.0	Asbestos Cement	140.0	-7.83	1.00
P-1855	6.14	J-1010	J-1615	100.0	Asbestos Cement	140.0	-7.83	1.00
P-1860	57.80	J-1120	J-1050	100.0	Asbestos Cement	140.0	-6.93	0.88
P-1865	36.52	J-1425	J-1835	100.0	Asbestos Cement	140.0	-3.85	0.49

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-414	416.43	3.79	512.14	135.9
J-647	476.26	0.00	493.13	24.0
J-648	480.81	0.00	493.10	17.4
J-649	487.15	0.00	493.06	8.4
J-650	490.94	0.00	493.03	3.0
J-651	494.68	0.00	492.99	-2.4
J-652	495.33	0.00	492.96	-3.4
J-653	496.09	0.00	492.94	-4.5
J-654	498.82	0.32	492.93	-8.4
J-655	470.09	0.00	493.19	32.8
J-10005	452.49	0.00	538.44	122.0
J-10010	452.44	0.00	538.69	122.4
J-10015	440.09	0.00	552.53	159.6
J-10020	440.29	0.00	552.53	159.3
J-10025	410.32	0.00	538.25	181.6
J-10030	411.07	0.00	538.25	180.5
J-10035	424.46	0.00	532.07	152.7
J-10040	425.11	0.00	532.12	151.9
J-10045	414.50	0.00	495.27	114.7
J-10055	422.98	0.00	513.47	128.5
J-10060	423.00	0.00	513.63	128.7
J-10065	425.00	0.00	513.06	125.0
J-10070	425.10	11.37	513.07	124.9
J-10075	420.97	0.00	514.23	132.4
J-10080	421.00	0.00	514.22	132.3
J-10085	431.28	0.00	494.44	89.6
J-10090	430.80	0.00	494.44	90.3
J-10095	433.68	0.00	523.62	127.7
J-10100	433.89	4.37	523.98	127.9
J-10105	456.44	0.00	510.68	77.0
J-10110	456.45	0.00	510.72	77.0
J-10115	418.00	7.36	511.70	133.0
J-10120	418.00	0.00	511.66	132.9
J-10125	461.52	0.00	514.59	75.3
J-10130	461.53	12.83	514.59	75.3
J-10135	432.40	0.00	527.40	134.9
J-10140	433.10	0.00	527.56	134.1
J-10145	426.73	0.00	514.63	124.8
J-10150	427.90	0.00	514.64	123.1
J-10155	418.00	6.64	486.29	96.9
J-10160	417.99	0.00	486.32	97.0
J-10165	427.03	0.00	523.59	137.1
J-10170	425.44	0.00	523.73	139.5
J-10175	436.00	0.00	508.82	103.4
J-10180	435.05	0.00	500.59	93.0
J-10185	428.00	0.00	514.63	123.0
J-10190	423.00	11.23	513.59	128.6
J-10195	423.15	0.00	529.41	150.8
J-10200	456.53	0.00	510.78	77.0
J-10205	428.00	1.02	523.42	135.4

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10210	433.22	0.00	528.24	134.9
J-10215	433.94	0.00	526.47	131.3
J-10220	433.17	10.47	532.75	141.4
J-10225	433.10	0.00	533.43	142.4
J-10230	423.00	0.00	513.57	128.6
J-10235	426.59	0.00	512.85	122.4
J-10240	427.03	0.00	512.85	121.8
J-10245	429.31	0.00	498.23	97.8
J-10250	431.55	0.00	497.91	94.2
J-10255	432.52	0.00	499.48	95.0
J-10260	431.70	0.00	499.48	96.2
J-10265	416.39	7.65	509.92	132.8
J-10270	415.41	0.00	510.30	134.7
J-10275	414.82	0.00	510.72	136.1
J-10280	463.27	0.00	557.59	133.9
J-10285	461.48	0.00	557.74	136.6
J-10290	442.08	3.97	491.73	70.5
J-10295	440.04	0.00	491.73	73.4
J-10300	413.27	0.00	472.76	84.4
J-10305	415.17	0.00	474.22	83.8
J-10310	409.45	4.66	471.17	87.6
J-10315	410.24	8.39	479.75	98.7
J-10320	411.00	0.00	488.87	110.5
J-10325	426.84	0.00	512.85	122.1
J-10330	426.00	0.00	512.84	123.3
J-10335	431.16	0.00	499.48	97.0
J-10340	427.17	0.00	512.85	121.6
J-10345	496.09	0.00	492.95	-4.5
J-10355	416.49	0.00	508.33	130.4
J-10360	431.97	0.00	495.44	90.1
J-10365	432.26	0.00	495.73	90.1
J-10370	401.14	0.00	495.18	133.5
J-10375	401.28	0.00	494.43	132.2
J-10380	441.35	0.00	548.53	152.1
J-10385	441.44	0.00	548.85	152.5
J-10390	424.00	0.00	513.72	127.4
J-10395	423.53	0.00	513.75	128.1
J-10400	499.11	0.00	492.91	-8.8
J-10405	497.17	0.00	492.93	-6.0
J-10410	431.00	3.99	526.96	136.2
J-10415	418.78	0.00	476.35	81.7
J-10420	460.17	0.00	572.02	158.8
J-10425	458.99	0.00	572.02	160.4
J-10430	425.47	0.00	502.39	109.2
J-10435	424.15	7.31	502.62	111.4
J-10440	455.00	0.00	531.63	108.8
J-10445	454.76	0.00	532.75	110.7
J-10450	415.10	0.00	512.14	137.8
J-10455	415.00	0.00	512.14	137.9
J-10460	437.07	0.00	477.96	58.0

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10465	438.23	0.00	477.96	56.4
J-10470	411.00	0.00	489.13	110.9
J-10475	415.30	0.00	487.82	102.9
J-10480	416.06	6.12	483.51	95.7
J-10485	424.00	0.00	512.07	125.0
J-10490	422.00	0.00	511.54	127.1
J-10495	494.68	0.00	492.99	-2.4
J-10500	495.33	0.00	492.97	-3.3
J-10505	460.89	0.00	573.13	159.3
J-10510	426.14	0.00	505.69	112.9
J-10515	426.02	0.00	504.96	112.1
J-10520	435.23	3.69	477.96	60.7
J-10525	459.15	0.00	548.24	126.5
J-10530	460.62	8.98	549.22	125.8
J-10535	427.86	8.49	498.77	100.7
J-10540	427.86	0.00	499.11	101.1
J-10545	460.98	21.96	572.07	157.7
J-10550	424.98	0.00	503.19	111.0
J-10555	423.12	0.00	502.96	113.3
J-10560	433.32	0.00	520.63	123.9
J-10565	432.89	0.00	522.10	126.6
J-10570	422.40	0.00	515.77	132.5
J-10575	408.98	0.00	479.75	100.5
J-10580	433.26	0.00	478.29	63.9
J-10585	490.94	0.00	493.04	3.0
J-10590	487.15	0.00	493.06	8.4
J-10595	439.53	0.00	547.86	153.8
J-10600	460.28	0.00	565.27	149.0
J-10605	459.13	0.00	564.26	149.2
J-10610	410.86	0.00	511.26	142.5
J-10615	405.99	0.00	469.12	89.6
J-10620	432.04	7.01	496.19	91.1
J-10625	418.00	0.00	494.44	108.5
J-10630	419.86	0.00	494.44	105.9
J-10635	446.27	0.00	496.89	71.8
J-10640	421.00	3.30	514.15	132.2
J-10645	452.69	0.00	537.96	121.0
J-10650	426.13	17.11	503.84	110.3
J-10655	460.33	8.85	507.60	67.1
J-10660	457.24	0.00	523.00	93.4
J-10665	430.29	0.00	514.63	119.7
J-10670	422.00	0.00	505.33	118.3
J-10675	468.02	2.92	493.22	35.8
J-10680	470.09	0.00	493.19	32.8
J-10685	480.81	0.00	493.11	17.5
J-10690	476.26	0.00	493.14	24.0
J-10695	455.00	13.29	529.09	105.2
J-10700	507.00	0.32	492.80	-20.2
J-10705	505.01	0.00	492.84	-17.3
J-10710	451.00	0.00	502.53	73.2

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10715	450.41	0.00	508.72	82.8
J-10720	450.89	0.00	515.04	91.1
J-10725	426.00	0.00	513.22	123.8
J-10730	408.13	0.00	482.55	105.6
J-10735	409.65	8.10	482.55	103.5
J-10740	427.32	0.00	514.44	123.7
J-10745	456.87	0.00	510.40	76.0
J-10750	440.64	0.00	551.50	157.3
J-10755	451.77	0.00	525.27	104.3
J-10760	453.90	0.00	527.09	103.9
J-10765	433.25	0.00	529.83	137.1
J-10770	426.39	0.00	477.61	72.7
J-10775	434.11	0.00	478.04	62.3
J-10780	452.15	0.00	560.37	153.6
J-10785	455.00	0.00	561.89	151.7
J-10790	434.00	0.00	543.54	155.5
J-10795	433.98	5.45	544.44	156.8
J-10800	441.33	9.89	550.28	154.7
J-10805	462.00	0.00	569.61	152.7
J-10810	449.93	5.05	494.84	63.8
J-10815	424.53	0.00	516.74	130.9
J-10820	424.00	5.81	516.74	131.6
J-10825	427.06	0.00	521.07	133.4
J-10830	427.69	0.00	522.14	134.1
J-10835	422.25	0.00	489.27	95.1
J-10840	441.41	0.00	511.23	99.1
J-10845	444.72	10.95	509.65	92.2
J-10850	424.25	0.00	499.98	107.5
J-10855	410.89	0.00	489.87	112.1
J-10860	442.69	0.00	477.96	50.1
J-10865	428.00	22.28	520.64	131.5
J-10870	428.00	0.00	519.40	129.7
J-10875	426.30	0.00	512.85	122.9
J-10880	409.68	0.00	534.74	177.5
J-10885	406.29	1.58	533.19	180.1
J-10890	461.03	4.96	509.98	69.5
J-10895	429.27	4.99	492.48	89.7
J-10900	429.53	0.00	493.22	90.4
J-10905	408.25	6.51	491.22	117.8
J-10910	463.31	0.00	569.56	150.8
J-10915	462.31	0.00	567.50	149.3
J-10920	395.05	0.00	459.63	91.7
J-10925	409.56	0.00	482.55	103.6
J-10930	414.23	5.95	490.87	108.8
J-10935	414.00	0.00	485.22	101.1
J-10940	460.55	2.65	490.40	42.4
J-10945	460.62	2.56	493.47	46.6
J-10950	426.22	0.00	516.74	128.5
J-10955	412.94	0.00	492.44	112.9
J-10960	428.61	0.00	525.22	137.1

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10965	480.88	0.00	555.68	106.2
J-10970	478.43	0.00	556.43	110.7
J-10975	426.89	10.97	510.41	118.6
J-10980	462.28	0.00	552.43	128.0
J-10985	460.48	9.78	561.12	142.8
J-10990	419.19	0.00	486.29	95.3
J-10995	457.20	0.00	509.65	74.5
J-11000	430.41	5.27	480.07	70.5
J-11005	409.67	5.92	537.81	181.9
J-11010	408.86	3.47	448.77	56.6
J-11015	417.85	1.58	509.34	129.9
J-11020	427.02	0.00	517.65	128.6
J-11025	494.30	7.23	554.57	85.6
J-11030	416.00	0.00	521.07	149.1
J-11035	426.00	0.00	513.21	123.8
J-11040	417.56	14.36	486.91	98.4
J-11045	462.22	0.00	514.59	74.3
J-11050	429.25	9.08	499.12	99.2
J-11055	418.62	7.24	501.14	117.1
J-11060	436.03	26.02	496.94	86.5
J-11065	415.87	0.00	512.14	136.7
J-11070	417.79	2.07	517.04	140.9
J-11075	420.82	2.16	518.90	139.2
J-11080	415.22	7.20	458.37	61.2
J-11085	427.79	0.00	486.81	83.8
J-11090	451.40	0.00	514.91	90.2
J-11095	449.68	8.84	511.34	87.5
J-11100	387.00	4.97	442.88	79.3
J-11105	428.14	0.00	500.81	103.2
J-11110	421.15	0.00	504.63	118.5
J-11115	416.00	2.27	509.24	132.3
J-11120	443.00	13.32	556.18	160.7
J-11125	414.31	1.31	474.71	85.7
J-11130	421.62	3.74	473.71	73.9
J-11135	436.28	0.00	524.78	125.6
J-11140	454.00	25.13	535.01	115.0
J-11145	419.41	14.85	534.86	163.9
J-11150	426.60	17.11	500.73	105.2
J-11155	424.00	6.98	514.41	128.3
J-11160	407.44	1.82	491.00	118.6
J-11165	443.00	16.54	530.76	124.6

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10700	507.00	0.32	492.80	-20.2
J-10705	505.01	0.00	492.84	-17.3
J-10400	499.11	0.00	492.91	-8.8
J-654	498.82	0.32	492.93	-8.4
J-10405	497.17	0.00	492.93	-6.0
J-653	496.09	0.00	492.94	-4.5
J-10345	496.09	0.00	492.95	-4.5
J-652	495.33	0.00	492.96	-3.4
J-10500	495.33	0.00	492.97	-3.3
J-651	494.68	0.00	492.99	-2.4
J-10495	494.68	0.00	492.99	-2.4
J-650	490.94	0.00	493.03	3.0
J-10585	490.94	0.00	493.04	3.0
J-649	487.15	0.00	493.06	8.4
J-10590	487.15	0.00	493.06	8.4
J-648	480.81	0.00	493.10	17.4
J-10685	480.81	0.00	493.11	17.5
J-647	476.26	0.00	493.13	24.0
J-10690	476.26	0.00	493.14	24.0
J-655	470.09	0.00	493.19	32.8
J-10680	470.09	0.00	493.19	32.8
J-10675	468.02	2.92	493.22	35.8
J-10940	460.55	2.65	490.40	42.4
J-10945	460.62	2.56	493.47	46.6
J-10860	442.69	0.00	477.96	50.1
J-10465	438.23	0.00	477.96	56.4
J-11010	408.86	3.47	448.77	56.6
J-10460	437.07	0.00	477.96	58.0
J-10520	435.23	3.69	477.96	60.7
J-11080	415.22	7.20	458.37	61.2
J-10775	434.11	0.00	478.04	62.3
J-10810	449.93	5.05	494.84	63.8
J-10580	433.26	0.00	478.29	63.9
J-10655	460.33	8.85	507.60	67.1
J-10890	461.03	4.96	509.98	69.5
J-10290	442.08	3.97	491.73	70.5
J-11000	430.41	5.27	480.07	70.5
J-10635	446.27	0.00	496.89	71.8
J-10770	426.39	0.00	477.61	72.7
J-10710	451.00	0.00	502.53	73.2
J-10295	440.04	0.00	491.73	73.4
J-11130	421.62	3.74	473.71	73.9
J-11045	462.22	0.00	514.59	74.3
J-10995	457.20	0.00	509.65	74.5
J-10130	461.53	12.83	514.59	75.3
J-10125	461.52	0.00	514.59	75.3
J-10745	456.87	0.00	510.40	76.0
J-10105	456.44	0.00	510.68	77.0
J-10200	456.53	0.00	510.78	77.0
J-10110	456.45	0.00	510.72	77.0
J-11100	387.00	4.97	442.88	79.3
J-10415	418.78	0.00	476.35	81.7

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10715	450.41	0.00	508.72	82.8
J-11085	427.79	0.00	486.81	83.8
J-10305	415.17	0.00	474.22	83.8
J-10300	413.27	0.00	472.76	84.4
J-11025	494.30	7.23	554.57	85.6
J-11125	414.31	1.31	474.71	85.7
J-11060	436.03	26.02	496.94	86.5
J-11095	449.68	8.84	511.34	87.5
J-10310	409.45	4.66	471.17	87.6
J-10615	405.99	0.00	469.12	89.6
J-10085	431.28	0.00	494.44	89.6
J-10895	429.27	4.99	492.48	89.7
J-10365	432.26	0.00	495.73	90.1
J-10360	431.97	0.00	495.44	90.1
J-11090	451.40	0.00	514.91	90.2
J-10090	430.80	0.00	494.44	90.3
J-10900	429.53	0.00	493.22	90.4
J-10620	432.04	7.01	496.19	91.1
J-10720	450.89	0.00	515.04	91.1
J-10920	395.05	0.00	459.63	91.7
J-10845	444.72	10.95	509.65	92.2
J-10180	435.05	0.00	500.59	93.0
J-10660	457.24	0.00	523.00	93.4
J-10250	431.55	0.00	497.91	94.2
J-10255	432.52	0.00	499.48	95.0
J-10835	422.25	0.00	489.27	95.1
J-10990	419.19	0.00	486.29	95.3
J-10480	416.06	6.12	483.51	95.7
J-10260	431.70	0.00	499.48	96.2
J-10155	418.00	6.64	486.29	96.9
J-10335	431.16	0.00	499.48	97.0
J-10160	417.99	0.00	486.32	97.0
J-10245	429.31	0.00	498.23	97.8
J-11040	417.56	14.36	486.91	98.4
J-10315	410.24	8.39	479.75	98.7
J-10840	441.41	0.00	511.23	99.1
J-11050	429.25	9.08	499.12	99.2
J-10575	408.98	0.00	479.75	100.5
J-10535	427.86	8.49	498.77	100.7
J-10935	414.00	0.00	485.22	101.1
J-10540	427.86	0.00	499.11	101.1
J-10475	415.30	0.00	487.82	102.9
J-11105	428.14	0.00	500.81	103.2
J-10175	436.00	0.00	508.82	103.4
J-10735	409.65	8.10	482.55	103.5
J-10925	409.56	0.00	482.55	103.6
J-10760	453.90	0.00	527.09	103.9
J-10755	451.77	0.00	525.27	104.3
J-10695	455.00	13.29	529.09	105.2
J-11150	426.60	17.11	500.73	105.2
J-10730	408.13	0.00	482.55	105.6
J-10630	419.86	0.00	494.44	105.9

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10965	480.88	0.00	555.68	106.2
J-10850	424.25	0.00	499.98	107.5
J-10625	418.00	0.00	494.44	108.5
J-10440	455.00	0.00	531.63	108.8
J-10930	414.23	5.95	490.87	108.8
J-10430	425.47	0.00	502.39	109.2
J-10650	426.13	17.11	503.84	110.3
J-10320	411.00	0.00	488.87	110.5
J-10445	454.76	0.00	532.75	110.7
J-10970	478.43	0.00	556.43	110.7
J-10470	411.00	0.00	489.13	110.9
J-10550	424.98	0.00	503.19	111.0
J-10435	424.15	7.31	502.62	111.4
J-10515	426.02	0.00	504.96	112.1
J-10855	410.89	0.00	489.87	112.1
J-10955	412.94	0.00	492.44	112.9
J-10510	426.14	0.00	505.69	112.9
J-10555	423.12	0.00	502.96	113.3
J-10045	414.50	0.00	495.27	114.7
J-11140	454.00	25.13	535.01	115.0
J-11055	418.62	7.24	501.14	117.1
J-10905	408.25	6.51	491.22	117.8
J-10670	422.00	0.00	505.33	118.3
J-11110	421.15	0.00	504.63	118.5
J-10975	426.89	10.97	510.41	118.6
J-11160	407.44	1.82	491.00	118.6
J-10665	430.29	0.00	514.63	119.7
J-10645	452.69	0.00	537.96	121.0
J-10340	427.17	0.00	512.85	121.6
J-10240	427.03	0.00	512.85	121.8
J-10005	452.49	0.00	538.44	122.0
J-10325	426.84	0.00	512.85	122.1
J-10010	452.44	0.00	538.69	122.4
J-10235	426.59	0.00	512.85	122.4
J-10875	426.30	0.00	512.85	122.9
J-10185	428.00	0.00	514.63	123.0
J-10150	427.90	0.00	514.64	123.1
J-10330	426.00	0.00	512.84	123.3
J-10740	427.32	0.00	514.44	123.7
J-11035	426.00	0.00	513.21	123.8
J-10725	426.00	0.00	513.22	123.8
J-10560	433.32	0.00	520.63	123.9
J-11165	443.00	16.54	530.76	124.6
J-10145	426.73	0.00	514.63	124.8
J-10070	425.10	11.37	513.07	124.9
J-10065	425.00	0.00	513.06	125.0
J-10485	424.00	0.00	512.07	125.0
J-11135	436.28	0.00	524.78	125.6
J-10530	460.62	8.98	549.22	125.8
J-10525	459.15	0.00	548.24	126.5
J-10565	432.89	0.00	522.10	126.6
J-10490	422.00	0.00	511.54	127.1

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

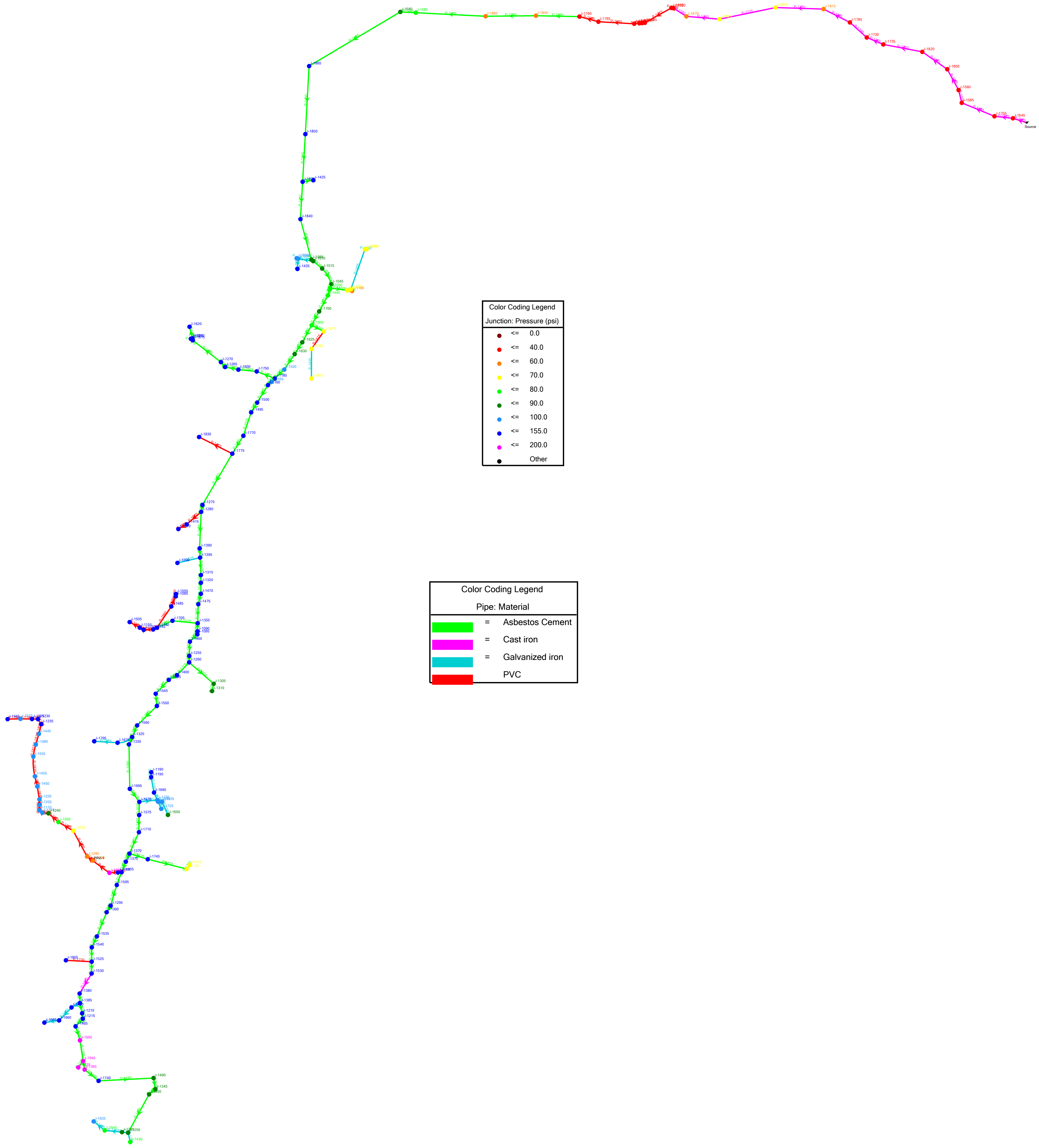
Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10390	424.00	0.00	513.72	127.4
J-10095	433.68	0.00	523.62	127.7
J-10100	433.89	4.37	523.98	127.9
J-10980	462.28	0.00	552.43	128.0
J-10395	423.53	0.00	513.75	128.1
J-11155	424.00	6.98	514.41	128.3
J-10055	422.98	0.00	513.47	128.5
J-10950	426.22	0.00	516.74	128.5
J-10230	423.00	0.00	513.57	128.6
J-10190	423.00	11.23	513.59	128.6
J-11020	427.02	0.00	517.65	128.6
J-10060	423.00	0.00	513.63	128.7
J-10870	428.00	0.00	519.40	129.7
J-11015	417.85	1.58	509.34	129.9
J-10355	416.49	0.00	508.33	130.4
J-10815	424.53	0.00	516.74	130.9
J-10215	433.94	0.00	526.47	131.3
J-10865	428.00	22.28	520.64	131.5
J-10820	424.00	5.81	516.74	131.6
J-10640	421.00	3.30	514.15	132.2
J-10375	401.28	0.00	494.43	132.2
J-10080	421.00	0.00	514.22	132.3
J-11115	416.00	2.27	509.24	132.3
J-10075	420.97	0.00	514.23	132.4
J-10570	422.40	0.00	515.77	132.5
J-10265	416.39	7.65	509.92	132.8
J-10120	418.00	0.00	511.66	132.9
J-10115	418.00	7.36	511.70	133.0
J-10825	427.06	0.00	521.07	133.4
J-10370	401.14	0.00	495.18	133.5
J-10280	463.27	0.00	557.59	133.9
J-10830	427.69	0.00	522.14	134.1
J-10140	433.10	0.00	527.56	134.1
J-10270	415.41	0.00	510.30	134.7
J-10135	432.40	0.00	527.40	134.9
J-10210	433.22	0.00	528.24	134.9
J-10205	428.00	1.02	523.42	135.4
J-414	416.43	3.79	512.14	135.9
J-10275	414.82	0.00	510.72	136.1
J-10410	431.00	3.99	526.96	136.2
J-10285	461.48	0.00	557.74	136.6
J-11065	415.87	0.00	512.14	136.7
J-10165	427.03	0.00	523.59	137.1
J-10765	433.25	0.00	529.83	137.1
J-10960	428.61	0.00	525.22	137.1
J-10450	415.10	0.00	512.14	137.8
J-10455	415.00	0.00	512.14	137.9
J-11075	420.82	2.16	518.90	139.2
J-10170	425.44	0.00	523.73	139.5
J-11070	417.79	2.07	517.04	140.9
J-10220	433.17	10.47	532.75	141.4
J-10225	433.10	0.00	533.43	142.4

FlexTable: Junction Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10610	410.86	0.00	511.26	142.5
J-10985	460.48	9.78	561.12	142.8
J-10600	460.28	0.00	565.27	149.0
J-11030	416.00	0.00	521.07	149.1
J-10605	459.13	0.00	564.26	149.2
J-10915	462.31	0.00	567.50	149.3
J-10910	463.31	0.00	569.56	150.8
J-10195	423.15	0.00	529.41	150.8
J-10785	455.00	0.00	561.89	151.7
J-10040	425.11	0.00	532.12	151.9
J-10380	441.35	0.00	548.53	152.1
J-10385	441.44	0.00	548.85	152.5
J-10035	424.46	0.00	532.07	152.7
J-10805	462.00	0.00	569.61	152.7
J-10780	452.15	0.00	560.37	153.6
J-10595	439.53	0.00	547.86	153.8
J-10800	441.33	9.89	550.28	154.7
J-10790	434.00	0.00	543.54	155.5
J-10795	433.98	5.45	544.44	156.8
J-10750	440.64	0.00	551.50	157.3
J-10545	460.98	21.96	572.07	157.7
J-10420	460.17	0.00	572.02	158.8
J-10505	460.89	0.00	573.13	159.3
J-10020	440.29	0.00	552.53	159.3
J-10015	440.09	0.00	552.53	159.6
J-10425	458.99	0.00	572.02	160.4
J-11120	443.00	13.32	556.18	160.7
J-11145	419.41	14.85	534.86	163.9
J-10880	409.68	0.00	534.74	177.5
J-10885	406.29	1.58	533.19	180.1
J-10030	411.07	0.00	538.25	180.5
J-10025	410.32	0.00	538.25	181.6
J-11005	409.67	5.92	537.81	181.9

Print Preview



Title: Penticton South Irrigation System

090526 Penticton South Irrigation System.wtg

8/21/2009

Urban Systems Ltd
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666

Project Engineer: Steve Brubacher
Bentley WaterCAD V8 XM Edition
[08.09.400.34]

FlexTable: Pipe Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-101	2,025.29	J-10505	R-1	650.0	Steel	100.0	-533.43	1.61
P-137	3.80	J-11005	PRV-Lochore Rd	50.0	PVC	150.0	3.47	1.77
P-138	99.83	PRV-Lochore Rd	J-11010	50.0	PVC	150.0	3.47	1.77
P-139	3.72	J-10610	PRV-Three Mile Rd	50.0	PVC	150.0	4.97	2.53
P-140	36.46	PRV-Three Mile Rd	J-10615	50.0	PVC	150.0	4.97	2.53
P-141	170.61	J-10415	PRV-Pearson Rd	100.0	Cast iron	130.0	-5.97	0.76
P-142	1.54	PRV-Pearson Rd	J-10770	100.0	Cast iron	130.0	-5.97	0.76
P-144	44.22	J-647	J-648	50.0	PVC	150.0	0.32	0.16
P-145	62.19	J-648	J-649	50.0	PVC	150.0	0.32	0.16
P-146	40.30	J-649	J-650	50.0	PVC	150.0	0.32	0.16
P-147	57.54	J-650	J-651	50.0	PVC	150.0	0.32	0.16
P-148	29.37	J-651	J-652	50.0	PVC	150.0	0.32	0.16
P-149	31.30	J-652	J-653	50.0	PVC	150.0	0.32	0.16
P-150	20.96	J-653	J-654	50.0	PVC	150.0	0.32	0.16
P-151	71.10	J-655	J-647	50.0	PVC	150.0	0.32	0.16
P-152	51.07	J-655	J-10675	50.0	PVC	150.0	-0.32	0.16
P-10005	16.44	J-10335	J-10260	100.0	PVC	150.0	0.00	0.00
P-10010	28.83	J-10420	J-10505	350.0	Steel	100.0	-301.52	3.13
P-10015	154.22	J-11115	J-10055	50.0	PVC	150.0	-2.27	1.16
P-10020	251.12	J-10330	J-414	100.0	Asbestos Cement	140.0	3.80	0.48
P-10025	22.40	J-10450	J-10455	100.0	Steel	100.0	0.00	0.00
P-10030	14.35	J-10280	J-10285	100.0	Cast iron	130.0	-7.23	0.92
P-10035	111.57	J-10970	J-10280	100.0	Cast iron	130.0	-7.23	0.92
P-10040	92.85	J-10965	J-10970	100.0	PVC	150.0	-7.23	0.92
P-10045	106.19	J-11025	J-10965	100.0	Cast iron	130.0	-7.23	0.92
P-10050	155.31	J-10980	J-10285	350.0	Steel	100.0	-284.51	2.96
P-10055	63.54	J-10805	J-10420	350.0	Steel	100.0	-301.52	3.13
P-10060	223.13	J-10985	J-10805	350.0	Steel	100.0	-301.52	3.13
P-10065	94.26	J-10285	J-10985	350.0	Steel	100.0	-291.74	3.03
P-10070	107.98	J-10005	J-10445	200.0	Cast iron	130.0	107.19	3.41
P-10075	48.28	J-10440	J-10695	200.0	Cast iron	130.0	107.19	3.41
P-10080	21.20	J-10440	J-10445	200.0	Cast iron	130.0	-107.19	3.41
P-10085	61.55	J-10760	J-10695	150.0	Cast iron	130.0	-38.78	2.19
P-10090	56.05	J-10755	J-10760	150.0	Cast iron	130.0	-38.78	2.19
P-10095	142.31	J-11090	J-11095	150.0	Cast iron	130.0	33.73	1.91
P-10100	515.01	J-10695	J-11060	150.0	Cast iron	130.0	55.13	3.12
P-10105	131.22	J-11060	J-10085	150.0	Cast iron	130.0	29.11	1.65
P-10110	393.65	J-10085	J-11040	150.0	Cast iron	130.0	29.11	1.65
P-10115	99.06	J-10990	J-10155	50.0	PVC	150.0	0.00	0.00
P-10120	52.57	J-10715	J-10720	50.0	PVC	150.0	-5.05	2.57
P-10125	51.19	J-10710	J-10715	50.0	PVC	150.0	-5.05	2.57
P-10130	63.59	J-10810	J-10710	50.0	PVC	150.0	-5.05	2.57
P-10135	5.61	J-10045	PRV-Lower Bench Rd	100.0	Cast iron	130.0	-15.81	2.01
P-10140	157.35	J-10955	J-10045	100.0	Cast iron	130.0	-9.69	1.23
P-10145	87.05	J-10930	J-10955	100.0	Cast iron	130.0	-9.69	1.23
P-10150	166.00	J-10935	J-11130	50.0	PVC	150.0	3.74	1.91
P-10155	81.76	J-10930	J-10935	50.0	PVC	150.0	3.74	1.91
P-10160	43.41	J-10045	J-10475	50.0	PVC	150.0	6.12	3.12
P-10165	24.86	J-10475	J-10480	50.0	PVC	150.0	6.12	3.12
P-10170	43.20	J-10010	J-10645	300.0	Cast iron	130.0	168.33	2.38

FlexTable: Pipe Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-10175	4.80	J-10005	J-10010	200.0	Cast iron	130.0	-107.19	3.41
P-10180	175.34	J-10645	J-11140	300.0	Cast iron	130.0	168.33	2.38
P-10185	93.85	J-10530	J-10980	350.0	Steel	100.0	-284.51	2.96
P-10190	30.48	J-10525	J-10530	350.0	Steel	100.0	-275.52	2.86
P-10195	296.37	J-10010	J-10525	350.0	Steel	100.0	-275.52	2.86
P-10200	198.18	J-11020	J-10150	250.0	Cast iron	130.0	98.57	2.01
P-10205	103.56	J-10870	J-11020	250.0	Cast iron	130.0	104.38	2.13
P-10210	64.98	J-10815	J-10820	50.0	PVC	150.0	0.00	0.00
P-10215	9.31	J-10085	J-10090	50.0	PVC	150.0	0.00	0.00
P-10220	13.61	J-10265	J-10270	200.0	Cast iron	130.0	-75.88	2.42
P-10225	13.61	J-10270	J-10275	200.0	Cast iron	130.0	-79.85	2.54
P-10230	231.51	J-11110	J-10265	200.0	Cast iron	130.0	-68.23	2.17
P-10235	139.01	J-10435	J-11110	200.0	Cast iron	130.0	-53.32	1.70
P-10240	21.19	J-10430	J-10435	200.0	Cast iron	130.0	-46.01	1.46
P-10245	143.19	J-11105	J-10430	200.0	Cast iron	130.0	-46.01	1.46
P-10250	108.98	J-10620	J-10245	150.0	Cast iron	130.0	-28.75	1.63
P-10255	41.34	J-10365	J-10620	150.0	Cast iron	130.0	-21.74	1.23
P-10265	58.82	J-10585	J-10495	50.0	PVC	150.0	0.32	0.16
P-10270	27.55	J-10500	J-10495	50.0	PVC	150.0	-0.32	0.16
P-10275	37.95	J-10500	J-10345	50.0	PVC	150.0	0.32	0.16
P-10280	25.30	J-10345	J-10405	50.0	PVC	150.0	0.32	0.16
P-10285	20.08	J-10400	J-10405	50.0	PVC	150.0	-0.32	0.16
P-10290	105.34	J-10705	J-10400	50.0	PVC	150.0	-0.32	0.16
P-10295	21.69	J-10420	J-10425	350.0	Steel	100.0	0.00	0.00
P-10300	83.00	J-10800	J-10385	300.0	Cast iron	130.0	170.31	2.41
P-10305	102.30	J-10960	J-10410	250.0	Cast iron	130.0	-104.62	2.13
P-10310	87.55	J-10170	J-10960	250.0	Cast iron	130.0	-104.62	2.13
P-10315	9.73	J-10165	J-10170	250.0	Cast iron	130.0	-97.42	1.98
P-10320	11.55	J-10205	J-10165	250.0	Cast iron	130.0	-97.42	1.98
P-10325	109.40	J-11045	J-10125	50.0	PVC	150.0	0.00	0.00
P-10330	43.86	J-10625	J-10630	50.0	PVC	150.0	0.00	0.00
P-10335	99.06	J-10845	J-10995	100.0	Cast iron	130.0	0.00	0.00
P-10340	208.80	J-10840	J-10560	100.0	Cast iron	130.0	-15.91	2.03
P-10345	87.18	J-10200	J-10840	100.0	Cast iron	130.0	-4.96	0.63
P-10350	11.48	J-10110	J-10200	100.0	Cast iron	130.0	-4.96	0.63
P-10355	108.44	J-10160	J-11040	150.0	Cast iron	130.0	-14.75	0.83
P-10360	5.68	J-10155	J-10160	150.0	Cast iron	130.0	-14.75	0.83
P-10365	9.51	J-10145	J-10150	300.0	Asbestos Cement	140.0	-40.54	0.57
P-10370	12.74	J-10235	J-10240	50.0	Galvanized iron	120.0	0.00	0.00
P-10375	12.50	J-10230	J-10190	200.0	Asbestos Cement	140.0	-16.75	0.53
P-10380	10.63	J-10190	J-10060	200.0	Asbestos Cement	140.0	-27.98	0.89
P-10385	60.22	J-10060	J-10390	250.0	Asbestos Cement	140.0	-30.25	0.62
P-10390	19.99	J-10390	J-10395	250.0	Asbestos Cement	140.0	-30.25	0.62
P-10395	107.71	J-10070	J-11035	200.0	Asbestos Cement	140.0	-15.17	0.48
P-10400	5.62	J-10065	J-10070	100.0	Asbestos Cement	140.0	-3.80	0.48
P-10405	29.28	J-10460	J-10520	100.0	Cast iron	130.0	0.00	0.00
P-10410	24.88	J-10460	J-10465	100.0	Cast iron	130.0	0.00	0.00
P-10415	71.49	J-10860	J-10465	100.0	Cast iron	130.0	0.00	0.00
P-10420	100.00	J-11000	J-10580	100.0	Cast iron	130.0	9.66	1.23
P-10425	37.32	J-10575	J-10315	50.0	Galvanized iron	120.0	0.00	0.00

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-10430	70.59	J-10470	J-10855	100.0	PVC	150.0	-8.39	1.07
P-10435	24.75	J-10320	J-10470	100.0	PVC	150.0	-8.39	1.07
P-10440	19.36	J-10315	J-10320	50.0	Galvanized iron	120.0	-8.39	4.27
P-10445	75.29	J-10120	J-10610	100.0	Cast iron	130.0	4.97	0.63
P-10450	143.02	J-10920	J-11100	50.0	PVC	150.0	4.97	2.53
P-10455	81.12	J-10615	J-10920	50.0	PVC	150.0	4.97	2.53
P-10465	8.12	J-10115	J-10120	100.0	Cast iron	130.0	4.97	0.63
P-10470	190.64	J-11070	J-10115	100.0	Cast iron	130.0	12.32	1.57
P-10475	24.46	J-10410	J-10135	250.0	Cast iron	130.0	-108.62	2.21
P-10480	120.09	J-10195	J-11055	50.0	PVC	150.0	7.24	3.69
P-10485	11.27	J-10035	J-10195	50.0	PVC	150.0	7.24	3.69
P-10490	5.14	J-10035	J-10040	100.0	Cast iron	130.0	-7.24	0.92
P-10495	5.04	J-10015	J-10020	300.0	Cast iron	130.0	-16.43	0.23
P-10500	179.49	J-11145	J-10880	100.0	Cast iron	130.0	1.58	0.20
P-10505	369.93	J-10015	J-11145	100.0	Cast iron	130.0	16.43	2.09
P-10510	99.02	J-10545	J-10910	300.0	Cast iron	130.0	209.95	2.97
P-10515	87.91	J-10915	J-10600	300.0	Cast iron	130.0	209.95	2.97
P-10520	81.09	J-10910	J-10915	300.0	Cast iron	130.0	209.95	2.97
P-10525	15.28	J-10310	J-10300	50.0	PVC	150.0	-4.66	2.37
P-10530	50.63	J-10730	J-10735	50.0	PVC	150.0	0.00	0.00
P-10535	289.75	J-10735	J-10155	100.0	Cast iron	130.0	-8.10	1.03
P-10540	81.69	J-10925	J-10735	50.0	PVC	150.0	0.00	0.00
P-10545	122.53	J-10630	J-10090	50.0	PVC	150.0	0.00	0.00
P-10550	13.54	J-10255	J-10260	100.0	PVC	150.0	0.00	0.00
P-10555	15.18	J-10175	J-10180	50.0	Galvanized iron	120.0	9.08	4.62
P-10560	175.75	J-10175	J-11095	150.0	Cast iron	130.0	-24.89	1.41
P-10565	5.13	J-10025	J-10030	100.0	Cast iron	130.0	0.00	0.00
P-10570	9.18	J-10125	J-10130	50.0	PVC	150.0	0.00	0.00
P-10575	192.36	J-10555	J-11150	150.0	Steel	100.0	17.11	0.97
P-10580	45.12	J-10655	J-10660	50.0	PVC	150.0	-8.85	4.51
P-10585	207.41	J-10275	J-11070	200.0	Cast iron	130.0	-79.85	2.54
P-10590	154.45	J-10540	J-11105	200.0	Cast iron	130.0	-46.01	1.46
P-10595	30.67	J-10535	J-10540	200.0	Cast iron	130.0	-46.01	1.46
P-10600	71.59	J-10245	J-10535	200.0	Cast iron	130.0	-37.53	1.19
P-10615	63.03	J-10680	J-10690	50.0	PVC	150.0	0.32	0.16
P-10620	114.04	J-10945	J-10675	100.0	PVC	150.0	3.56	0.45
P-10625	46.11	J-10685	J-10690	50.0	PVC	150.0	-0.32	0.16
P-10630	63.83	J-10590	J-10685	50.0	PVC	150.0	-0.32	0.16
P-10635	51.13	J-10700	J-10705	50.0	PVC	150.0	-0.32	0.16
P-10655	37.02	J-10590	J-10585	50.0	PVC	150.0	0.32	0.16
P-10670	45.44	J-10675	J-10680	50.0	PVC	150.0	0.32	0.16
P-10675	73.58	J-10880	J-10885	50.0	Galvanized iron	120.0	1.58	0.80
P-10680	87.41	J-10830	J-10205	250.0	Cast iron	130.0	-96.40	1.96
P-10685	73.57	J-10825	J-10830	250.0	Cast iron	130.0	-96.40	1.96
P-10690	132.26	J-11070	J-11075	250.0	Cast iron	130.0	-94.24	1.92
P-10695	104.09	J-10490	J-11015	50.0	Galvanized iron	120.0	1.58	0.80
P-10700	25.23	J-10485	J-10490	50.0	Galvanized iron	120.0	1.58	0.80
P-10705	53.91	J-10725	J-10485	50.0	Galvanized iron	120.0	1.58	0.80
P-10710	5.89	J-10055	J-10060	50.0	PVC	150.0	-2.27	1.16
P-10715	236.81	J-10075	J-11155	300.0	Asbestos Cement	140.0	-33.55	0.47

FlexTable: Pipe Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-10720	5.82	J-10075	J-10080	250.0	Asbestos Cement	140.0	33.55	0.68
P-10725	16.46	J-10340	J-10325	50.0	Galvanized iron	120.0	0.00	0.00
P-10730	8.04	J-10105	J-10110	100.0	Cast iron	130.0	-4.96	0.63
P-10735	53.52	J-10745	J-10105	100.0	Cast iron	130.0	-4.96	0.63
P-10740	69.02	J-10835	J-10670	50.0	PVC	150.0	-7.20	3.67
P-10745	35.46	J-10100	J-10215	100.0	Cast iron	130.0	-20.28	2.58
P-10750	7.83	J-10095	J-10100	100.0	Cast iron	130.0	-15.91	2.03
P-10755	33.86	J-10565	J-10095	100.0	Cast iron	130.0	-15.91	2.03
P-10760	32.66	J-10560	J-10565	100.0	Cast iron	130.0	-15.91	2.03
P-10765	168.53	PRV-Lower Bench Rd	J-10175	100.0	Cast iron	130.0	-15.81	2.01
P-10770	73.13	J-10865	J-10870	250.0	Cast iron	130.0	104.38	2.13
P-10775	171.21	J-11135	J-10865	250.0	Cast iron	130.0	126.66	2.58
P-10780	247.12	J-11165	J-11135	250.0	Cast iron	130.0	126.66	2.58
P-10785	339.95	J-11140	J-11165	300.0	Cast iron	130.0	143.20	2.03
P-10790	130.89	J-10820	J-11020	100.0	Cast iron	130.0	-5.81	0.74
P-10795	85.65	J-10815	J-10950	50.0	Galvanized iron	120.0	0.00	0.00
P-10800	204.21	J-11155	J-10145	300.0	Asbestos Cement	140.0	-40.54	0.57
P-10805	12.63	J-10185	J-10150	300.0	Asbestos Cement	140.0	-12.83	0.18
P-10810	44.35	J-10665	J-10185	300.0	Asbestos Cement	140.0	-12.83	0.18
P-10815	315.22	J-10130	J-10665	300.0	Asbestos Cement	140.0	-12.83	0.18
P-10820	264.62	J-10640	J-10395	250.0	Asbestos Cement	140.0	30.25	0.62
P-10825	43.09	J-10080	J-10640	250.0	Asbestos Cement	140.0	33.55	0.68
P-10830	60.98	J-10240	J-10340	50.0	Galvanized iron	120.0	0.00	0.00
P-10835	74.33	J-10875	J-10065	100.0	Asbestos Cement	140.0	-3.80	0.48
P-10840	31.54	J-10550	J-10555	150.0	Cast iron	130.0	17.11	0.97
P-10845	90.75	J-10650	J-10550	150.0	Cast iron	130.0	17.11	0.97
P-10850	43.52	J-10515	J-10650	150.0	Cast iron	130.0	34.22	1.94
P-10855	28.25	J-10510	J-10515	150.0	Cast iron	130.0	34.22	1.94
P-10860	182.83	J-10975	J-10510	150.0	Cast iron	130.0	34.22	1.94
P-10865	93.22	J-10740	J-10975	150.0	Cast iron	130.0	45.20	2.56
P-10870	53.21	J-10150	J-10740	250.0	Cast iron	130.0	45.20	0.92
P-10875	165.20	J-10415	J-11125	50.0	PVC	150.0	1.31	0.67
P-10880	58.30	J-10770	J-10775	100.0	Cast iron	130.0	-5.97	0.76
P-10885	168.30	J-11085	J-11000	100.0	Cast iron	130.0	14.93	1.90
P-10890	141.63	J-10895	J-11085	100.0	Cast iron	130.0	14.93	1.90
P-10895	25.90	J-10360	J-10365	150.0	Cast iron	130.0	-21.74	1.23
P-10900	234.72	J-10900	J-10360	150.0	Cast iron	130.0	-19.92	1.13
P-10905	77.82	J-10895	J-10900	150.0	Cast iron	130.0	-19.92	1.13
P-10910	13.50	J-10245	J-10250	100.0	Steel	100.0	8.77	1.12
P-10915	83.76	J-10940	J-10945	50.0	PVC	150.0	-2.65	1.35
P-10920	140.39	J-10635	J-10945	100.0	Steel	100.0	8.77	1.12
P-10925	42.10	J-10250	J-10635	100.0	Steel	100.0	8.77	1.12
P-10935	97.54	J-10905	J-10855	100.0	Cast iron	130.0	8.39	1.07
P-10940	80.50	J-10375	J-10905	100.0	Cast iron	130.0	14.91	1.90
P-10945	18.86	J-10370	J-10375	100.0	Cast iron	130.0	14.91	1.90
P-10950	16.85	J-10270	J-10355	50.0	Galvanized iron	120.0	3.97	2.02
P-10955	13.76	J-10290	J-10295	50.0	Galvanized iron	120.0	0.00	0.00
P-10960	70.56	J-10850	J-10290	50.0	Galvanized iron	120.0	3.97	2.02
P-10965	71.18	J-10355	J-10850	50.0	Galvanized iron	120.0	3.97	2.02
P-10970	34.06	J-10570	J-10170	50.0	PVC	150.0	-7.20	3.67

FlexTable: Pipe Table (090526 Penticton North Irrigation System.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)
P-10975	44.65	J-10670	J-10570	50.0	PVC	150.0	-7.20	3.67
P-10980	132.66	J-11080	J-10835	50.0	PVC	150.0	-7.20	3.67
P-10985	12.71	J-10210	J-10215	100.0	Cast iron	130.0	29.13	3.71
P-10990	69.74	J-10840	J-10845	100.0	Cast iron	130.0	10.95	1.39
P-10995	80.28	J-10890	J-10745	100.0	Cast iron	130.0	-4.96	0.63
P-11005	61.87	J-10790	J-10795	300.0	Cast iron	130.0	-155.47	2.20
P-11010	285.82	J-10225	J-10790	250.0	Cast iron	130.0	-155.47	3.17
P-11015	56.38	J-10210	J-10765	250.0	Cast iron	130.0	-137.75	2.81
P-11020	8.45	J-10135	J-10140	250.0	Cast iron	130.0	-108.62	2.21
P-11025	18.96	J-10380	J-10385	300.0	Cast iron	130.0	-170.31	2.41
P-11030	39.10	J-10595	J-10380	300.0	Cast iron	130.0	-170.31	2.41
P-11035	198.22	J-10795	J-10595	300.0	Cast iron	130.0	-170.31	2.41
P-11040	40.02	J-10600	J-10605	300.0	Cast iron	130.0	209.95	2.97
P-11045	93.71	J-10785	J-10605	300.0	Cast iron	130.0	-209.95	2.97
P-11050	59.72	J-10780	J-10785	300.0	Cast iron	130.0	-209.95	2.97
P-11055	164.80	J-11120	J-10780	300.0	Cast iron	130.0	-209.95	2.97
P-11060	162.41	J-10020	J-11120	300.0	Cast iron	130.0	-196.63	2.78
P-11065	63.35	J-10800	J-10750	300.0	Cast iron	130.0	-180.20	2.55
P-11070	34.37	J-10545	J-10505	300.0	Cast iron	130.0	-231.91	3.28
P-11080	20.55	J-10305	J-10415	50.0	PVC	150.0	-4.66	2.37
P-11085	14.01	J-10300	J-10305	50.0	PVC	150.0	-4.66	2.37
P-11090	148.61	J-11075	J-10825	250.0	Cast iron	130.0	-96.40	1.96
P-11095	227.86	J-10215	J-10660	100.0	Cast iron	130.0	8.85	1.13
P-11100	103.33	J-10765	J-10220	250.0	Cast iron	130.0	-137.75	2.81
P-11105	19.16	J-10220	J-10225	250.0	Cast iron	130.0	-155.47	3.17
P-11110	37.59	J-10140	J-10210	250.0	Cast iron	130.0	-108.62	2.21
P-11115	54.14	J-10750	J-10020	300.0	Cast iron	130.0	-180.20	2.55
P-11120	24.39	J-10520	J-10775	100.0	Cast iron	130.0	-3.69	0.47
P-11125	13.98	J-10775	J-10580	100.0	Cast iron	130.0	-9.66	1.23
P-11130	243.00	J-11160	J-10360	50.0	PVC	150.0	-1.82	0.93
P-11135	236.74	J-11110	J-10370	100.0	Cast iron	130.0	14.91	1.90
P-11140	107.41	J-10825	J-11030	25.0	PVC	150.0	0.00	0.00
P-11145	60.33	J-10220	J-10040	100.0	Cast iron	130.0	7.24	0.92
P-11150	29.49	J-11050	J-10335	100.0	PVC	150.0	-9.08	1.16
P-11155	90.51	J-10335	J-10180	100.0	PVC	150.0	-9.08	1.16
P-11160	99.77	J-10450	J-414	100.0	Steel	100.0	0.00	0.00
P-11165	32.39	J-414	J-11065	100.0	Steel	100.0	0.00	0.00
P-11170	10.42	J-10325	J-10875	50.0	Galvanized iron	120.0	0.00	0.00
P-11175	5.75	J-10875	J-10330	100.0	Asbestos Cement	140.0	3.80	0.48
P-11180	25.96	J-11005	J-10030	100.0	Cast iron	130.0	-9.39	1.20
P-11185	365.61	J-10030	J-10795	100.0	Cast iron	130.0	-9.39	1.20
P-11190	314.19	J-10755	J-10720	150.0	Cast iron	130.0	38.78	2.19
P-11195	5.03	J-10720	J-11090	150.0	Cast iron	130.0	33.73	1.91
P-11200	7.65	J-11035	J-10725	200.0	Asbestos Cement	140.0	-15.17	0.48
P-11205	243.67	J-10725	J-10230	200.0	Asbestos Cement	140.0	-16.75	0.53

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1005	399.12	0.00	505.83	151.5
J-1010	399.48	0.00	505.83	151.0
J-1015	499.33	0.00	524.16	35.2
J-1020	498.88	0.00	524.20	35.9
J-1025	448.00	0.00	512.06	90.9
J-1030	447.46	0.00	512.06	91.7
J-1035	467.53	0.00	510.97	61.7
J-1040	467.71	0.00	510.97	61.4
J-1045	455.13	0.00	511.54	80.1
J-1050	455.99	0.00	511.46	78.7
J-1055	408.27	0.32	491.20	117.7
J-1060	408.87	0.00	492.01	118.0
J-1065	449.73	0.00	512.16	88.6
J-1070	450.52	2.21	512.11	87.4
J-1075	508.69	0.00	523.48	21.0
J-1080	508.75	0.00	523.53	21.0
J-1085	508.76	0.00	523.58	21.0
J-1090	423.41	0.00	505.34	116.3
J-1095	423.57	0.00	505.30	116.0
J-1100	393.92	0.00	498.22	148.1
J-1105	395.91	0.00	498.22	145.2
J-1110	342.57	0.00	410.10	95.9
J-1115	344.41	0.00	410.10	93.2
J-1120	462.92	0.00	510.97	68.2
J-1125	467.01	0.00	510.97	62.4
J-1130	431.40	0.00	499.66	96.9
J-1135	433.32	0.00	499.66	94.2
J-1140	397.98	0.00	504.81	151.6
J-1145	395.97	0.00	503.36	152.4
J-1150	393.84	0.00	500.10	150.8
J-1155	392.92	0.00	498.55	149.9
J-1160	438.35	0.00	509.69	101.3
J-1165	439.58	0.00	509.74	99.6
J-1170	451.39	0.00	497.59	65.6
J-1175	452.00	4.93	497.52	64.6
J-1180	469.56	6.93	510.83	58.6
J-1185	438.51	0.00	509.80	101.2
J-1190	424.17	0.00	499.66	107.1
J-1195	425.76	0.00	499.66	104.9
J-1200	508.73	0.00	523.38	20.8
J-1205	342.06	0.00	410.10	96.6
J-1210	400.00	0.00	493.84	133.2
J-1215	398.60	0.00	493.70	135.0
J-1220	341.70	0.00	410.10	97.1
J-1225	339.00	0.00	410.10	100.9
J-1230	339.27	0.00	410.10	100.5
J-1235	339.57	0.00	410.10	100.1
J-1240	352.78	0.00	410.10	81.4
J-1245	429.51	1.50	486.18	80.4
J-1250	433.19	0.00	490.45	81.3
J-1255	418.65	0.00	504.97	122.5
J-1260	414.47	0.00	504.88	128.3

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1265	410.26	1.21	507.40	137.9
J-1270	409.22	0.00	507.17	139.0
J-1275	417.40	0.00	507.52	127.9
J-1280	417.42	0.00	507.37	127.7
J-1285	378.57	0.00	410.10	44.8
J-1290	381.92	0.00	410.10	40.0
J-1295	408.52	0.00	497.79	126.7
J-1300	408.80	0.00	497.69	126.2
J-1305	442.87	2.46	504.74	87.8
J-1310	444.85	0.00	504.74	85.0
J-1315	426.96	0.00	506.23	112.5
J-1320	427.54	0.00	506.11	111.5
J-1325	402.32	0.00	501.68	141.0
J-1330	403.58	0.00	501.45	138.9
J-1335	376.53	0.00	492.68	164.9
J-1340	378.59	0.00	492.68	161.9
J-1345	431.29	2.52	491.09	84.9
J-1350	433.94	0.00	490.99	81.0
J-1355	422.90	0.00	505.45	117.2
J-1360	388.93	0.00	498.22	155.1
J-1365	382.33	0.00	492.54	156.4
J-1370	408.59	0.00	498.49	127.6
J-1375	407.48	0.00	498.37	129.0
J-1380	397.45	0.00	494.37	137.6
J-1385	394.19	0.00	494.11	141.8
J-1390	422.01	0.00	506.68	120.2
J-1395	423.03	4.90	506.51	118.5
J-1400	397.73	3.78	504.23	151.2
J-1405	398.91	0.00	503.93	149.1
J-1410	410.67	4.83	496.58	122.0
J-1415	411.64	0.00	500.14	125.6
J-1420	386.27	0.00	490.48	147.9
J-1425	429.85	3.85	513.64	118.9
J-1430	434.26	7.40	488.81	77.4
J-1435	435.00	0.32	510.98	107.9
J-1440	455.20	0.00	511.33	79.7
J-1445	339.91	0.00	410.10	99.6
J-1450	340.34	0.00	410.10	99.0
J-1455	340.68	0.95	410.10	98.5
J-1460	416.93	0.00	505.16	125.2
J-1465	390.75	0.00	493.42	145.7
J-1470	426.30	0.00	505.93	113.0
J-1475	421.65	0.00	505.76	119.4
J-1480	340.00	0.00	410.10	99.5
J-1485	406.56	0.00	495.87	126.8
J-1490	433.02	0.00	491.28	82.7
J-1495	432.93	0.00	509.32	108.4
J-1500	433.44	0.00	509.45	107.9
J-1505	395.01	4.61	494.58	141.3
J-1510	339.65	0.00	410.10	100.0
J-1515	451.81	0.00	511.89	85.3
J-1520	445.57	0.00	509.98	91.4

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1525	396.00	0.00	495.44	141.2
J-1530	395.57	0.00	495.11	141.3
J-1535	403.44	4.82	496.37	131.9
J-1540	399.96	0.00	495.94	136.3
J-1545	401.64	0.00	503.33	144.3
J-1550	408.44	0.00	502.94	134.1
J-1555	340.00	0.00	410.10	99.5
J-1560	404.34	0.83	502.06	138.7
J-1565	339.63	0.00	410.10	100.0
J-1570	415.55	0.00	499.75	119.5
J-1575	417.59	0.00	499.38	116.1
J-1580	520.00	0.00	532.00	17.0
J-1585	520.00	0.00	532.32	17.5
J-1590	360.02	0.00	410.10	71.1
J-1595	400.69	0.00	498.05	138.2
J-1600	418.03	0.00	508.03	127.7
J-1605	454.84	0.00	510.76	79.4
J-1610	461.87	0.00	510.75	69.4
J-1615	400.77	0.00	505.90	149.2
J-1620	398.00	7.83	505.41	152.5
J-1625	452.98	6.94	510.44	81.6
J-1630	448.88	0.00	510.24	87.1
J-1635	410.05	3.90	474.09	90.9
J-1640	424.48	0.00	479.53	78.1
J-1645	520.00	0.00	533.65	19.4
J-1650	438.27	0.00	499.66	87.1
J-1655	383.00	3.82	493.04	156.2
J-1660	381.43	0.00	483.60	145.0
J-1665	372.40	0.63	477.90	149.7
J-1670	494.57	0.00	524.57	42.6
J-1675	400.22	0.00	500.05	141.7
J-1680	461.67	0.00	518.50	80.7
J-1685	464.89	0.00	518.83	76.6
J-1690	428.99	0.00	499.66	100.3
J-1695	405.75	0.00	500.20	134.1
J-1700	454.41	0.00	511.03	80.4
J-1705	402.03	0.00	505.07	146.3
J-1710	413.86	8.96	498.91	120.7
J-1715	365.40	0.00	410.10	63.5
J-1720	433.92	0.00	499.66	93.3
J-1725	430.88	0.38	499.66	97.6
J-1730	520.00	0.00	529.25	13.1
J-1735	520.00	0.00	529.69	13.8
J-1740	389.32	0.00	492.23	146.1
J-1745	413.85	0.00	498.20	119.7
J-1750	427.15	0.00	508.89	116.0
J-1755	520.00	0.00	533.19	18.7
J-1760	498.00	0.00	522.34	34.5
J-1765	503.07	0.00	522.71	27.9
J-1770	435.43	0.00	509.03	104.5
J-1775	432.93	5.58	508.79	107.7
J-1780	462.04	1.14	510.20	68.4

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1785	505.52	0.00	528.70	32.9
J-1790	411.38	0.00	506.51	135.0
J-1795	394.93	1.89	497.71	145.9
J-1800	520.00	0.00	531.42	16.2
J-1805	393.68	2.84	491.80	139.3
J-1810	461.52	0.00	510.20	69.1
J-1815	490.72	0.00	527.97	52.9
J-1820	520.00	0.00	530.67	15.1
J-1825	477.25	0.00	525.39	68.3
J-1830	411.04	4.56	496.22	120.9
J-1835	427.42	0.00	513.75	122.5
J-1840	440.20	0.00	513.00	103.3
J-1845	490.54	0.00	521.40	43.8
J-1850	434.38	0.00	514.77	114.1
J-1855	483.91	0.00	526.79	60.9
J-1860	480.43	0.00	520.33	56.6
J-1865	440.58	0.00	516.23	107.4

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1730	520.00	0.00	529.25	13.1
J-1735	520.00	0.00	529.69	13.8
J-1820	520.00	0.00	530.67	15.1
J-1800	520.00	0.00	531.42	16.2
J-1580	520.00	0.00	532.00	17.0
J-1585	520.00	0.00	532.32	17.5
J-1755	520.00	0.00	533.19	18.7
J-1645	520.00	0.00	533.65	19.4
J-1200	508.73	0.00	523.38	20.8
J-1080	508.75	0.00	523.53	21.0
J-1075	508.69	0.00	523.48	21.0
J-1085	508.76	0.00	523.58	21.0
J-1765	503.07	0.00	522.71	27.9
J-1785	505.52	0.00	528.70	32.9
J-1760	498.00	0.00	522.34	34.5
J-1015	499.33	0.00	524.16	35.2
J-1020	498.88	0.00	524.20	35.9
J-1290	381.92	0.00	410.10	40.0
J-1670	494.57	0.00	524.57	42.6
J-1845	490.54	0.00	521.40	43.8
J-1285	378.57	0.00	410.10	44.8
J-1815	490.72	0.00	527.97	52.9
J-1860	480.43	0.00	520.33	56.6
J-1180	469.56	6.93	510.83	58.6
J-1855	483.91	0.00	526.79	60.9
J-1040	467.71	0.00	510.97	61.4
J-1035	467.53	0.00	510.97	61.7
J-1125	467.01	0.00	510.97	62.4
J-1715	365.40	0.00	410.10	63.5
J-1175	452.00	4.93	497.52	64.6
J-1170	451.39	0.00	497.59	65.6
J-1120	462.92	0.00	510.97	68.2
J-1825	477.25	0.00	525.39	68.3
J-1780	462.04	1.14	510.20	68.4
J-1810	461.52	0.00	510.20	69.1
J-1610	461.87	0.00	510.75	69.4
J-1590	360.02	0.00	410.10	71.1
J-1685	464.89	0.00	518.83	76.6
J-1430	434.26	7.40	488.81	77.4
J-1640	424.48	0.00	479.53	78.1
J-1050	455.99	0.00	511.46	78.7
J-1605	454.84	0.00	510.76	79.4
J-1440	455.20	0.00	511.33	79.7
J-1045	455.13	0.00	511.54	80.1
J-1700	454.41	0.00	511.03	80.4
J-1245	429.51	1.50	486.18	80.4
J-1680	461.67	0.00	518.50	80.7
J-1350	433.94	0.00	490.99	81.0
J-1250	433.19	0.00	490.45	81.3
J-1240	352.78	0.00	410.10	81.4
J-1625	452.98	6.94	510.44	81.6
J-1490	433.02	0.00	491.28	82.7

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1345	431.29	2.52	491.09	84.9
J-1310	444.85	0.00	504.74	85.0
J-1515	451.81	0.00	511.89	85.3
J-1630	448.88	0.00	510.24	87.1
J-1650	438.27	0.00	499.66	87.1
J-1070	450.52	2.21	512.11	87.4
J-1305	442.87	2.46	504.74	87.8
J-1065	449.73	0.00	512.16	88.6
J-1635	410.05	3.90	474.09	90.9
J-1025	448.00	0.00	512.06	90.9
J-1520	445.57	0.00	509.98	91.4
J-1030	447.46	0.00	512.06	91.7
J-1115	344.41	0.00	410.10	93.2
J-1720	433.92	0.00	499.66	93.3
J-1135	433.32	0.00	499.66	94.2
J-1110	342.57	0.00	410.10	95.9
J-1205	342.06	0.00	410.10	96.6
J-1130	431.40	0.00	499.66	96.9
J-1220	341.70	0.00	410.10	97.1
J-1725	430.88	0.38	499.66	97.6
J-1455	340.68	0.95	410.10	98.5
J-1450	340.34	0.00	410.10	99.0
J-1555	340.00	0.00	410.10	99.5
J-1480	340.00	0.00	410.10	99.5
J-1165	439.58	0.00	509.74	99.6
J-1445	339.91	0.00	410.10	99.6
J-1510	339.65	0.00	410.10	100.0
J-1565	339.63	0.00	410.10	100.0
J-1235	339.57	0.00	410.10	100.1
J-1690	428.99	0.00	499.66	100.3
J-1230	339.27	0.00	410.10	100.5
J-1225	339.00	0.00	410.10	100.9
J-1185	438.51	0.00	509.80	101.2
J-1160	438.35	0.00	509.69	101.3
J-1840	440.20	0.00	513.00	103.3
J-1770	435.43	0.00	509.03	104.5
J-1195	425.76	0.00	499.66	104.9
J-1190	424.17	0.00	499.66	107.1
J-1865	440.58	0.00	516.23	107.4
J-1775	432.93	5.58	508.79	107.7
J-1435	435.00	0.32	510.98	107.9
J-1500	433.44	0.00	509.45	107.9
J-1495	432.93	0.00	509.32	108.4
J-1320	427.54	0.00	506.11	111.5
J-1315	426.96	0.00	506.23	112.5
J-1470	426.30	0.00	505.93	113.0
J-1850	434.38	0.00	514.77	114.1
J-1095	423.57	0.00	505.30	116.0
J-1750	427.15	0.00	508.89	116.0
J-1575	417.59	0.00	499.38	116.1
J-1090	423.41	0.00	505.34	116.3
J-1355	422.90	0.00	505.45	117.2

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1055	408.27	0.32	491.20	117.7
J-1060	408.87	0.00	492.01	118.0
J-1395	423.03	4.90	506.51	118.5
J-1425	429.85	3.85	513.64	118.9
J-1475	421.65	0.00	505.76	119.4
J-1570	415.55	0.00	499.75	119.5
J-1745	413.85	0.00	498.20	119.7
J-1390	422.01	0.00	506.68	120.2
J-1710	413.86	8.96	498.91	120.7
J-1830	411.04	4.56	496.22	120.9
J-1410	410.67	4.83	496.58	122.0
J-1255	418.65	0.00	504.97	122.5
J-1835	427.42	0.00	513.75	122.5
J-1460	416.93	0.00	505.16	125.2
J-1415	411.64	0.00	500.14	125.6
J-1300	408.80	0.00	497.69	126.2
J-1295	408.52	0.00	497.79	126.7
J-1485	406.56	0.00	495.87	126.8
J-1370	408.59	0.00	498.49	127.6
J-1280	417.42	0.00	507.37	127.7
J-1600	418.03	0.00	508.03	127.7
J-1275	417.40	0.00	507.52	127.9
J-1260	414.47	0.00	504.88	128.3
J-1375	407.48	0.00	498.37	129.0
J-1535	403.44	4.82	496.37	131.9
J-1210	400.00	0.00	493.84	133.2
J-1695	405.75	0.00	500.20	134.1
J-1550	408.44	0.00	502.94	134.1
J-1215	398.60	0.00	493.70	135.0
J-1790	411.38	0.00	506.51	135.0
J-1540	399.96	0.00	495.94	136.3
J-1380	397.45	0.00	494.37	137.6
J-1265	410.26	1.21	507.40	137.9
J-1595	400.69	0.00	498.05	138.2
J-1560	404.34	0.83	502.06	138.7
J-1330	403.58	0.00	501.45	138.9
J-1270	409.22	0.00	507.17	139.0
J-1805	393.68	2.84	491.80	139.3
J-1325	402.32	0.00	501.68	141.0
J-1525	396.00	0.00	495.44	141.2
J-1530	395.57	0.00	495.11	141.3
J-1505	395.01	4.61	494.58	141.3
J-1675	400.22	0.00	500.05	141.7
J-1385	394.19	0.00	494.11	141.8
J-1545	401.64	0.00	503.33	144.3
J-1660	381.43	0.00	483.60	145.0
J-1105	395.91	0.00	498.22	145.2
J-1465	390.75	0.00	493.42	145.7
J-1795	394.93	1.89	497.71	145.9
J-1740	389.32	0.00	492.23	146.1
J-1705	402.03	0.00	505.07	146.3
J-1420	386.27	0.00	490.48	147.9

FlexTable: Junction Table (090526 Penticton South Irrigation System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1100	393.92	0.00	498.22	148.1
J-1405	398.91	0.00	503.93	149.1
J-1615	400.77	0.00	505.90	149.2
J-1665	372.40	0.63	477.90	149.7
J-1155	392.92	0.00	498.55	149.9
J-1150	393.84	0.00	500.10	150.8
J-1010	399.48	0.00	505.83	151.0
J-1400	397.73	3.78	504.23	151.2
J-1005	399.12	0.00	505.83	151.5
J-1140	397.98	0.00	504.81	151.6
J-1145	395.97	0.00	503.36	152.4
J-1620	398.00	7.83	505.41	152.5
J-1360	388.93	0.00	498.22	155.1
J-1655	383.00	3.82	493.04	156.2
J-1365	382.33	0.00	492.54	156.4
J-1340	378.59	0.00	492.68	161.9
J-1335	376.53	0.00	492.68	164.9

APPENDIX C

PROJECT COST ESTIMATES

Penticton Irrigation Master Plan - System Replacement Costs
APPENDIX C

Cost Estimate Notes: The following costs are considered Class D and include a contingency of 35% and an engineering allowance of 10%. The only exception is the water meter projects which only include a contingencyof 15% and engineering of 5%. Costs do not include any borrowing charges.

Budgeted Pipe Installation Life

Pipe Material	Year of Initial Installation	Begin Replacement Age	Average Replacement A	End Replac	Percent
AC	1965	55	65	75	1.3%
GI	1965	55	65	75	1.3%
CI	1965	55	65	75	1.3%
PVC	2005	55	75	95	1.1%
DI	N/A	55	75	95	1.1%
Steel	1965	55	75	95	1.1%
Intake Structure	1965	65	65	65	1.5%
Water Meter	2012	10	12	15	6.7%

North System Distribution			Project Cost	Annual Reserve Fund	Start Year	End Year	25 Year Total Cost
PROJECT 1	**- AC replaced with PVC**	**$**	**626,800**	**8,357**	**2020**	**2040**	**$447,714**
PROJECT 2	**- GI Replaced with PVC**	**$**	**114,400**	**1,525**	**2020**	**2040**	**$81,714**
PROJECT 3	**- CI Replaced with PVC**	**$**	**2,806,100**	**37,415**	**2020**	**2040**	**$2,004,357**
PROJECT 4	**- PVC Replaced with PVC**	**$**	**679,600**	**7,154**	**2060**	**2100**	**$0**
PROJECT 5	**- CI Replaced with DI**	**$**	**1,045,600**	**11,006**	**2020**	**2040**	**$746,857**
PROJECT 6	**- GI Replaced with DI**	**$**	**0**	**0**	**2020**	**2040**	**$0**
PROJECT 7	**- Steel Replaced with Steel**	**$**	**844,100**	**8,885**	**2020**	**2060**	**$308,817**
North System Transmission							
PROJECT 8	**- Replacement of Intake Structure**	**$**	**725,000**	**11,154**	**2030**	**2030**	**$725,000**
PROJECT 9	**- Replacement of Steel Pipe**	**$**	**1,476,300**	**15,540**	**2020**	**2060**	**$540,110**
South System Distribution							
PROJECT 10	**- AC Replaced with PVC**	**$**	**1,576,800**	**21,024**	**2020**	**2040**	**$1,126,286**
PROJECT 11	**- GI Replaced with PVC**	**$**	**9,800**	**131**	**2020**	**2040**	**$7,000**
PROJECT 12	**- CI Replaced with PVC**	**$**	**15,500**	**207**	**2020**	**2040**	**$11,071**
PROJECT 13	**- PVC Replaced with PVC**	**$**	**333,500**	**3,511**	**2060**	**2100**	**$0**
PROJECT 14	**- AC Replaced with DI**	**$**	**70,900**	**746**	**2020**	**2040**	**$50,643**
PROJECT 15	**- GI Replaced with DI**	**$**	**0**	**0**	**2020**	**2040**	**$0**
South System Transmission							
PROJECT 16	**- Replacement of Intake Structure**	**$**	**725,000**	**11,154**	**2030**	**2030**	**$725,000**
PROJECT 17	**- CI Replaced with PVC**	**$**	**402,000**	**5,360**	**2020**	**2040**	**$287,143**
PROJECT 18	**- PVC Replaced with PVC**	**$**	**99,100**	**1,043**	**2060**	**2100**	**$0**
Meters							
PROJECT 19	**- Water Meter Installation - North System**	**$**	**1,108,800**	**73,920**	**2012**	**2012**	**$1,108,800**
PROJECT 20	**- Water Meter Installation - South System**	**$**	**302,400**	**20,160**	**2012**	**2012**	**$302,400**
PROJECT 21	**- Water Meter Replacement - North System**	**$**	**369,600**	**24,640**	**2022**	**2027**	**$369,600**
	- Water Meter Replacement - North System	**$**	**369,600**	**24,640**	**2032**	**2042**	**$100,800**
	- Water Meter Replacement - North System	**$**	**369,600**	**24,640**	**2042**	**2057**	**$0**
PROJECT 22	**- Water Meter Replacement - South System**	**$**	**100,800**	**6,720**	**2022**	**2027**	**$100,800**
	- Water Meter Replacement - South System	**$**	**100,800**	**6,720**	**2032**	**2042**	**$27,491**
	- Water Meter Replacement - South System	**$**	**100,800**	**6,720**	**2042**	**2057**	**$0**
TOTAL IRRIGATION REPLACEMENT COST			**$14,372,900**	**$332,372**			**$9,071,603**

File: 1017.0055.01 - D

Penticton Irrigation Master Plan - System Replacement Costs
APPENDIX C

Annual Irrigation System Costs																			
North System Distribution	**2010**	**2011**	**2012**	**2013-2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
PROJECT 1 - AC replaced with PVC					29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848	29,848
PROJECT 2 - GI Replaced with PVC					5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448	5,448
PROJECT 3 - CI Replaced with PVC					133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624	133,624
PROJECT 4 - PVC Replaced with PVC																			
PROJECT 5 - CI Replaced with DI					49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790	49,790
PROJECT 6 - GI Replaced with DI					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECT 7 - Steel Replaced with Steel					20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588	20,588
North System Transmission																			
PROJECT 8 - Replacement of Intake Structure															725,000				
PROJECT 9 - Steel Replaced with Steel					36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007	36,007
South System Distribution																			
PROJECT 10 - AC Replaced with PVC					75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086	75,086
PROJECT 11 - GI Replaced with PVC					467	467	467	467	467	467	467	467	467	467	467	467	467	467	467
PROJECT 12 - CI Replaced with PVC					738	738	738	738	738	738	738	738	738	738	738	738	738	738	738
PROJECT 13 - PVC Replaced with PVC																			
PROJECT 14 - AC Replaced with DI					3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376	3,376
PROJECT 15 - GI Replaced with DI					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South System Transmission																			
PROJECT 16 - Replacement of Intake Structure															725,000				
PROJECT 17 - CI Replaced with PVC					19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143	19,143
PROJECT 18 - PVC Replaced with PVC																			
Meters																			
PROJECT 19 - Water Meter Installation - North System			1,108,800																
PROJECT 20 - Water Meter Installation - South System			302,400																
PROJECT 21 - Water Meter Replacement - North System							61,600	61,600	61,600	61,600	61,600	61,600							
- Water Meter Replacement - North System																	33,600	33,600	33,600
- Water Meter Replacement - North System																			
PROJECT 22 - Water Meter Replacement - South System							16,800	16,800	16,800	16,800	16,800	16,800							
- Water Meter Replacement - South System																	9,164	9,164	9,164
- Water Meter Replacement - South System																			
TOTAL IRRIGATION REPLACEMENT COST	**$0**	**$0**	**$1,411,200**	**$0**	**$374,114**	**$374,114**	**$452,514**	**$452,514**	**$452,514**	**$452,514**	**$452,514**	**$452,514**	**$374,114**	**$374,114**	**$1,824,114**	**$374,114**	**$416,878**	**$416,878**	**$416,878**

City of Penticton Irrigation Master Plan
Unit Costs Spreadsheet

			PVC replacing G.I., C.I and A.C. piping (mm)													
	25 Sch 40		50 Sch 40		75 Sch 40		100		150		200		250		300	
Location	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**
Supply Cost (June 8, 2009)																
a. Supply ($/m)	$ 2.66	$ 2.66	$ 9.08	$ 9.08	$ 12.00	$ 12.00	$ 14.93	$ 14.93	$ 24.57	$ 24.57	$ 42.13	$ 42.13	$ 62.61	$ 62.61	$ 89.24	$ 89.24
b. Fittings ($/m)	$ 0.27	$ 0.27	$ 0.91	$ 0.91	$ 1.20	$ 1.20	$ 1.49	$ 1.49	$ 2.46	$ 2.46	$ 4.21	$ 4.21	$ 6.26	$ 6.26	$ 8.92	$ 8.92
Trench Width	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.75	1.0	1.0	1.0	1.0	1.0	1.0
Trench Depth	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
c. Bedding Sand ($/m³)	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00
- depth below pipe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
- depth above pipe invert	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
- volume + 20% for compaction (m²/m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.7	0.7	0.7	0.7	0.8	0.8
- cost ($/m)	$ 5.09	$ 5.09	$ 5.38	$ 5.38	$ 5.65	$ 5.65	$ 5.91	$ 5.91	$ 9.58	$ 9.58	$ 13.65	$ 13.65	$ 14.42	$ 14.42	$ 15.10	$ 15.10
d. Service Connections - 25mm ($/m)*																
- cost per service connection	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00
- frequency of service connections (m per)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
- service connection cost (per m)	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00
Total Material Supply w services($/m)	**$ 33.02**	**$ 33.02**	**$ 40.36**	**$ 40.36**	**$ 43.85**	**$ 43.85**	**$ 47.33**	**$ 47.33**	**$ 61.61**	**$ 61.61**	**$ 84.99**	**$ 84.99**	**$ 108.29**	**$ 108.29**	**$ 138.26**	**$ 138.26**
Total Material Supply w/o services($/m)	**$ 8.02**	**$ 8.02**	**$ 15.36**	**$ 15.36**	**$ 18.85**	**$ 18.85**	**$ 22.33**	**$ 22.33**	**$ 36.61**	**$ 36.61**	**$ 59.99**	**$ 59.99**	**$ 83.29**	**$ 83.29**	**$ 113.26**	**$ 113.26**
Restoration																
Restoration Width (m)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0
a. Asphalt Milling and Removal ($/m)	$ 7.50		$ 7.50		$ 7.50		$ 7.50		$ 11.25		$ 15.00		$ 15.00		$ 15.00	
b. Sawcutting ($/m)**	$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00	
c. Granular Subbase (Supply) ($/m³)**	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00
- 200mm	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 5.25	$ 5.25	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00
- 300mm																
d. Granular Road Base (Supply) ($/m³)**	$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00	
- 75mm	$ 1.88		$ 1.88		$ 1.88		$ 1.88		$ 2.81		$ 3.75		$ 3.75		$ 3.75	
- 150mm																
e. Hot-Mix Asphalt Paving ($/m³)**	$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00	
- 50mm	$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00	
- 80mm																
f. Imported Backfill ($/m³)	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00
- volume required (m³/m)	0.13	0.19	0.11	0.18	0.10	0.16	0.09	0.15	0.09	0.19	0.08	0.20	0.03	0.15	0.00	0.10
- cost ($/m)	$ 3.13	$ 4.69	$ 2.81	$ 4.38	$ 2.50	$ 4.06	$ 2.19	$ 3.75	$ 2.34	$ 4.69	$ 1.88	$ 5.00	$ 0.63	$ 3.75	$ -	$ 2.50
g. Service Connections across Asphalt ($/m)																
- unit cost (per m)	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 298.23	$ 298.23	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75
- width of asphalt (m)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
- frequency of service connections (m per)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
- percentage of long service connections	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
- cost per metre of pipe installed ($/m)	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 14.91	$ 14.91	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04
Total Restoration ($/m)	**$ 50.95**	**$ 18.13**	**$ 50.63**	**$ 17.82**	**$ 50.32**	**$ 17.51**	**$ 50.01**	**$ 17.20**	**$ 61.57**	**$ 24.85**	**$ 72.66**	**$ 32.04**	**$ 71.41**	**$ 30.79**	**$ 70.79**	**$ 29.54**
Labour																
a. Excavator ($/hr)	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00
b. Compactor ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
c. Loader ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
b. Pipe Crew ($/hr)	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00
c. Trucks ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
d. Welding ($/hr)																
e. Welding Technician ($/hr)																
f. Blasting ($/hr)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
g. Traffic Control ($/hr)	$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00	
h. D8-D9 Bulldozer ($/hr)																
Total Hourly Rate ($/hr)	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00	$ 700.00	$ 650.00
Night Work Premium (%)																
Hourly Rate w 20% Contractor Mark-up ($/hr)	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00	$ 840.00	$ 780.00
Production Rate (m/day)	150	150	150	150	150	150	100	150	100	125	80	100	80	100	80	100
Labour Per Metre Cost ($/m)	**$ 44.80**	**$ 41.60**	**$ 44.80**	**$ 41.60**	**$ 44.80**	**$ 41.60**	**$ 67.20**	**$ 41.60**	**$ 67.20**	**$ 49.92**	**$ 84.00**	**$ 62.40**	**$ 84.00**	**$ 62.40**	**$ 84.00**	**$ 62.40**
Total Supply and Install - Distribution	**$ 130**	**$ 95**	**$ 135**	**$ 100**	**$ 140**	**$ 105**	**$ 165**	**$ 105**	**$ 190**	**$ 135**	**$ 240**	**$ 180**	**$ 265**	**$ 200**	**$ 295**	**$ 230**
Total Supply and Install - Transmission	**$ 105**	**$ 70**	**$ 110**	**$ 75**	**$ 115**	**$ 80**	**$ 140**	**$ 80**	**$ 165**	**$ 110**	**$ 215**	**$ 155**	**$ 240**	**$ 175**	**$ 270**	**$ 205**

Notes:
1) Supply costs include 10% mark-up, 7% PST and delivery to Penticton
2) Corrosion Protection costs not included
3) Assumed Rock Blasting Crew required full time
4) Pipe in tunnel assumes PE slip linning of existing pipe.
* Based upon the total length of distribution pipe over the number of total services
** Unit cost estimated from Bid Summary Sheet for PRIORITY 1 WATER SYSTEMS UPGRADES for District of Peachland

City of Penticton Irrigation Master Plan
Unit Costs Spreadsheet

	DI replacing C.I.(mm)												Steel replacing Steel (mm)				HDPE Slip Lining of Steel (mm)
	50		100		150		200		250		300		350		650		750
Location	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**Road**	**Boulevard**	**In Tunnel**
Supply Cost (June 8, 2009)																	
a. Supply ($/m)	$ -	$ -	$ 51.68	$ 51.68	$ 49.80	$ 49.80	$ 62.01	$ 62.01	$ 80.26	$ 80.26	$ 89.24	$ 89.24	$ 136.19	$ 136.19	$ 372.34	$ 372.34	$263
b. Fittings ($/m)	$ -	$ -	$ 5.17	$ 5.17	$ 4.98	$ 4.98	$ 6.20	$ 6.20	$ 8.03	$ 8.03	$ 8.92	$ 8.92	$ 13.62	$ 13.62	$ 37.23	$ 37.23	
Trench Width	0.5	0.5	0.5	0.5	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	
Trench Depth	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.5	1.5	
c. Bedding Sand ($/m³)	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00	
- depth below pipe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
- depth above pipe invert	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	1.0	1.0	
- volume + 20% for compaction (m²/m)	0.3	0.3	0.3	0.3	0.5	0.5	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	1.3	1.3	
- cost ($/m)	$ 5.38	$ 5.38	$ 5.91	$ 5.91	$ 9.58	$ 9.58	$ 13.65	$ 13.65	$ 14.42	$ 14.42	$ 15.10	$ 15.10	$ 15.69	$ 15.69	$ 25.85	$ 25.85	$0
d. Service Connections - 25mm ($/m)*																	
- cost per service connection	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	
- frequency of service connections (m per)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	
- service connection cost (per m)	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	
Total Material Supply w services($/m)	**$ 30.38**	**$ 30.38**	**$ 87.75**	**$ 87.75**	**$ 89.36**	**$ 89.36**	**$ 106.86**	**$ 106.86**	**$ 127.71**	**$ 127.71**	**$ 138.26**	**$ 138.26**	**$ 190.50**	**$ 190.50**	**$ 460.43**	**$ 460.43**	**$263**
Total Material Supply w/o services($/m)	**$ 5.38**	**$ 5.38**	**$ 62.75**	**$ 62.75**	**$ 64.36**	**$ 64.36**	**$ 81.86**	**$ 81.86**	**$ 102.71**	**$ 102.71**	**$ 113.26**	**$ 113.26**	**$ 165.50**	**$ 165.50**	**$ 435.43**	**$ 435.43**	**$263**
Restoration																	
Restoration Width (m)	0.5	0.5	0.5	0.5	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	
a. Asphalt Milling and Removal ($/m)	$ 7.50		$ 7.50		$ 12.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 22.50		
b. Sawcutting ($/m)**	$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		$ 5.00		
c. Granular Subbase (Supply) ($/m³)**	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	$ 35.00	
- 200mm	$ 3.50	$ 3.50	$ 3.50	$ 3.50	$ 5.60	$ 5.60	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 7.00	$ 10.50	$ 10.50	
- 300mm																	
d. Granular Road Base (Supply) ($/m³)**	$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 51.00		
- 75mm	$ 1.88		$ 1.88		$ 3.00		$ 3.75		$ 3.75		$ 3.75		$ 3.75		$ 5.74		
- 150mm																	
e. Hot-Mix Asphalt Paving ($/m³)**	$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 300.00		$ 301.00		
- 50mm	$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.00		$ 15.05		
- 80mm																	
f. Imported Backfill ($/m³)	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	
- volume required (m³/m)	0.11	0.18	0.09	0.15	0.09	0.19	0.08	0.20	0.03	0.15	0.00	0.10	0.13	0.25	0.19	0.38	
- cost ($/m)	$ 2.81	$ 4.38	$ 2.19	$ 3.75	$ 2.34	$ 4.69	$ 1.88	$ 5.00	$ 0.63	$ 3.75	$ -	$ 2.50	$ 3.13	$ 6.25	$ 4.69	$ 9.38	
g. Service Connections across Asphalt ($/m)																	
- unit cost (per m)	$ 198.94	$ 198.94	$ 198.94	$ 198.94	$ 318.48	$ 318.48	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 400.75	$ 618.68	$ 618.68	
- width of asphalt (m)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
- frequency of service connections (m per)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	
- percentage of long service connections	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
- cost per metre of pipe installed ($/m)	$ 9.95	$ 9.95	$ 9.95	$ 9.95	$ 15.92	$ 15.92	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 20.04	$ 30.93	$ 30.93	
Total Restoration ($/m)	**$ 50.63**	**$ 17.82**	**$ 50.01**	**$ 17.20**	**$ 63.87**	**$ 26.21**	**$ 72.66**	**$ 32.04**	**$ 71.41**	**$ 30.79**	**$ 70.79**	**$ 29.54**	**$ 73.91**	**$ 33.29**	**$ 99.41**	**$ 50.81**	**$0**
Labour																	
a. Excavator ($/hr)	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	
b. Compactor ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	
c. Loader ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	
b. Pipe Crew ($/hr)	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$300
c. Trucks ($/hr)	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	
d. Welding ($/hr)	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$125
e. Welding Technician ($/hr)	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$ 62.50	$125
f. Blasting ($/hr)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0
g. Traffic Control ($/hr)	$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$ 50.00		$0
h. D8-D9 Bulldozer ($/hr)																	$500
Total Hourly Rate ($/hr)	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$ 1,262.50	$ 1,212.50	$1,050
Night Work Premium (%)																	
Hourly Rate w 20% Contractor Mark-up ($/hr)	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$ 1,515.00	$ 1,455.00	$1,260
Production Rate (m/day)	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	$70
Labour Per Metre Cost ($/m)	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$ 161.60**	**$ 155.20**	**$144**
Total Supply and Install - Distribution	**$ 245**	**$ 205**	**$ 300**	**$ 260**	**$ 315**	**$ 270**	**$ 340**	**$ 295**	**$ 360**	**$ 315**	**$ 370**	**$ 325**	**$ 425**	**$ 380**	**$ 720**	**$ 665**	**$405**
Total Supply and Install - Transmission	**$ 220**	**$ 180**	**$ 275**	**$ 235**	**$ 290**	**$ 245**	**$ 315**	**$ 270**	**$ 335**	**$ 290**	**$ 345**	**$ 300**	**$ 400**	**$ 355**	**$ 695**	**$ 640**	**$405**

Notes:
1) Supply costs include 10% mark-up, 7% PST and deliv
2) Corrosion Protection costs not included
3) Assumed Rock Blasting Crew required full time
4) Pipe in tunnel assumes PE slip linning of existing pipe
* Based upon the total length of distribution pipe over the
** Unit cost estimated from Bid Summary Sheet for PRIC

Penticton Irrigation Master Plan
North Distribution System Upgrade Projects

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 1 - Replacement of AC Pipe with PVC					
a)	100mm Ø adjacent to asphalt	lin. m	251	$105	$26,355
b)	100mm Ø in asphalt	lin. m	80	$165	$13,200
c)	200mm Ø adjacent to asphalt	lin. m	6	$180	$1,080
d)	200mm Ø in asphalt	lin. m	464	$240	$111,360
e)	250mm Ø adjacent to asphalt	lin. m	0	$200	$0
f)	250mm Ø in asphalt	lin. m	314	$265	$83,210
g)	300mm Ø adjacent to asphalt	lin. m	441	$230	$101,430
h)	300mm Ø in asphalt	lin. m	324	$295	$95,580
	SUB-TOTAL			**$**	**432,215**
	CONTINGENCY & ENGINEERING (45%)			**$**	**194,500**
	PROJECT 1 - TOTAL (Rounded)			**$**	**626,800**
Project 2 - Replacement of GI Pipe with PVC					
a)	50mm Ø adjacent to asphalt	lin. m	504	$100	$50,400
b)	50mm Ø in asphalt	lin. m	211	$135	$28,485
	SUB-TOTAL			**$**	**78,885**
	CONTINGENCY & ENGINEERING (45%)			**$**	**35,500**
	PROJECT 2 - TOTAL (Rounded)			**$**	**114,400**
Project 3 - Replacement of CI Pipe with PVC					
a)	100mm Ø adjacent to asphalt	lin. m	2,401	$105	$252,105
b)	100mm Ø in asphalt	lin. m	1,872	$165	$308,880
c)	150mm Ø adjacent to asphalt	lin. m	1,234	$135	$166,590
d)	150mm Ø in asphalt	lin. m	1,342	$190	$254,980
e)	200mm Ø adjacent to asphalt	lin. m	0	$180	$0
f)	200mm Ø in asphalt	lin. m	1,203	$240	$288,720
g)	250mm Ø adjacent to asphalt	lin. m	231	$200	$46,200
h)	250mm Ø in asphalt	lin. m	1,375	$265	$364,375
i)	300mm Ø adjacent to asphalt	lin. m	88	$230	$20,240
j)	300mm Ø in asphalt	lin. m	790	$295	$233,050
	SUB-TOTAL			**$**	**1,935,140**
	CONTINGENCY & ENGINEERING (45%)			**$**	**870,900**
	PROJECT 3 - TOTAL (Rounded)			**$**	**2,806,100**
Project 4 - Replacement of PVC Pipe with PVC					
a)	25mm Ø adjacent to asphalt	lin. m	107	$95	$10,165
b)	25mm Ø in asphalt	lin. m	0	$130	$0
c)	50mm Ø adjacent to asphalt	lin. m	1,834	$100	$183,400
d)	50mm Ø in asphalt	lin. m	1,648	$135	$222,480
e)	100mm Ø adjacent to asphalt	lin. m	114	$105	$11,970
f)	100mm Ø in asphalt	lin. m	246	$165	$40,590
	SUB-TOTAL			**$**	**468,605**
	CONTINGENCY & ENGINEERING (45%)			**$**	**210,900**
	PROJECT 4 - TOTAL (Rounded)			**$**	**679,600**
Project 5 - Replacement of CI Pipe with DI					
a)	100mm Ø adjacent to asphalt	lin. m	736	$260	$191,360
b)	100mm Ø in asphalt	lin. m	210	$300	$63,000
c)	250mm Ø adjacent to asphalt	lin. m	0	$315	$0
d)	250mm Ø in asphalt	lin. m	286	$360	$102,960
e)	300mm Ø adjacent to asphalt	lin. m	0	$325	$0
f)	300mm Ø in asphalt	lin. m	983	$370	$363,710
	SUB-TOTAL			**$**	**721,030**
	CONTINGENCY & ENGINEERING (45%)			**$**	**324,500**
	PROJECT 5 - TOTAL (Rounded)			**$**	**1,045,600**
Project 6 - Replacement of GI Pipe with DI					
a)	50mm Ø adjacent to asphalt	lin. m	0		$0
b)	50mm Ø in asphalt	lin. m	74		$0
	SUB-TOTAL			**$**	**0**
	CONTINGENCY & ENGINEERING (45%)			**$**	**0**
	PROJECT 6 - TOTAL (Rounded)			**$**	**0**
Project 7 - Replacement of Steel Pipe with Steel					
a)	100mm Ø adjacent to asphalt	lin. m	140	$260	$36,400
b)	100mm Ø in asphalt	lin. m	154	$300	$46,200
c)	150mm Ø adjacent to asphalt	lin. m	0	$270	$0
d)	150mm Ø in asphalt	lin. m	315	$315	$99,225
e)	350mm Ø adjacent to asphalt	lin. m	32	$380	$12,160
f)	350mm Ø in asphalt	lin. m	913	$425	$388,025
	SUB-TOTAL			**$**	**582,010**
	CONTINGENCY & ENGINEERING (45%)			**$**	**262,000**
	PROJECT 7 - TOTAL (Rounded)			**$**	**844,100**
	SUB-TOTAL			**$**	**4,217,885**
	CONTINGENCY & ENGINEERING (45%)			**$**	**1,898,100**
	TOTAL (Rounded)			**$**	**6,116,000**

Penticton Irrigation Master Plan
North Transmission System Upgrade Projects

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 8 - Replacement of Intake Structure					
a)	Intake Structure Replacement	LS	1	$500,000	$500,000
	SUB-TOTAL			$	**500,000**
	CONTINGENCY & ENGINEERING (45%)			$	**225,000**
	PROJECT 8 - TOTAL (Rounded)			$	**725,000**
Project 9 - Replacement of Steel Pipe					
a)	650mm Ø adjacent to asphalt	lin. m	756	$640	$483,840
b)	750mmØ HDPE Slip Lining of 900mmØ Steel Pipe	lin. m	1,319	$405	$534,195
c)	Mobilization of Equipment for Slip Lining	LS	1	$2,000	$2,000
d)	Connection to existing infrastructure	LS	1	$100,000	$100,000
	SUB-TOTAL			$	**1,018,035**
	CONTINGENCY & ENGINEERING (45%)			$	**458,200**
	PROJECT 9 - TOTAL (Rounded)			$	**1,476,300**
	SUB-TOTAL			$	**1,518,035**
	CONTINGENCY & ENGINEERING (45%)			$	**683,200**
	TOTAL (Rounded)			$	**2,201,300**

NOTE: Quantity of north system transmission piping obtained from information provided by the City of Penticton on June 1, 2009.

Penticton Irrigation Master Plan
South Distribution System Upgrade Projects

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 10 - Replacement of AC Pipe with PVC					
a)	100mm Ø adjacent to asphalt	lin. m	987	$105	$103,635
b)	100mm Ø in asphalt	lin. m	206	$165	$33,990
c)	150mm Ø adjacent to asphalt	lin. m	770	$135	$103,950
d)	150mm Ø in asphalt	lin. m	0	$190	$0
e)	200mm Ø adjacent to asphalt	lin. m	572	$180	$102,960
f)	200mm Ø in asphalt	lin. m	237	$240	$56,880
g)	250mm Ø adjacent to asphalt	lin. m	609	$200	$121,800
h)	250mm Ø in asphalt	lin. m	8	$265	$2,120
i)	300mm Ø adjacent to asphalt	lin. m	1,165	$230	$267,950
j)	300mm Ø in asphalt	lin. m	997	$295	$294,115
	SUB-TOTAL			**$**	**1,087,400**
	CONTINGENCY & ENGINEERING (45%)			**$**	**489,400**
	PROJECT 10 - TOTAL (Rounded)			**$**	**1,576,800**
Project 11 - Replacement of GI Pipe with PVC					
a)	25mm Ø adjacent to asphalt	lin. m	145	$95	$13,775
b)	25mm Ø in asphalt	lin. m	192	$130	$24,960
c)	50mm Ø adjacent to asphalt	lin. m	964	$100	$96,400
d)	50mm Ø in asphalt	lin. m	98	$135	$13,230
e)	75mm Ø adjacent to asphalt	lin. m	21	$105	$2,205
f)	75mm Ø in asphalt	lin. m	32	$140	$4,480
	SUB-TOTAL			**$**	**6,685**
	CONTINGENCY & ENGINEERING (45%)			**$**	**3,100**
	PROJECT 11 - TOTAL (Rounded)			**$**	**9,800**
Project 12 - Replacement of CI Pipe with PVC					
a)	150mm Ø adjacent to asphalt	lin. m	79	$135	$10,665
b)	150mm Ø in asphalt	lin. m	0	$190	$0
	SUB-TOTAL			**$**	**10,665**
	CONTINGENCY & ENGINEERING (45%)			**$**	**4,800**
	PROJECT 12 - TOTAL (Rounded)			**$**	**15,500**
Project 13 - Replacement of PVC Pipe with PVC					
a)	18mm Ø adjacent to asphalt*	lin. m	58	$95	$5,510
b)	18mm Ø in asphalt*	lin. m	124	$130	$16,120
c)	50mm Ø adjacent to asphalt	lin. m	474	$105	$49,770
d)	50mm Ø in asphalt	lin. m	32	$140	$4,480
e)	200mm Ø adjacent to asphalt	lin. m	280	$180	$50,400
f)	200mm Ø in asphalt	lin. m	432	$240	$103,680
	SUB-TOTAL			**$**	**229,960**
	CONTINGENCY & ENGINEERING (45%)			**$**	**103,500**
	PROJECT 13 - TOTAL (Rounded)			**$**	**333,500**
Project 14 - Replacement of AC Pipe with DI					
a)	100mm Ø adjacent to asphalt	lin. m	188	$260	$48,880
b)	100mm Ø in asphalt	lin. m	0	$300	$0
c)	150mm Ø adjacent to asphalt	lin. m	50	$0	$0
d)	150mm Ø in asphalt	lin. m	0	$0	$0
	SUB-TOTAL			**$**	**48,880**
	CONTINGENCY & ENGINEERING (45%)			**$**	**22,000**
	PROJECT 14 - TOTAL (Rounded)			**$**	**70,900**
Project 15 - Replacement of GI Pipe with DI					
a)	50mm Ø adjacent to asphalt	lin. m	0		$0
b)	50mm Ø in asphalt	lin. m	0		$0
	SUB-TOTAL			**$**	**0**
	CONTINGENCY & ENGINEERING (45%)			**$**	**0**
	PROJECT 15 - TOTAL (Rounded)			**$**	**0**
	SUB-TOTAL			**$**	**1,383,590**
	CONTINGENCY & ENGINEERING (45%)			**$**	**622,700**
	PROJECT 3 - TOTAL (Rounded)			**$**	**2,006,300**

* Assumed the same unit price as 25mm PVC pipe

Penticton Irrigation Master Plan
South Transmission System Upgrade Projects

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 16 - Replacement of Intake Structure					
a)	Intake Structure Replacement	ea.	1	$500,000	$500,000
	SUB-TOTAL			$	**500,000**
	CONTINGENCY & ENGINEERING (45%)			$	**225,000**
	PROJECT 16 - TOTAL (Rounded)			$	**725,000**
Project 17 - Replacement of CI Pipe with PVC					
a)	300mm Ø adjacent to asphalt	lin. m	1,352	$205	$277,160
b)	300mm Ø in asphalt	lin. m	0	$270	$0
	SUB-TOTAL			$	**277,160**
	CONTINGENCY & ENGINEERING (45%)			$	**124,800**
	PROJECT 17 - TOTAL (Rounded)			$	**402,000**
Project 18 - Replacement of PVC Pipe with PVC					
a)	300mm Ø adjacent to asphalt	lin. m	333	$205	$68,265
b)	300mm Ø in asphalt	lin. m	0	$270	$0
	SUB-TOTAL			$	**68,265**
	CONTINGENCY & ENGINEERING (45%)			$	**30,800**
	PROJECT 18 - TOTAL (Rounded)			$	**99,100**
	SUB-TOTAL			$	**845,425**
	CONTINGENCY & ENGINEERING (45%)			$	**380,500**
	PROJECT 3 - TOTAL (Rounded)			$	**1,226,000**

Penticton Irrigation Master Plan
North & South Irrigation System Water Metering Installation Costs

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 19 - Install Water Meters on North Irrigation System					
a)	New water meters	ea.	308	$3,000	$924,000
	SUB-TOTAL			**$**	**924,000**
	CONTINGENCY (20%)			**$**	**184,800**
	PROJECT 19 - TOTAL (Rounded)			**$**	**1,108,800**
Project 20 - Install Water Meters on South Irrigations					
a)	New water meters	lin. m	84	$3,000	$252,000
	SUB-TOTAL			**$**	**252,000**
	CONTINGENCY (20%)			**$**	**50,400**
	PROJECT 20 - TOTAL (Rounded)			**$**	**302,400**
	SUB-TOTAL			**$**	**1,176,000**
	CONTINGENCY (20%)			**$**	**235,200**
	TOTAL (Rounded)			**$**	**1,411,200**

Penticton Irrigation Master Plan
North & South Irrigation System Water Metering Replacement Costs

COST ESTIMATE

ITEM	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
Project 21 - Install Water Meters on North Irrigation System					
a)	Replacement water meters	ea.	308	$1,000	$308,000
	SUB-TOTAL			**$**	**308,000**
	CONTINGENCY (20%)			**$**	**61,600**
	PROJECT 21 - TOTAL (Rounded)			**$**	**369,600**
Project 22 - Install Water Meters on South Irrigations					
a)	Replacement water meters	lin. m	84	$1,000	$84,000
	SUB-TOTAL			**$**	**84,000**
	CONTINGENCY (20%)			**$**	**16,800**
	PROJECT 22 - TOTAL (Rounded)			**$**	**100,800**
	SUB-TOTAL			**$**	**392,000**
	CONTINGENCY (20%)			**$**	**78,400**
	TOTAL (Rounded)			**$**	**470,400**

APPENDIX D

OPERATING AND MAINTENANCE COSTS FOR NORTH & SOUTH IRRIGATION SYSTEM

Estimated Costs to Operate the Irrigation System

Task Description	2009 Budget	2008 Actual	2007 Actual	2006 Actual	Average	Costs included in O&M for Report	USL Comments	City Notes
General								
General Management & Support - 20%	$49,185	$46,824	$44,256	$42,849	$45,779	$45,779		
Administration - 20%	$81,340	$79,427	$66,540	$45,874	$68,295	$68,295		
Water License Annual Assessment - 3	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000		
Standby Wages - 20%	$2,300	$3,980	$1,860	$1,838	$2,495	$2,495		
Meter Reading						$75,000	USL Estimate	
Sub-total	**$137,825**	**$135,231**	**$117,656**	**$95,561**	**$121,568**	**$196,568**		
Operational Costs								
Dam Inspection	$10,000	$9,800	$5,831	$549	$4,582	$4,582		Averaged - 70% attributable to irrigation
Inspection/Mtce - Ellis Creek	$36,000	$30,052	$21,178	$35,316	$30,637	$30,637		
Inspection/Mtce - Penticton Creek	$43,000	$39,537	$53,461	$46,359	$31,912	$31,912		Averaged - 70% attributable to irrigation
Rip/Rap Program - Ellis Creek	$5,000	$8,069	$64	$6,490	$4,906	$4,906		
Rip/Rap Program - Penticton Creek	$5,000	$4,324	$11,110	$968	$3,745	$3,745		Averaged - 70% attributable to irrigation
Clean & Repair Intakes	$0	$53,701	$0	$17,329	$12,430	$12,430		Averaged - 70% attributable to irrigation
Engineering and Record Keeping	$7,500	$5,413	$2,445	$5,492	$5,213	$5,213		
System Maintenance	$56,000	$51,155	$55,535	$47,377	$52,517	$52,517		
Sub-total	**$162,500**	**$202,051**	**$149,624**	**$159,880**	**$145,941**	**$145,941**		
Capital Upgrades								
Dam Upgrade - Penticton 2	$0	$182,158	$66,578	$0	$31,092		Capital Cost	Averaged - 50% attributable to irrigation
Irrigation Upgrading Study	$0	$64,063	$10,959	$0	$18,756	$18,756		
Grey back Dam Upgrade & Consulting	$25,000	$163,234	$11,803	$0	$25,005		Capital Cost	Averaged - 50% attributable to irrigation
Ellis 2 Dam - Upgrade & Consulting	$31,000	$0	$6,033	$0	$9,258		Capital Cost	
Ellis 4 Dam - Upgrade & Consulting	$13,000	$0	$0	$0	$3,250		Capital Cost	
Water Mgmt Plan-Pent/Ellis Creeks	$0	$14,569	$0	$0	$3,642	$3,642		
Creek Flow Measurment	$0	$9,908	$0	$0	$1,239	$1,239		Averaged - 50% attributable to irrigation
Misc Dam Projects	$41,500	$25,935	$0	$0	$11,801	$11,801		Averaged - 70% attributable to irrigation
Irrigation Upgrade	$55,000	$11,594	$44,531	$15,825	$31,738		Capital Cost	
Storage Capacity of Dams	$100,000	$0	$0	$0	$12,500		Capital Cost	Averaged - 50% attributable to irrigation
Creek Flow Measurement	$0	$0	$23,014	$0	$2,877	$2,877		Averaged - 50% attributable to irrigation
Ellis Creek Inundation Study	$0	$0	$0	$22,773	$5,693	$5,693		
Penticton Creek Inundation Study	$0	$0	$0	$21,756	$3,807	$3,807		Averaged - 70% attributable to irrigation
Environment/Habitat Plan	$0	$0	$0	$16,883	$2,955	$2,955		Averaged - 70% attributable to irrigation
Dam Safety Assessment	$0	$0	$0	$1,421	$249	$249		Averaged - 70% attributable to irrigation
Penticton Dam #1 Removal	$0	$0	$0	$87,553	$15,322		Capital Cost	Averaged - 70% attributable to irrigation
Penticton Creek Repairs	$0	$0	$0	$30,093	$5,266	$5,266		Averaged - 70% attributable to irrigation
Sub-total	**$265,500**	**$471,461**	**$162,918**	**$196,304**	**$184,448**	**$56,284**		
TOTAL	**$565,825**	**$808,743**	**$430,198**	**$451,745**	**$451,958**	**$398,793**		

City Notes:

All information is based off old accounting records - accuracy unclear & some assumptions have been made

The items under the General heading are estimated based on the split between domestic and irrigation water - percentages indicated

The costs of maintaining the Ellis Dam and Creek System are 100% attributable to the Irrigation

The cost of maintaining the Penticton Dam and Creek System are at this time shared between the domestic and irrigation - Approximaltey 10% of the water for domestic

APPENDIX E

MATRIX OF SURVEY RESPONSES

Summary of Interviews - Agriculture Irrigation Uses - 2009

	Penticton	SEKID	Glenmore/ Ellison	Westbank	Summerland	Black Mountain	Peachland	Lake Country	Greater Vernon Services
Is there a water bylaw to regulate irrigation use?	Bylaw 2005-02 Irrigation, Sewer and Water Bylaw Bylaw 2007-06 Fees & Charges	Bylaw #579 Irrigation Water Distribution & Reg.	Bylaw #73 Bylaw #84	Bylaw 645	Bylaw 98-001 Water Fees Bylaw 2003-203 Water Meters	Bylaw 677 Tax Bylaw 649 Land Classes Bylaw 593 Irrigation Bylaw	Bylaw 1862, 1713	Bylaw 713 Rates Bylaw 633 Water Reg.	Bylaw 2387
What are the types of users? (R,C,I,Ag)	Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, Ag	R, C, I, AG
What is the irrigation service area?	1,811 acres	80% water use by agriculture	9,007.5 acres	950 acres 30% demand from agriculture					8,600 acres
How many connections? How many irrigation connections?	399 irrigation connections	450 irrigation connections 1,700 domestic connections	5,212 connections	>5,000 residential 150		Total 7,150 connections 860 irrigation connections	145 to date		6,108 irrigation connections, 6,310 total
What is the irrigation flow rating?	5, 6, 7 USGPM/acre	2.25 acre feet/ acre Old rate was 2.5 Drought year 1.8 5, 6, 6.5 USGPM/ac	Glenmore 4.5, Ellison 5 USGM/acre	5 – USGM/ acre	2.5 acre feet/ acre 6.5 USGPM/ acre	5 to 7 USGPM/acre	6 USGPM/acre	6.25 USGPM/acre Wood Lake 6.0 USGPM/acre WOCID & Oyama	5 USGPM/ acre
Is the water supply seasonal? Period of supply?	Seasonal		April 1 to September30	To September 30				120 days	April 15 – September 15, different rate for off season
Is the water treated for domestic use?	Non -treated		Both	Treated	Treated	Treated	Treated	Treated	Treated
Are there different grades of water supply?	No	Grade A Grade G no rights Grade B pressure restriction	Grade A chlorinated/ pressure Grade A-1 chlorinated w/o min. pressure guan. Grade A-2 no chlor./ no pressure guarantee	Grade C Grade A		Grade A – rights & use Grade C – rights/ presently dry Grade D – no rights unless water available			Only for South Vernon Irrigation District (200 lots)
When were meters first installed?	Not metered to date	First installed in 1009 1994 – 1998 for irrigation users	2006-2007	Completed in 2007	On-going 54% complete in 2008	Installed but not used for charge	On-going Mock billing in 2009 first metered bill in 2010	No irrigation meters	Started in 2007, approx. 75% complete
Water rate – by meter reading or flat rate?	Flat rate	Flat rate Touch pad	Flat rate Radio read	Flat rate Radio read	Flat rate	Flat rate	Flat rate	Flat rate	Flat rate
Water rates?	$133/ acre/ year	Grade A and B $63/acre/yr Grade G $0 no supply	Grade A $54.80/ acre/yr Grade A-1 $46 Grade A-2 $43	Grade C $63.94/acre/yr Grade A $55/parcel	$128.84/acre/yr $278.18/acre/yr Greenhouse $84.70/ac/yr Garnett Lake area	Grade A $68/acre/year Grade C $51/acre/year	$95.27/acre/year	$147/acre/year	$85.21/acre/year
Are there penalties for excessive use of irrigation water?	Not at this time	Yes	Not at this time	Monitor no penalties	Not at this time	Not at this time	Not at this time		Not at this time
	www.penticton.ca	www.sekid.ca Toby Pike 1 250-861-4200	www.glenmoreellison.com Darren Schalp 1 250-763-6506	www.wbid.ca Brain Jamieson 1 250-768-5154	www.summerland.ca	www.bmid.ca 1 250-765-5169	www.peachland.ca 1 250-767-2647	www.lakecountry.bc.ca Janice Peterson 1 250-766-5650	www.greatervernon.ca Al Cotsworth 1 250 550-3702

Notes: 2.25 acre feet (27") is 733,162 USG or 2,775 m3