

## Appendix A

List of Background Documents

### List of Background Documents

Data Category/Item	Description
<b>Source Flows</b>	
Rose Valley Dam Totals (LID)	<i>Flow per month/max day for 1998 – 2011</i>
Rose Valley Dam Dailies (LID)	<i>Flow per day for Rose Valley Dam 24" and 30" mains</i>
WID Flow Reports 2009-2011	<i>Flow by month for 2009-2011</i>
WID Daily Flow for 2009-2011	<i>Flow per day for 2009-2010 (complete)</i>
WID Peak Flows over Max Day	<i>10-minute increment flow data for max day (2009 and 2010)</i>
WID peak pressures at PRVs	
WID low flow day	
Shanbooldard (Pritchard) Pump Log Books 2009-2011	<i>pump log books were recorded every 2-4 days, so max day and peak hour cannot be determined</i>
Sunnyside Log Books 2009-2011	
West Kelowna Estates Log Books 2009-2011	
<b>Water Quality Data</b>	
Lakeview Irrigation District Water Quality Report 2009, 2010	
CARO "Certificate of Analysis" Reports for "WID Water", "Rose Valley", and "Westside Water"	<i>general parameters and recoverable metals from grab samples</i>
LID Water Quality 2001-2011	<i>general parameters, nutrients, metals and coliforms for Rose Valley, Big Horn Dam, Bear Creek Headgates and Bald Range Creek</i>
<b>PRV Settings</b>	
LID - PRV Checklist	<i>handwritten log books</i>
Sunnyside - PRV Settings	<i>table and handwritten log books</i>
WID - PRV Settings	<i>table and handwritten log books</i>
WKE - PRV Settings	<i>table and handwritten log books</i>
Hydrant Flow Data	
Pressure test results at selected locations in system	
Metering Data	<i>all complete metering data is from 3rd quarter 2010 to 2nd quarter 2011, and also 2011 calendar year</i>
Quarterly metering data for all DWK Customers	<i>includes Folio # for each parcel which corresponds to GIS Attribute</i>
Residential Consumption Tracker	
<b>Non-Domestic Flows</b>	
LID Agricultural by Area	<i>list of addresses and corresponding acres of irrigable land</i>
DWK Parks Water Consumption	<i>list of DWK parks and water consumption (metered) for 2nd quarter 2010 to 3rd quarter 2011</i>
2011 WID Ag METER MASTER LIST	<i>list of addresses and service size, allowed flow</i>
<b>Financial</b>	
2010 Public Sector Accounting Board (PSAB) and tangible capital asset (TCA) information	
2011 Actual Operating and Maintenance Costs – DWK, WID and LID	
2012 Budget Operating and Maintenance Costs – DWK, WID and LID	
<b>Reports</b>	
Seismic Stability Analysis, Rose Valley Dam, April 2005 – Golder Associates	
Lakeview Irrigation District, Water System Study, March 1991 – RCPL (AECOM)	
Lakeview Irrigation District, Long Term Water Supply Strategy, February 1994 – RCPL (AECOM)	
Powers Creek Water Supply and Demand Analysis, November 2009 – Dobson Engineering Ltd.	
Interior Watershed Assessment Procedure for the Lambly Creek Watershed, Nov. 1998 – Riverside Forest Products Ltd.	
LID Potential Upstream Storage Capacity, 2008 – Dobson Engineering	
Lambly Creek Dam Feasibility Report, 2005 – Agua Consulting	
Water Storage Alternatives, 2001 – Knight & Piesold	
Lambly Creek Watershed Update Report, 1998 – Dobson Engineering	
Overall Water Supply Plan for the Westside Area, 1981 – Knight & Piesold	

Raising of Existing Embankment and Modifications to Outlet Structures, 1979 – Knight & Piesold
LID Water Quality Reports, 2008 & 2009 – Larratt Aquatic
Erosion Causing Damage to Bald Range Road and Creek, Tributary to Lambly Creek, 2007 – Larratt Aquatic
Effects of Recreational Motorcycle Use on Water Quality, 2003 – Dobson Engineering
Water Quality Assessment and Objectives for Lambly Creek Community Watershed, 2001 - MoE
Capital Expenditure Charge Bylaw Update, 2006 – Stantec
"Water Supply & Treatment - Cost/Benefit Review", Technical Memo No. 1, Pages 4-5, 2003 - Associated Engineering
"2004 Capital Works Plan", Section 4 – Future System, December, 2004 - Agua Consulting Inc.
Other
DWK Official Community Plan (obtained online)
Current Development Cost Charge practices for the water service areas
Current Water Rate Structures for water service areas (obtained online)
Current IHA Orders/Recommendations
Existing Water Models
Geodatabase of legal cadastral, contours, etc. (some obtained online)
As-built drawing records for key facilities (reservoirs, pump stations, PRV, etc.)

## Appendix B

Software Selection Matrix

## Memorandum

To	Rob Hillis, P. Eng., District of West Kelowna	Page	1
CC			
Subject	Water Utility Master Plan – Modelling Software Review		
From	John Van Andel, AECOM		
Date	July 13, 2011	Project Number	60216671

### Introduction

In reviewing any water distribution system, a complete and reliable distribution model is a useful tool available to assist in the analysis. A comprehensive computer model will allow the District of West Kelowna to accurately assess many different scenarios and conditions for future planning and upgrading of the District water system.

We understand that the District's main objectives in selecting a water modelling software include:

- Ability to import existing EPANET models
- Ability to simulate multiple-node fire flow analysis
- A user-friendly software as the District plans to eventually maintain the model in-house
- Reasonable capital and maintenance costs
- GIS compatibility
- Compatibility with other municipalities for informal support and networking

### Water Distribution Modelling Software

There are a number of water distribution modelling software packages widely used across North America. All of these packages have been developed based on the same fundamental principles of hydraulics and the Hazen-Williams headloss equation. In fact, these software packages are all based on the US EPA's analytical approach, EPANET, the software which currently holds the District's existing models. Based on the District's objectives, we short-listed our review to include the following software vendors and products:

1. Innovyze (formerly MWH Soft Inc.) – produces InfoWater; and
2. Bentley Systems – produces WaterCAD and WaterGEMS.

These vendors provide the majority of water modelling software to municipalities in BC and throughout North America.

The primary functional difference between these two vendors and their respective software packages are the graphical interface, background platform (stand-alone, AutoCAD, GIS, etc.) and add-on modules (demand allocation, calibration, etc.).

**Software Review**

A review matrix was developed to compare these software packages, based on five primary model categories. Each category was further divided into sub-features, and the modelling software programs were scored on a scale from 1 to 10 for each sub-feature (with 10 being the highest). Preliminary weighting factors were then assigned to each sub-feature to emphasize which features are most important for a hydraulic model and to meet the District’s objectives.

**Table 1** on the following page provides the detailed review matrix. The matrix includes a description of the strengths and weaknesses of the various model sub-features, scores for each sub-feature and the overall software ranking.

Note that EPANET (the District’s current modelling software) was not included in the review as it was agreed upon by the District and AECOM that EPANET does not provide the capabilities required for this project.

As part of our review, we have also compiled a list of numerous local municipalities and the modelling packages they are currently using. As seen in **Table 2** below, the software packages being used by other BC Interior municipalities varies. Note that WaterCAD has been available longer, meaning some municipalities may be using WaterCAD for historical reasons.

**Table 2 – Local Municipality Software Summary**

Municipality	Current Water Modelling Software
City of Kelowna	InfoWater
City of Penticton	WaterCAD
Regional District of North Okanagan (City of Vernon)	WaterCAD
City of Summerland	EPANET
District of Peachland	WaterCAD
City of Kamloops	WaterCAD

**Conclusions and Recommendations**

As seen in our review matrix, both InfoWater and WaterCAD were ranked highly. InfoWater received a noticeably higher ranking due to its lower purchase and technical support cost. While InfoWater requires a license of ESRI’s ArcGIS, the District currently has an ESRI license which they can also use for InfoWater.

Based upon our review, we recommend the District select **Innovyze’s InfoWater** software for this project. Based on a 3,500 pipe license (sufficient for the District’s current water distribution system and future growth), the purchase cost for a stand-alone license of InfoWater is \$6,500 and the annual maintenance /support cost is \$1,000. A “Suite” version of this software is also available, which includes modules such as criticality modelling, energy management, demand allocator, vulnerability assessment, further ArcGIS integration, calibrator and water quality calibrator. This “Suite” version is approximately \$1,000 more to purchase and \$200 more per year to maintain. At this stage we do not recommend the District purchase the “Suite” package as these add-on features are primarily used during model development and would likely be used infrequently by District staff.

As the model construction, calibration and output reporting will be occurring over the next few months, the District does not need to purchase the modelling software immediately. Moving forward, we can review the District's needs related to operating the model and determine an appropriate time to purchase the software

We look forward to reviewing this information with the District and agreeing on a preferred software so we can begin building the model.

Table 1 - Water Model Software Review Matrix

Software Features	Description	Weighting	InfoWater			WATERCAD 8			Water GEMS 8		
			Notes	Score (Out of 10)	Weighted Score	Notes	Score (Out of 10)	Weighted Score	Notes	Score (Out of 10)	Weighted Score
<b>1. Cost</b>											
1.1	Purchase Cost (5,000 pipes)	12%	\$6,500 (excludes ArcGIS, for 3,500 pipe model)	9	10.8%	\$13,000 - Standalone	8	9.6%	\$19,500	7	8.4%
1.2	Support Cost (annual)	3%	\$1,000 (excludes ArcGIS, for 3,500 pipe model)	9	2.7%	\$3,000 - Standalone	8	2.4%	\$4,700	7	2.1%
<b>2. User Friendly</b>											
2.1	Easy to Use	7%	Moderate ease of use. GIS features / add-ons can add to learning curve, but moderate curve considering the features available	8	5.6%	Easiest program to use. Self explanatory, multiple icons and easy to pick-up if infrequent use	10	7.0%	Moderate level of difficulty to use, with mild learning curve. Similar to WaterCAD but slightly harder to use due to the additional GIS features	8	5.6%
2.2	Graphical Interface	6%	Good graphics, easy to turn GIS background layers on and off. Colour coding, time-series plots, HGL animations. Tables and graphs easy to update after various model simulations.	10	6.0%	Standard graphics, colour coding and multiple time-series plots on one graph. Can do comparison plots. Need to reactivate the results graphs after each model simulation	7	4.2%	Standard graphics, colour coding and multiple time-series plots on one graph. Can do comparison plots. Able to have GIS background layers. Need to reactivate result graphs after model simulation	9	5.4%
2.3	Unit Conversion	2%	Imperial or SI units for both input/output. Output results can be switched from Imperial to SI, but model requires re-running to update	8	1.6%	Imperial or SI units for both input/output. Output results can be switched from Imperial to SI, but model requires re-running to update	8	1.6%	Imperial or SI units for both input/output. Output results can be switched from Imperial to SI, but model requires re-running to update	8	1.6%
2.4	Help File Documentation and Website	5%	Vendor is Innovize (formerly MVH Soft). Good software help files. Unlimited phone, fax and email support. Technical support is provided by the U.S., as well as local BC representative	10	5.0%	Vendor is Bentley Systems. Good help files. Technical support is from the U.S. Level of customer service varies per annual payment, therefore service can be slow to respond at times.	8	4.0%	Vendor is Bentley Systems. Good help files. Technical support is from the U.S. Level of customer service varies per annual payment, therefore service can be slow to respond at times.	8	4.0%
<b>3. Water Quality Features</b>											
3.1	Extended Period Simulation	5%	Interactive EPS to allow modification of controls at any time step. Able to up to 10 demand patterns to model various land uses. Transient analysis not included.	9	4.5%	Basic EPS features, with limited space to input numerous demand patterns. Unable to conduct transient analysis.	7	3.5%	Basic EPS features, with limited space to input numerous demand patterns. Unable to conduct transient analysis.	7	3.5%
3.2	Water Age / Chlorine Decay	4%	Models water age, chlorine decay and 5 methods of reservoir mixing. Source tracing is an add-on	9	3.6%	Models water age, chlorine decay and 5 methods of reservoir mixing. Source tracing is an add-on	9	3.6%	Models water age, chlorine decay and 5 methods of reservoir mixing. Source tracing is an add-on	9	3.6%
<b>4. Compatibility</b>											
4.1	GIS Integration	5%	Works from within ArcGIS, therefore requires ESRI license. Allows for complete GIS capability including import shape-files. Cannot directly open geodatabase.	9	4.5%	Open architecture that can import shape files, but cannot export results as shape files. Compatible with ArcView/ArcInfo but has limited capability with respect to importing GIS background layers.	5	2.5%	Has proprietary open GIS architecture, does not rely on ESRI packages. Can file share various GIS systems (ArcView/ArcInfo). Cannot open personal geodatabase	9	4.5%
4.2	Output Results	3%	Good output tables, can be copied to Excel or ODBC database. Reports and graphs from different scenarios can be compared at the same time.	10	3.0%	Good output tables, map display more limited than other packages. Multiple scenario results can be compared.	7	2.1%	Establish persistent links between the model and GIS, spreadsheet and databases. Multiple scenario results presentation	9	2.7%
4.3	EPANET	10%	Based on EPANET engine. Can import EPANET model files and export to EPANET format	10	10.0%	Based on EPANET engine, and can import files from EPANET. No direct export to EPANET format	8	8.0%	Based on EPANET engine. Can import EPANET model files, and export to EPANET format	10	10.0%
4.4	SCADA	3%	SCADA data can be integrated and overlaid on results. No direct integration of data to input into model	7	2.1%	No	0	0.0%	SCADA data can be integrated and overlaid on results. No direct integration of data to input into model	7	2.1%
<b>5. Model Features</b>											
5.1	Hydraulic Components	5%	Good hydraulic engine and excellent demand allocation features. Able to model all hydraulic components and control settings	9	4.5%	Good hydraulic engine and able to model all components and control settings. Demand allocation tools are limited and require processing in Excel.	7	3.5%	Good hydraulic engine and excellent demand allocation features. Able to model all hydraulic components and control settings	9	4.5%
5.2	Automated Multiple Node Analysis	5%	Yes, able to compute flow at any junction, given a specified minimum pressure. Can create zones so fire flow tests are not run at every node (i.e. at a reservoir)	10	5.0%	Yes, able to compute flow at any junction, given a specified minimum pressure. Can create zones so fire flow tests are not run at every node (i.e. at a reservoir)	10	5.0%	Yes, able to compute flow at any junction, given a specified minimum pressure. Can create zones so fire flow tests are not run at every node (i.e. at a reservoir)	10	5.0%
5.3	Multiple Demands	5%	Yes multiple demands can be allocated to a common node, including a number of demand patterns	10	5.0%	Yes multiple demands can be allocated to a common node. The number of multiple demand patterns is limited and less than other packages	9	4.5%	Yes multiple demands can be allocated to a common node, including a number of demand patterns	10	5.0%
5.4	Calibration	4%	Automated calibration process, by calibrating the model using user-defined pipe groups. Comparison of simulation data against real time spatial data	10	4.0%	Darwin Calibration. Enhanced parameter adjustment module - demand/roughness	9	3.6%	Darwin Calibration. Enhanced parameter adjustment module - demand/roughness	10	4.0%
5.5	Scenario Manager	5%	Has scenario manager feature. Able to model numerous scenarios including varying demands, pipe network, controls, etc. Able to activate/deactivate portions of the network for the various scenarios.	10	5.0%	Has scenario manager feature. Able to model numerous scenarios including varying demands, pipe network, controls, etc.	9	4.5%	Has scenario manager feature. Able to model numerous scenarios including varying demands, pipe network, controls, etc.	10	5.0%
5.6	Model Partitioning	3%	Yes. Able to partition the model and activate/deactivate pressures/zones as selected by the user. Partitions are "grayed" and the remain in the display.	10	3.0%	Able to deactivate pipes and demands using scenario manager, however network "turns off" and does not remain in display	8	2.4%	Able to deactivate pipes and demands using scenario manager, however network "turns off" and does not remain in display	8	2.4%
5.7	Energy Management	3%	Yes. Can apply varying rate structures. Rate structures cannot vary based on month/week/day	9	2.7%	Yes. Can apply varying rate structures. Rate structures cannot vary based on month/week/day	9	2.7%	Yes. Can apply varying rate structures. Rate structures cannot vary based on month/week/day	9	2.7%
5.8	System Head Curves	3%	Yes	10	3.0%	Yes	10	3.0%	Yes	10	3.0%
5.9	Uni-Directional Flushing	2%	Source tracing add-on can assist with UDF analysis. A separate software is available for UDF analysis, although its ability is limited as it is not fully automated	7	1.4%	Similar to other programs, it can calculate shortest transport path. Implementation plans are developed manually	7	1.4%	Similar to other programs, it can calculate shortest transport path. Implementation plans are developed manually	7	1.4%
<b>OVERALL EVALUATION</b>		100%	<b>93.0%</b>	<b>79.1%</b>			<b>86.5%</b>				

## Appendix C

Upland Water System Operation Memo and Licenses

## Memorandum

To	Rob Hillis, P. Eng., District of West Kelowna	Page 1
CC		
Subject	Water Utility Master Plan – Upland Water System Operation	
From	John Van Andel, AECOM	
Date	March 6, 2012	Project Number 60216671

On November 8 and 10, 2011, AECOM Staff attended a site tour of the District of West Kelowna watersheds and upland water systems with District Staff. This memo summarizes the current configuration and operation of the District's upland reservoirs, dams, waterways and facilities as seen on the tours and described by District Staff.

The District's water supply is obtained primarily from two watersheds; the Powers Creek Watershed and the Lambly (Bear) Creek Watershed. Historically, these watersheds have been utilized and operated independently by their respective former irrigation districts (Westbank and Lakeview); and are currently operating in this manner. The objective of this memo is to document the current operation of each upland system, with recommendations on optimization and/or modifications to follow in the Water Master Plan Report.

**Figure 1**, attached, shows both the Powers Creek and Lambly Creek Watershed upland water systems and each of the features described below. The database of dams within the District was downloaded from iMap BC, and is included in **Appendix A** to this memo.

### **Powers Creek Watershed**

The Powers Creek watershed encompasses an area of 139 km<sup>2</sup> and ranges in elevation from 1,860 m at the summit of Whiterocks Mountain to 342 m at the drainage point into Okanagan Lake. Powers Creek flows through the Westbank service area and discharges into Okanagan Lake at Gellatly Bay. The upper watershed consists of six storage lakes: Tadpole, Dobbin, Horseshow, Paynter, Jackpine and Lambly Lake. Flow upstream of the Powers Creek Diversion Pipeline is routed through Lambly Lake, which is used to store and regulate flows throughout the winter. The following descriptions detail each asset in the system, listed in order from the top of the system, following the flow of water by gravity.

#### *Sandberg Ditch*

Sandberg ditch is at the northernmost extents of the Powers Creek Watershed, bordering the Lambly Creek Watershed. In the spring, the Sandberg headgate is closed which diverts water into Tadpole Lake. The ditch enters Tadpole Lake on the far north end of the lake, near Whiterocks FSR. During the winter, the headgate is closed and water flows naturally to Lambly Creek.

### *Whiterocks Ditch*

Whiterocks ditch diverts water from the Lambly Creek Watershed into the Powers Creek Watershed via Tadpole Lake. The ditch is regulated by two head gates, one at the top of the ditch and one in the middle. In the spring, the top headgate is opened and the middle headgate is closed which diverts water into the northeast end of Tadpole Lake. The ditch flows consistently until June or July as the snowpack melts. If the ditch was not utilized, demands would require use of storage in Tadpole Lake by mid-May. During the winter, the middle head gate is opened and water continues to flow to Tadpole Lake.

### *Tadpole Lake*

The Sandberg and Whiterocks ditches fill Tadpole Lake during spring snowmelt and continue to flow until frozen. Tadpole lake contains 3,602 ML of storage and is regulated by a manual head gate which discharges into Alocin Creek.

There is a head gate at the north end of Tadpole Lake which allows a year-round flow of 7.3 ML/d (3 cfs) to Lambly Creek for fish habitat.

There is an overflow spillway at the north end of Tadpole Lake which flows to Lambly Creek.

### *Nicola Ditch*

The Nicola ditch diverts water from Alocin Creek into Dobbin Lake. Around mid-May, District Staff install stop logs on the control structure to divert the water. Between where the Nicola ditch intersects Horseshoe Main FSR and Dobbin Lake is a low-lying area which regularly floods in during freshet. Due to the large amount of brush and deadfall on this section of the ditch, water quality may be a concern for flow passing through this area.

### *Dobbin Lake*

Dobbin Lake is fed primarily by the Nicola ditch and has 692 ML of storage. A manual headgate is located on the downstream end of the lake, with a v-notch weir allowing discharge into Bit Creek. In the spring, Dobbin Lake is the first to be opened. A blasted rock overflow spillway on the northeast end of Dobbin Lake spills back into Alocin Creek via the Nicola ditch.

### *Bit Creek Ditch*

The Bit Creek ditch diverts water into the east side of Horseshoe Lake. There is no maintenance required or structure to operate for this ditch to function.

### *Horseshoe Lake*

Horseshoe Lake contains 995 ML of storage. There are three dams on Horseshoe Lake. A manual head gate and dam is located on the northwest segment of the lake, discharging to the Bit Creek/Powers Creek Headwaters. A spillway dam is located on the south end of Horseshoe Lake, discharging into Powers Creek. A saddle dam is located in the center arm of the lake which also discharges into Powers Creek.

### *Powers Creek Diversion Pipeline*

Flow from Powers Creek is intercepted near the intersection of Powers Creek and Horseshoe Main FSR into the Powers Creek diversion pipeline. A 475mm HDPE pipe diverts water from Powers Creek for 4 km to the east, discharging into Harding Creek. From Harding Creek, the diverted water flows into Lambly Lake. The diversion is used every fall for a few months to fill Lambly Lake.

*Paynter Lake*

Paynter Lake discharges to Paynter Creek, which then joins Powers Creek. There are three dams; a main dam with a manual head gate which is accessed by a basic scaffold structure; a saddle dam; and a spillway which overflows back to Powers Creek. The lake has 432 ML of storage which is used starting around August each year. The water in the lake contains high levels of colour and organics; due to the poorer quality, this water is blended with other higher quality sources.

*Jackpine Lake*

Jackpine Lake, the second largest lake in the watershed provides 1,224 ML of storage. Flow is regulated by a manual head gate, discharging to Jackpine Creek and eventually joining with Powers Creek near Jackpine Main FSR.

*Lambly Lake*

Lambly, or Bear Lake, is the largest lake in the watershed and the primary source of storage at 3,491 ML. All flows north of the Powers Creek Diversion flow into Lambly Lake and are stored and then flow-regulated throughout the winter. Naturally part of the Lambly Creek Watershed, the Lambly Lake Dam diverts the lake southward to supply the Powers Creek system. At the tail end of spring runoff, flashboards are installed on the south end of the lake to gain additional storage capacity.

Lambly Lake flows are regulated by an automatic head gate structure at the south end of the lake. The automatic head gate is housed in an insulated, corrugated metal building. The head gate is powered by solar, wind and a propane generator. Even with these multiple power sources, propane to power the generator must be brought to site an average of two times per week. Maintenance time related to delivering propane could be significantly reduced if a more reliable power source was installed. The facility has a pressure-current submersible flow monitor which is linked through SCADA back to the District office.

*Paddle Creek Diversion*

Paddle Creek is diverted to Lambly Lake instead of running naturally into Powers Creek. This diversion allows the flow from Paddle Creek to be stored and regulated as opposed to free-flowing down Powers Creek.

**Powers Creek Watershed Upland Storage**

The table below summarizes the active storage capacity available in each of the lakes.

**Table 1 – Powers Creek Watershed – Upland Reservoir Capacity**

Lake	Storage (ML)	Licensed Storage (ML)	Available Licensed Storage (ML)
Tadpole	3,602	2,467	2,467
Dobbin	692	524	524
Horseshoe	995	1,110	995
Paynter	432	432	432
Jackpine	1,224	951	951
Lambly	3,491	9,658	3,491
<b>Total</b>	<b>10,436</b>	<b>15,142</b>	<b>8,860</b>

The available licensed storage (total storage which is existing and also licensed) is **8,860 ML**.

In addition to lake storage, the District also holds storage licences on ditches and creeks. The table below summarizes this storage.

**Table 2 – Powers Creek Watershed – Upland Creek Capacity**

Creek/Ditch	Licensed Storage (ML)
Alocin Creek	952
Bit Creek	555
Powers Creek	2,975
Lambly Creek	3,419
Sandberg Ditch	1,569
Whiterocks Ditch	3,419
Paddle Creek	1,881
<b>Total</b>	<b>14,770</b>

**Powers Creek Watershed – Other Commitments**

Fisheries requires a minimum flow of 10 ML/d (4 cfs) to be released from Powers Creek for fish habitat.

**Powers Creek Watershed Summary**

The Powers Creek Watershed consists of six upland lakes which generally rely on man-made diversions to fill. There is a significant amount of operator maintenance required (often with long travel times) to regulate the flow in and out of the storage lakes. Water must be carefully balanced and conserved year-round to ensure adequate supply during low-flow periods. In general, the configuration of the upland diversions and storage provides adequate volume for the demand, but relies on considerable operator maintenance.

**Lambly Creek Watershed**

The Lambly (Bear) Creek watershed encompasses an area of 244 km<sup>2</sup> and ranges in elevation from over 1,900 m at the summit of Terrace Mountain to 342 m at the drainage point into Okanagan Lake. Lambly Creek flows southeast, discharging to Okanagan Lake at Bear Creek Provincial Park. The upper watershed consists of Esperon Lake, Christie Lake and Duo Via Lake which feed Big Horn Reservoir. Storage in Big Horn Reservoir is released down Lambly Creek, which is intercepted by the Rose Valley Diversion Pipeline, which pipes the flow to the Rose Valley Reservoir where the supply can experience a residence time of up to one year. The water is treated just after the Rose Valley dam and enters the distribution network from there. The following descriptions detail each component in the system, listed in order starting at the top of the system, following the flow of water by gravity.

*Esperon Lake*

Esperon Lake has a storage capacity of 190 ML. The Esperon Lake dam consists of a manual slide gate which is partially opened in early June and then closed early September. The majority of flow is contributed after June 1 when the DunWaters Diversion water license has expired (see below). During the summer, Operations Staff visit the dam an average of once per month to regulate the flow. Esperon Lake reliably fills and helps to fill Big Horn Reservoir.

### *DunWaters Diversion*

Completed in 2009, the DunWaters Diversion redirects water from Upper Shorts Creek into Big Horn Reservoir. The diversion runs parallel to Stuart FSR, from approximately km 29 to km 27. At km 27, the water follows a natural flow path for another 2 km, is culverted under Esperson FSR and then discharges into Big Horn Reservoir. The water licence on the DunWaters Diversion allows the water to be diverted from April 1 to June 1. The diversion is generally fully utilized during the licence period.

### *Big Horn Reservoir and Dam*

Big Horn Reservoir has a storage capacity of 2,300 ML. The dam head gate is manually controlled and housed in a corrugated metal building. At the end of October, the head gate is partially closed to maintain only fish flow requirements. Flow leaving the reservoir travels down Terrace Creek and meets up with Lambly Creek at km 13 of the Bear Creek FSR.

### *Rose Valley Reservoir Diversion Intake*

The intake for the Rose Valley diversion pipeline intercepts Lamby Creek approximately 5.5 km upstream from Okanagan Lake. The intake consists of a small concrete dam, 850 mm (34") diversion pipe, 600 mm (24") bypass pipe and 200 mm (8") pipe for fish flow. The configuration of the diversion chamber forces the water to become relatively stagnant before entering the diversion pipe. The dam and intake require maintenance visits at least once per week for debris clearing and monitoring. Permanent level and flow indicators and a turbidity meter is installed just downstream of the intake. The intent of the turbidity meter was to allow the operators to bypass flow during high turbidity events.

A rock wall was recently installed in the middle of the creek, just upstream of the dam to prevent debris from collecting in the diversion/bypass chamber. The rock wall has reduced debris, but the chamber is still regularly cleaned to prevent plugging.

The backwater area upstream of the chamber is cleaned from debris about every three years. The 600 mm bypass line is opened which drains this area and allows a pickup truck to be driven in for cleaning.

### *Rose Valley Reservoir Diversion Pipe*

The Rose Valley diversion pipe is an 850 mm continuous-weld steel pipe which runs for approximately 6 km from the intake to Rose Valley Reservoir. The pipe is cathodically protected along its entire length. We understand that a section of the pipe was recently exposed temporary due to homeowner activities, and was visually deemed to be in good condition.

### *Rose Valley Reservoir Diversion Control Valves*

Pipe control valves are located just upstream of the outfall. A 100 mm bypass valve allows the main valve to be cleaned (approximately every three years) and is kept open to prevent freezing. Both valves are automated and linked to SCADA.

### *Rose Valley Reservoir*

The Rose Valley Reservoir is the watershed's largest storage reservoir at 3,600 ML. The reservoir water quality is varied, with high color or nutrients at certain times in the year, generally just before freshet. The Operations Staff has become familiar with these occurrences and can treat and rectify most water quality issues. For example, algae blooms are controlled by treating with copper sulphate and regulating the flows from the diversion pipeline.

The Rose Valley Dam is located at the south end of the reservoir. A cast and concrete block building houses the intake pipes (600 mm and 750 mm) and controls. Immediately downstream of the dam, a small treatment building provides treatment with chlorine gas. Typical dosage at the dam is approximately 3.5 mg/l. Residual in the system is in the range of 1.2 mg/l at the District office on Bartley Road, and 0.25 mg/l at the ends of the system.

**Other Concerns in the District Watersheds**

During the site visits, other issues related to the watersheds and upland sources were discussed. In the Lambly Creek Watershed, a Burnco gravel pit is currently in operation just upstream of the Rose Valley diversion intake. Extensive water quality monitoring was undertaken by the District at the outset of the pit operation, but no significant impacts were detected. The effectiveness and quality of runoff detention devices used at the site are questionable and of concern to the District.

Another issue of concern is the Rose Valley land swap currently under discussion/approval which would transfer lands surrounding the Rose Valley Reservoir and intake to Westbank First Nations. The District is extremely concerned with the future of water quality for the watershed if it is no longer park or protected crown land.

**Lambly Creek Watershed Upland Storage**

The table below summarizes the active storage capacity available in each of the lakes.

**Table 3 – Lambly Creek Watershed – Upland Reservoir Capacity**

Lake	Storage (ML)	Licensed Storage (ML)	Available Licensed Storage (ML)
Esperon	200	247	200
Lambly	2,830	1,850	1,850
Big Horn	1,863	1,863	1,863
Rose Valley	2,916	2,916	2,916
<b>Total</b>	<b>6,100</b>	<b>6,876</b>	<b>6,829</b>

The available licensed storage (total storage which is existing and also licensed) is **6,829 ML**.

In addition to lake storage, the District also holds storage licences on ditches and creeks. The table below summarizes this storage.

**Table 4 – Lambly Creek Watershed – Upland Creek Capacity**

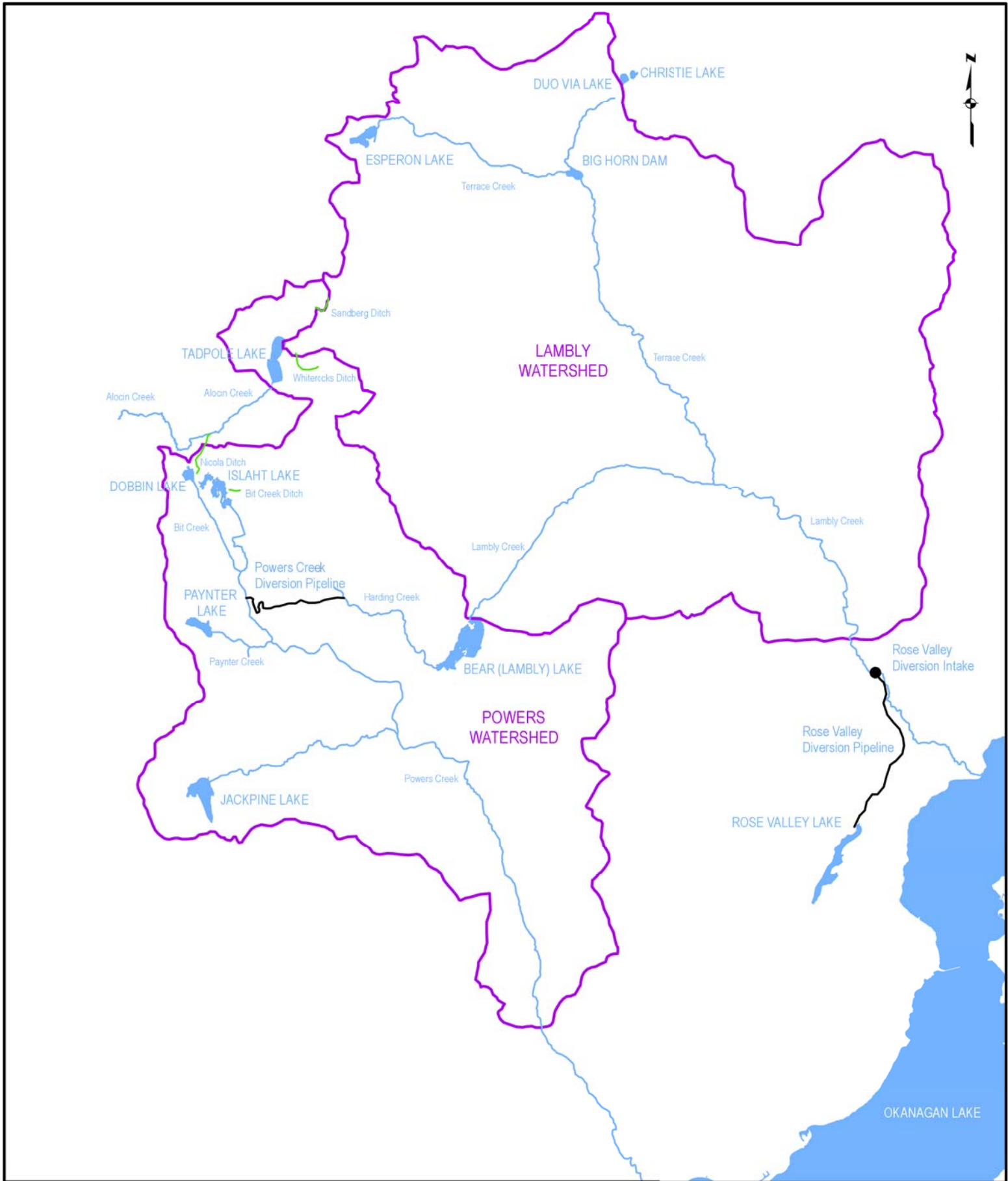
Creek/Ditch	Licensed Storage (ML)
DunWaters	1,480
Esperon	247
Lambly	3,084
Terrace	3,454
<b>Total</b>	<b>8,265</b>

**Lambly Creek Watershed – Other Commitments**

Fisheries requires a minimum flow of approximately 6 ML/d (2.5 cfs) to be released from Lambly Creek for fish habitat.

**Lambly Creek Watershed Summary**

The Lambly Creek Watershed consists of three upland lakes, Big Horn Reservoir and Rose Valley Reservoir. The water supply is managed by storing the spring runoff in the upland lakes and then regulating the release from April to June as the snow melts and licences permit. Water demands during spring runoff are generally met from streamflows below the Big Horn Reservoir. During the summer months and through the winter, storage from Big Horn Reservoir is utilized to meet demands. There is sufficient and often surplus capacity for the watershed. The main operational requirements are maintenance of the Rose Valley Intake and Diversion system. In contrast to the Powers Creek Watershed system, nominal operation and maintenance is required for its upland facilities.



**WEST KELOWNA**

Project No. 60216671      Date March 2012

**Legend**

- Intake
- Diversion Pipeline
- Watercourses
- Ditches
- Watershed
- Lakes

**AECOM**

0 425 850 1,700 2,550 3,400 Meters

**District of West Kelowna Watershed Figure**

**FIGURE 1.0**

## Appendix A

Dams within DWK Watersheds

Downloaded from iMap BC Online database August 2011

<b>Name</b>	<b>Owner</b>
1. <b>Glenrosa Lake Dam</b>	FICKE FRANK R & GERTRUDE B
2. <b>Shannon Lake Dam</b>	SHANNON LAKE GOLF COURSE LTD
3. <b>Rose Valley Dam</b>	<a href="#">LAKEVIEW IRRIGATION DISTRICT</a>
4. <b>Hayman Lake Dam</b>	YEULETT GEORGE V & RUTH C
5. <b>Allan Meadow Dam</b>	YEULETT GEORGE V & RUTH C
6. <b>Taylor Meadow Dam (South)</b>	ENSIGN RUSSELL H & DOREEN
7. <b>Taylor Meadow Dam (North)</b>	ENSIGN RUSSELL H & DOREEN
8. <b>Hidden Lake Dam</b>	ENSIGN RUSSELL H & DOREEN
9. <b>Lambly Lake Spillway Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
10. <b>Lambly Lake Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
11. <b>Webber Lake Dam (East)</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
12. <b>Jackpine Lake Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
13. <b>Paynter Lake Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
14. <b>Paynter Lake Saddle Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
15. <b>Horseshoe Lake East Dyke Dam (Isiaht)</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
16. <b>Horseshoe Lake Centre Dyke Dam (Isiaht)</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
17. <b>Horseshoe Lake West Dyke Dam (Isiaht)</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
18. <b>Dobbin Lake Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
19. <b>Tadpole Lake South Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
20. <b>Tadpole Lake North Dam</b>	<a href="#">WESTBANK IRRIGATION DISTRICT</a>
21. <b>Esperon Lake Dam</b>	<a href="#">LAKEVIEW IRRIGATION DISTRICT</a>
22. <b>Big Horn Reservoir Dam</b>	<a href="#">LAKEVIEW IRRIGATION DISTRICT</a>

### 1. Glenrosa Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240141-01
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	2.7
DAM_NAME:	GLENROSA LAKE DAM
DAM_OWNER:	FICKE FRANK R & GERTRUDE B
DAM_SAFETY_OFFICER:	Rowe, Steve ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561472
POINTS_CODE:	PD58813
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	78.0011191155429

#### Coordinate Position

BC Albers: 1453205, 556769  
Geographic: 49°50' N, 119°41' W  
UTM 11N: 306480, 5524891

### 2. Shannon Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240206-00
DAM_FUNCTION:	UNDETERMINED
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	SHANNON LAKE DAM
DAM_OWNER:	SHANNON LAKE GOLF COURSE LTD
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561435
POINTS_CODE:	PD59092
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Non-Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	63.875

#### Coordinate Position

BC Albers: 1458403, 558527  
Geographic: 49°51' N, 119°37' W  
UTM 11N: 311856, 5525988

### 3. Rose Valley Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	606.6
CREST_LENGTH_IN_METRES:	85.3
DAM_FILE_NO:	D240005-00
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	30.2
DAM_NAME:	ROSE VALLEY LAKE DAM
DAM_OWNER:	LAKEVIEW IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Jolley, William ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2011
OBJECTID:	1030560356
POINTS_CODE:	PD59086
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	80.3838624600734

#### Coordinate Position

BC Albers: 1461078, 563037  
 Geographic: 49°53' N, 119°34' W  
 UTM 11N: 315073, 5530129

### 4. Hayman Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240146-00
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	HAYMAN LAKE DAM
DAM_OWNER:	YEULETT GEORGE V & RUTH C
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561474
POINTS_CODE:	PD59099
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	106.543491706439

#### Coordinate Position

BC Albers: 1459855, 567012  
 Geographic: 49°55' N, 119°35' W  
 UTM 11N: 314355, 5534226

### 5. Allan Meadow Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240103-00
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	1.5
DAM_NAME:	ALLAN MEADOW DAM
DAM_OWNER:	YEULETT GEORGE V & RUTH C
DAM_SAFETY_OFFICER:	Noseworthy, Mike ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561463
POINTS_CODE:	PD59098
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	12.1307975830116

#### Coordinate Position

BC Albers: 1459244, 569305  
Geographic: 49°57' N, 119°35' W  
UTM 11N: 314035, 5536578

### 6. Taylor Meadow Dam (South)

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240217-01
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	TAYLOR MEADOW DAM (SOUTH)
DAM_OWNER:	ENSIGN RUSSELL H & DOREEN
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561498
POINTS_CODE:	PD59096
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	12.1998347939634

#### Coordinate Position

BC Albers: 1458556, 570451  
Geographic: 49°57' N, 119°36' W  
UTM 11N: 313495, 5537801

### 7. Taylor Meadow Dam (North)

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240217-02
DAM_FUNCTION:	SADDLE
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	TAYLOR MEADOW DAM (NORTH)
DAM_OWNER:	ENSIGN RUSSELL H & DOREEN
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561499
POINTS_CODE:	PD59095
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	20.5768377065087

#### Coordinate Position

BC Albers: 1458747, 570031  
Geographic: 49°57' N, 119°35' W  
UTM 11N: 313633, 5537360

### 8. Hidden Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240148-00
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	HIDDEN LAKE DAM
DAM_OWNER:	ENSIGN RUSSELL H & DOREEN
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561436
POINTS_CODE:	PD59097
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	37.5

#### Coordinate Position

BC Albers: 1456874, 569840  
Geographic: 49°57' N, 119°37' W  
UTM 11N: 311751, 5537404

### 9. Lambly Lake Spillway Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	60
DAM_FILE_NO:	D240016-02
DAM_FUNCTION:	SADDLE
DAM_HEIGHT_IN_METRES:	10.7
DAM_NAME:	LAMBLY LAKE SPILLWAY DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560414
POINTS_CODE:	PD59122
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	123.410556060344

#### Coordinate Position

BC Albers: 1450472, 568044  
 Geographic: 49°56' N, 119°42' W  
 UTM 11N: 305175, 5536421

### 10. Lambly Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	424
DAM_FILE_NO:	D240016-01
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	9.8
DAM_NAME:	LAMBLY LAKE DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560415
POINTS_CODE:	PD59121
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	384.716193070094

#### Coordinate Position

BC Albers: 1451084, 569572  
 Geographic: 49°57' N, 119°42' W  
 UTM 11N: 305972, 5537862

**11. Webber Lake Dam (East)**

<b>Dams - Small Scale Mapping</b>	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240222-02
DAM_FUNCTION:	UNDETERMINED
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	WEBBER LAKE DAM (EAST)
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561531
POINTS_CODE:	PD59116
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Non-Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	25.6023449666582

**Coordinate Position**

BC Albers: 1446765, 566438  
 Geographic: 49°56' N, 119°46' W  
 UTM 11N: 301297, 5535290

**12. Jackpine Lake Dam**

<b>Dams - Small Scale Mapping</b>	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240157-00
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	4.9
DAM_NAME:	JACKPINE LAKE DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Rowe, Steve ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2006
OBJECTID:	1030561476
POINTS_CODE:	PD59119
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	112.260326781103

**Coordinate Position**

BC Albers: 1444319, 564375  
 Geographic: 49°55' N, 119°48' W  
 UTM 11N: 298612, 5533547

### 13. Paynter Lake Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240196-01
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	5.2
DAM_NAME:	PAYNTER LAKE DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Rowe, Steve ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2006
OBJECTID:	1030561527
POINTS_CODE:	PD59124
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	55.7091641384073

#### Coordinate Position

BC Albers: 1443861, 568349  
Geographic: 49°57' N, 119°48' W  
UTM 11N: 298653, 5537549

### 14. Paynter Lake Saddle Dam

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	0
CREST_LENGTH_IN_METRES:	0
DAM_FILE_NO:	D240196-02
DAM_FUNCTION:	SADDLE
DAM_HEIGHT_IN_METRES:	0
DAM_NAME:	PAYNTER LAKE SADDLE DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Rowe, Steve ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
OBJECTID:	1030561556
POINTS_CODE:	PD59124
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	52.6856161132415

**15. Horseshoe Lake East Dyke Dam (Isiaht)**

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	1488.4
CREST_LENGTH_IN_METRES:	175
DAM_FILE_NO:	D240009-03
DAM_FUNCTION:	SPILLWAY
DAM_HEIGHT_IN_METRES:	6.1
DAM_NAME:	HORSESHOE LAKE EAST DYKE DAM (ISLAHT)
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560394
POINTS_CODE:	PD59129
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	108.185210433495

**Coordinate Position**

BC Albers: 1443784, 571751  
 Geographic: 49°59' N, 119°48' W  
 UTM 11N: 299001, 5540934

**16. Horseshoe Lake Centre Dyke Dam (Isiaht)**

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	1488.4
CREST_LENGTH_IN_METRES:	38
DAM_FILE_NO:	D240009-02
DAM_FUNCTION:	SADDLE
DAM_HEIGHT_IN_METRES:	10.4
DAM_NAME:	HORSESHOE LAKE CENTRE DYKE DAM (ISLAHT)
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560392
POINTS_CODE:	PD59130
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	29.4091412755374

**Coordinate Position**

BC Albers: 1443440, 571942  
 Geographic: 49°59' N, 119°48' W  
 UTM 11N: 298684, 5541166

**17. Horseshoe Lake West Dyke Dam (Isiaht)**

<b>Dams - Small Scale Mapping</b>	
<b>CREST_ELEVATION_IN_METRES:</b>	1488.4
<b>CREST_LENGTH_IN_METRES:</b>	84
<b>DAM_FILE_NO:</b>	D240009-01
<b>DAM_FUNCTION:</b>	MAIN
<b>DAM_HEIGHT_IN_METRES:</b>	6.4
<b>DAM_NAME:</b>	HORSESHOE LAKE WEST DAM (ISLAHT)
<b>DAM_OWNER:</b>	WESTBANK IRRIGATION DISTRICT
<b>DAM_SAFETY_OFFICER:</b>	Brazier, Bert ENV:EX
<b>DAM_TYPE:</b>	Earthfill
<b>DISTRICT_PRECINCT_NAME:</b>	VER - PEACHLAND
<b>NEXT_AUDIT_YEAR:</b>	2016
<b>OBJECTID:</b>	1030560391
<b>POINTS_CODE:</b>	PD59131
<b>REGION_NAME:</b>	OKANAGAN
<b>DAM_REGULATED_CODE:</b>	Regulated
<b>DAM_OPERATION_CODE:</b>	Active
<b>#SHAPE#:</b>	[Geometry]
<b>AREA:</b>	0
<b>LEN:</b>	82.1923307970928

**Coordinate Position**

BC Albers: 1443211, 572095  
 Geographic: 49°59' N, 119°48' W  
 UTM 11N: 298475, 5541347

**18. Dobbin Lake Dam**

<b>Dams - Small Scale Mapping</b>	
<b>CREST_ELEVATION_IN_METRES:</b>	1478.3
<b>CREST_LENGTH_IN_METRES:</b>	33.5
<b>DAM_FILE_NO:</b>	D240017-00
<b>DAM_FUNCTION:</b>	MAIN
<b>DAM_HEIGHT_IN_METRES:</b>	12.8
<b>DAM_NAME:</b>	DOBBIN LAKE DAM
<b>DAM_OWNER:</b>	WESTBANK IRRIGATION DISTRICT
<b>DAM_SAFETY_OFFICER:</b>	Brazier, Bert ENV:EX
<b>DAM_TYPE:</b>	Earthfill
<b>DISTRICT_PRECINCT_NAME:</b>	VER - PEACHLAND
<b>NEXT_AUDIT_YEAR:</b>	2016
<b>OBJECTID:</b>	1030560413
<b>POINTS_CODE:</b>	PD59128
<b>REGION_NAME:</b>	OKANAGAN
<b>DAM_REGULATED_CODE:</b>	Regulated
<b>DAM_OPERATION_CODE:</b>	Active
<b>#SHAPE#:</b>	[Geometry]
<b>AREA:</b>	0
<b>LEN:</b>	33.708539348361

**Coordinate Position**

BC Albers: 1442867, 572286  
 Geographic: 49°59' N, 119°48' W  
 UTM 11N: 298158, 5541579

**19. Tadpole Lake South Dam**

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	39.5
CREST_LENGTH_IN_METRES:	200
DAM_FILE_NO:	D240014-02
DAM_FUNCTION:	SADDLE
DAM_HEIGHT_IN_METRES:	11.7
DAM_NAME:	TADPOLE LAKE SOUTH DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560416
POINTS_CODE:	PD65207
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	33.5998976932966

**Coordinate Position**

BC Albers: 1444701, 575382  
 Geographic: 50°1' N, 119°47' W  
 UTM 11N: 300364, 5544422

**20. Tadpole Lake North Dam**

Dams - Small Scale Mapping	
CREST_ELEVATION_IN_METRES:	39.5
CREST_LENGTH_IN_METRES:	350
DAM_FILE_NO:	D240014-01
DAM_FUNCTION:	MAIN
DAM_HEIGHT_IN_METRES:	15.5
DAM_NAME:	TADPOLE LAKE NORTH DAM
DAM_OWNER:	WESTBANK IRRIGATION DISTRICT
DAM_SAFETY_OFFICER:	Brazier, Bert ENV:EX
DAM_TYPE:	Earthfill
DISTRICT_PRECINCT_NAME:	VER - PEACHLAND
NEXT_AUDIT_YEAR:	2016
OBJECTID:	1030560417
POINTS_CODE:	PD50407
REGION_NAME:	OKANAGAN
DAM_REGULATED_CODE:	Regulated
DAM_OPERATION_CODE:	Active
#SHAPE#:	[Geometry]
AREA:	0
LEN:	17.1164422120954

**Coordinate Position**

BC Albers: 1444893, 576413  
 Geographic: 50°1' N, 119°46' W  
 UTM 11N: 300682, 5545422

**21. Esperon Lake Dam**

<b>Dams - Small Scale Mapping</b>	
<b>CREST_ELEVATION_IN_METRES:</b>	0
<b>CREST_LENGTH_IN_METRES:</b>	0
<b>DAM_FILE_NO:</b>	D240128-00
<b>DAM_FUNCTION:</b>	UNDETERMINED
<b>DAM_HEIGHT_IN_METRES:</b>	0
<b>DAM_NAME:</b>	ESPERON LAKE DAM
<b>DAM_OWNER:</b>	LAKEVIEW IRRIGATION DISTRICT
<b>DAM_SAFETY_OFFICER:</b>	Noseworthy, Mike ENV:EX
<b>DAM_TYPE:</b>	Earthfill
<b>DISTRICT_PRECINCT_NAME:</b>	VER - PEACHLAND
<b>OBJECTID:</b>	1030561469
<b>POINTS_CODE:</b>	PD59270
<b>REGION_NAME:</b>	OKANAGAN
<b>DAM_REGULATED_CODE:</b>	Regulated
<b>DAM_OPERATION_CODE:</b>	Active
<b>#SHAPE#:</b>	[Geometry]
<b>AREA:</b>	0
<b>LEN:</b>	7.27174972066558

**Coordinate Position**

BC Albers: 1446612, 582605  
 Geographic: 50°4' N, 119°45' W  
 UTM 11N: 303162, 5551351

**22. Big Horn Reservoir Dam**

<b>Dams - Small Scale Mapping</b>	
<b>CREST_ELEVATION_IN_METRES:</b>	1357
<b>CREST_LENGTH_IN_METRES:</b>	168
<b>DAM_FILE_NO:</b>	D240015-00
<b>DAM_FUNCTION:</b>	MAIN
<b>DAM_HEIGHT_IN_METRES:</b>	29
<b>DAM_NAME:</b>	BIG HORN RESERVOIR DAM
<b>DAM_OWNER:</b>	LAKEVIEW IRRIGATION DISTRICT
<b>DAM_SAFETY_OFFICER:</b>	Jolley, William ENV:EX
<b>DAM_TYPE:</b>	Earthfill
<b>DISTRICT_PRECINCT_NAME:</b>	VER - PEACHLAND
<b>NEXT_AUDIT_YEAR:</b>	2013
<b>OBJECTID:</b>	1030563172
<b>POINTS_CODE:</b>	PD66397
<b>REGION_NAME:</b>	OKANAGAN
<b>DAM_REGULATED_CODE:</b>	Regulated
<b>DAM_OPERATION_CODE:</b>	Active
<b>#SHAPE#:</b>	[Geometry]
<b>AREA:</b>	0
<b>LEN:</b>	503.130303832861

**Coordinate Position**

BC Albers: 1452574, 581764  
 Geographic: 50°4' N, 119°40' W  
 UTM 11N: 308973, 5549772

Appendix D

Upland Watershed Photos

**Lambly Creek Watershed**



**Esperon Lake**



**Esperon Lake Headwall and Gate**



**Esperon Lake Headwall and Gate**



**Esperon Lake Headwall and Gate**



**Dunwaters Diversion**



**Dunwaters Diversion**



**Dunwaters Diversion**



**Dunwaters Diversion**



**Dunwaters Diversion**



**Dunwaters Diversion**



**Big Horn Dam**



**Big Horn Dam**



**Bighorn Dam**



**Rose Valley Dam Treatment Facility**



**Rose Valley Dam Treatment Facility**



**Rose Valley Dam Treatment Facility**



**Rose Valley Dam Treatment Facility**



**Rose Valley Dam Treatment Facility**



**Rose Valley Dam looking down  
on Treatment Facility**



**Rose Valley Dam looking towards  
Rose Valley Reservoir**



**Rose Valley Dam Headgate**



**Rose Valley Diversion Control Valves**



**Rose Valley Diversion Control Valves**



**Rose Valley Diversion Control Valves**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**



**Rose Valley Diversion Intake**

**Powers Creek Watershed**



**Whiterocks Ditch – Top Headgate**



**Bit Creek Diversion**



**Bit Creek Diversion**



**Bit Creek Diversion**



**Bit Creek Diversion**



**Dobbin Lake Head Gate**



**Dobbin Lake Head Gate**



**Dobbin Lake Head Gate**



**Horseshoe Lake**



**Horseshoe Lake**



**Horseshoe Lake**



**Horseshoe Lake**



**Horseshoe Lake**



**Jackpine Lake**



**Jackpine Lake**



**Jackpine Lake Head Gates**



**Lambly Lake Head Gates Facility**



**Lambly Lake Head Gates Facility**



**Lambly Lake Head Gates Facility**



**Lambly Lake Head Gates Facility**



**Nicola Diversion**



**Nicola Diversion**



**Nicola Diversion**



**Paddle Creek Head Gates**



**Paddle Creek Head Gates**



**Paynter Lake Dam**



**Paynter Lake**



**Powers Creek Diversion Pipeline**



**Powers Creek Diversion Pipeline**



**Powers Creek Diversion Pipeline**



**Powers Creek Diversion Pipeline**



**Power Creek Diversion Pipeline**



**Powers Creek Diversion outfall at  
Harding Creek**



**Powers Creek Diversion outfall at  
Harding Creek**



**Powers Creek Diversion outfall at  
Harding Creek**



**Powers Creek Diversion outfall at  
Harding Creek**



**Sandberg Ditch**



**Sandberg Ditch**



**Tadpole Lake Head Gates**



**Tadpole Lake**



**Tadpole Lake**



**Tadpole Lake Spillway**



**Whiterocks Ditch – Top Headgate**

## Appendix E

Detailed Review of the Long Term Water Supply  
Options

## Minutes of Meeting

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To **DWK – Rob Hillis** Page **1**

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CC

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Subject **Water Master Plan Supplemental – Long Term Water Supply Options**

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From

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Date **December 19, 2013** Project Number **60216671**

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### **Background**

The District of West Kelowna (District) has requested that AECOM further develop technical aspects of the Master Water Plan document dated October 15, 2012. The specific items included within this scope of work and addressed in this memorandum are:

Seven options are included within this memorandum for the long term supply of water within the DWK water service boundary. These options are:

- a. Option 1 – Maintain current system, treatment at all sources;
- b. Option 2 – Centralized treatment at Powers Creek and Rose Valley using all three raw water sources;
- c. Option 3 – Centralized treatment and raw water supply from Powers Creek and Rose Valley;
- d. Option 4 – Complete separation of the domestic and agricultural distribution networks;
- e. Option 5 – Separation of Sunnyside Only;
- f. Option 6 – Complete System Separation with Early Upgrade at Powers Creek; and
- g. Option 7 – Rose Valley Filtration Deferral Using Okanagan Lake as Raw Water Source.

This memo will address the four items above and provide a comprehensive document to supplement the existing Master Water Plan.

## Long Term Water Supply Options

### Option 1 – Expand Water System in Current Configuration

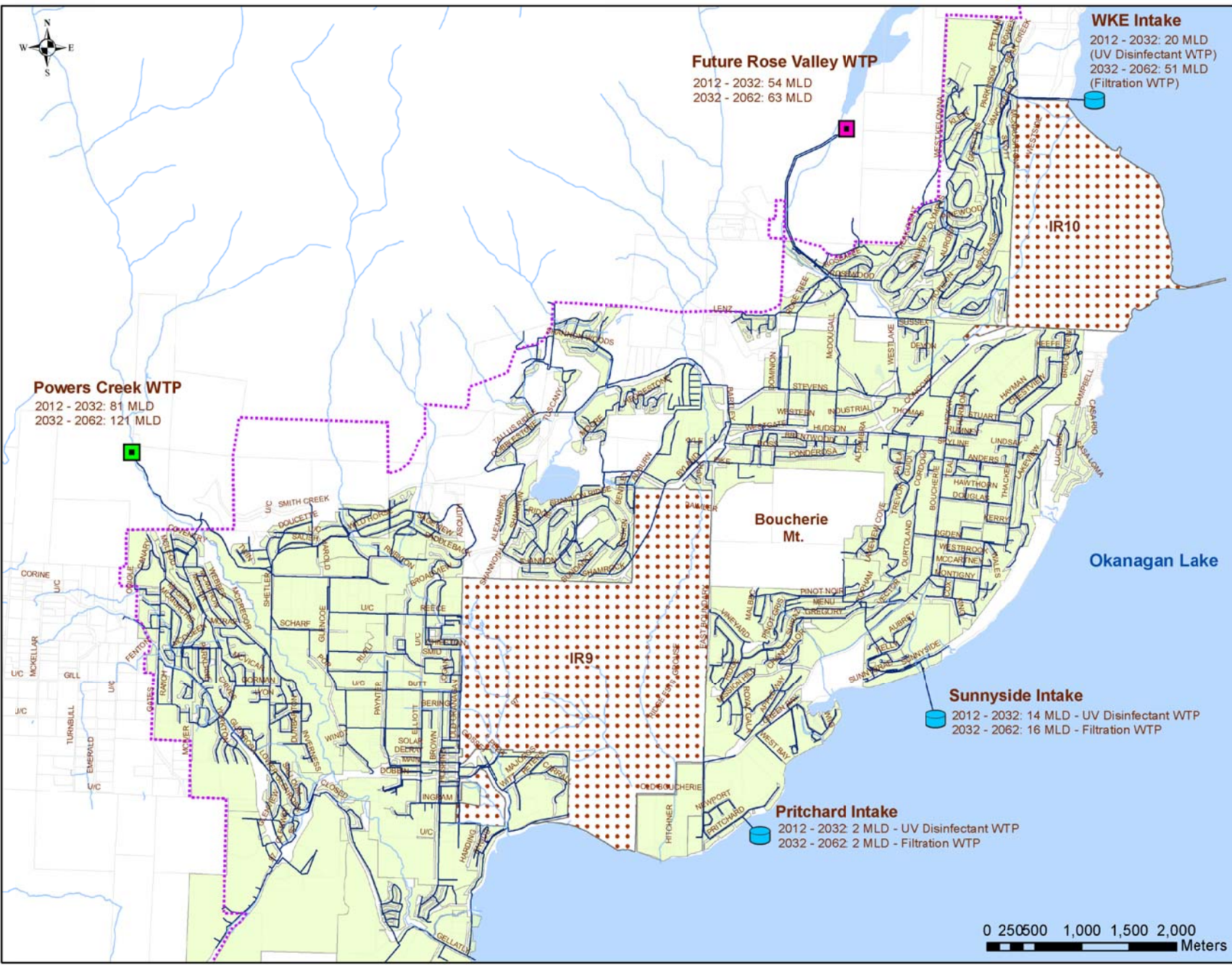
This option maintains the current configuration of the distribution system with treatment being added at all the existing facility locations. The geographic location of the new infrastructure is provided on **Figure 1**.

In summary the key infrastructure being added with this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Extend the intake and add 2-stage disinfection at the existing Pritchard Pump Station. Also required are building and mechanical improvements to the existing facility.
  - Extend the intake and add 2-stage disinfection at the existing Sunnyside Pump Station. The existing facility is relatively new so facility improvements are assumed to not be required.
  - Extend the intake and add 2-stage disinfection at the existing West Kelowna Pump Station. It is assumed that the existing facility needs to be completely re-constructed and a right-of-way obtained. Part of obtaining a new right-of-way will be securing sufficient land for the future.
  - Maintain the existing Powers Creek water treatment plant; and
  - Construct a new water conventional water treatment plant and treated water clearwell at the Rose Valley Reservoir site.
- Future Upgrades (2032 to 2062):
  - Add membrane filtration at the Pritchard, Sunnyside and West Kelowna Estates pump stations;
  - Further expand the existing Powers Creek water treatment plant;
  - Additional storage is required on Powers Creek to ensure there is enough flow during a 50 year drought. It is assumed that the additional storage will be provided at Lambly Lake.
  - Expand the Rose Valley water treatment plant to 63 ML/d. In this option, Rose Valley water treatment plant is small enough that there is sufficient infrastructure in the water shed to reliably ensure the supply of water during a 50 year drought. This option includes no watershed improvements for the Lambly Creek source.

### Option 2 – Centralize Upland Treatment Using All Three Raw Water Sources

This option relies on treatment plants only located at the existing Powers Creek site and a new plant at the Rose Valley Reservoir dam site. This reduces the number of treatment plants required long term meaning the operating cost associated with maintaining numerous facilities is reduced. To meet the long term raw water supply requirements the goal with this option is to maximize the existing upland watershed infrastructure. Once the capacity of the upland watershed is met supplemental water will be provided from Okanagan Lake to the Rose Valley Reservoir site water treatment plant. By providing the option for the supply of Okanagan Lake water to the Rose Valley Reservoir site the reliability and drought tolerance of this option is significantly improved. The geographic location of the new infrastructure is presented in **Figure 2**. In summary the key infrastructure being added with this option is:



**District of West Kelowna  
Water Utility Master Plan**

**Option 1  
Treatment at the 5  
Existing Water Sources**

**Legend**

- Future Water Treatment Plant
- Existing Water Treatment Plant
- Active Intake
- ⋯ Service Boundary
- Existing Watermain
- Streams
- Un-irrigated Park Space

Figure No: **Figure 1**

Project No: 60216671      Date: September, 2012





# District of West Kelowna Water Utility Master Plan

## Option 2 Rose Valley Treatment/ Interconnect

### Legend

- Future Water Treatment Plant
- Existing Water Treatment Plant
- Raw Water Supply Intake
- Inactive Intake (Emergency)
- Raw Water Supply PS
- Proposed Transmission Mains
- Proposed Raw Water Supply Main
- Service Boundary
- Existing Watermain
- Streams
- Un-irrigated Park Space

Figure No:

Figure 2

Project No:

60216671

Date:

September, 2012



### Future Rose Valley WTP

2012 - 2032: 90 MLD  
2032 - 2062: 170 MLD

Proposed Transmission Mains  
are connected to the Existing Watermain  
(Not to the Proposed Raw Water Main)

### Powers Creek WTP

2012 - 2032: 81 MLD  
2032 - 2062: 81 MLD

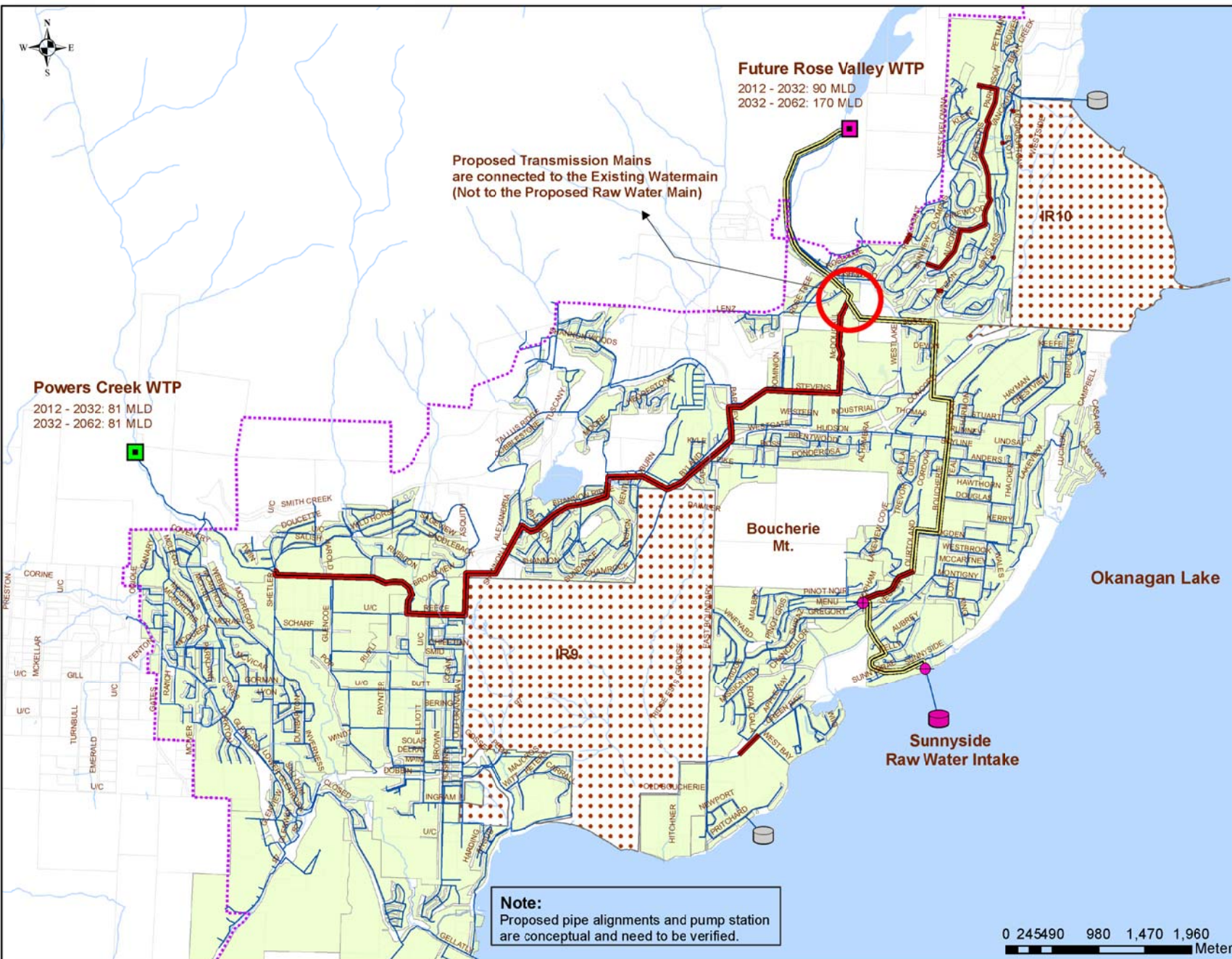
### Boucherie Mt.

### Okanagan Lake

### Sunnyside Raw Water Intake

**Note:**  
Proposed pipe alignments and pump station  
are conceptual and need to be verified.

0 245490 980 1,470 1,960  
Meters



- Immediate Infrastructure Upgrades (Now – 2032):
  - Maintain the existing Powers Creek water treatment plant. Depending on the actual demands some expansion may be required prior to the 20 year design horizon;
  - Construct a new water conventional water treatment plant and treated water clearwell at the Rose Valley Reservoir site;
  - Install a transmission main to convey treated water from the new Rose Valley water treatment plant site to West Kelowna Estates. This allows the existing West Kelowna Estates pump station to be abandoned.
- Future Upgrades (2032 to 2062):
  - Further expand the Rose Valley water treatment plant;
  - Provide a pipeline sized to convey 6,650 ML to Rose Valley WTP to supplement the raw water storage shortage in the upland watershed during a drought. In addition to the transmission main a pump station is necessary to convey Okanagan Lake water to the Rose Valley water treatment plant;
  - Install an interconnecting gravity transmission main to feed the legacy Westbank Irrigation District system from Rose Valley. This transmission main is a 600mm pipe 9.2km long and is designed to reduce the maximum daily flow required at the Powers Creek facility by 40 ML/d;
  - Provide a gravity transmission main to improve the transmission capacity of the network from the Rose Valley reservoir to the Sunnyside area.

### Option 3 – Centralized Upland Treatment Using Only the Upland Raw Water Sources

This option relies on treatment plants only located at the existing Powers Creek site and a new plant at the Rose Valley Reservoir dam site. This reduces the number of treatment plants required long term meaning the operating cost associated with maintaining numerous facilities is reduced. To meet the long term raw water supply requirements the goal with this option is to maximize the existing upland watershed infrastructure. Once the capacity of the upland watershed is met for this option additional upland storage will be provide for the Lambly Creek portion of the watershed. This option does not include any further expansion of the Power Creek watershed as this area is arguably already producing all the water it can sustainable yield, whereas more water can be produced by the Lambly Creek portion of the watershed. To meet the future demands of the legacy Westbank Irrigation District portion of the distribution system a transmission main will be provided in the future to convey water from the Rose Valley site across the western portion of the distribution system.

The geographic location of the new infrastructure is provided on **Figure 3**. In summary the key infrastructure being added with this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Same as Option 2
- Future Upgrades (2032 to 2062):
  - Further expand the Rose Valley water treatment plant;
  - Install an interconnecting gravity transmission main to feed the legacy Westbank Irrigation DWK system from Rose Valley. This transmission main is a 600mm pipe 9.2km long and is designed to reduce the maximum daily flow required at the Powers Creek facility by 40 ML/d;
  - To provide an additional 6,650 ML flow at the Rose Valley water treatment plant while accounting losses, 9,500 ML must be stored by adding more dams to Lambly Creek.



# District of West Kelowna Water Utility Master Plan

## Option 3

### Rose Valley Treatment/ Interconnect/ No Okanagan Lake

#### Legend

- Future Water Treatment Plant
- Existing Water Treatment Plant
- Inactive Intake (Emergency)
- Proposed Transmission Mains
- Service Boundary
- Streams
- Existing Watermain
- Un-irrigated Park Space

Figure No:

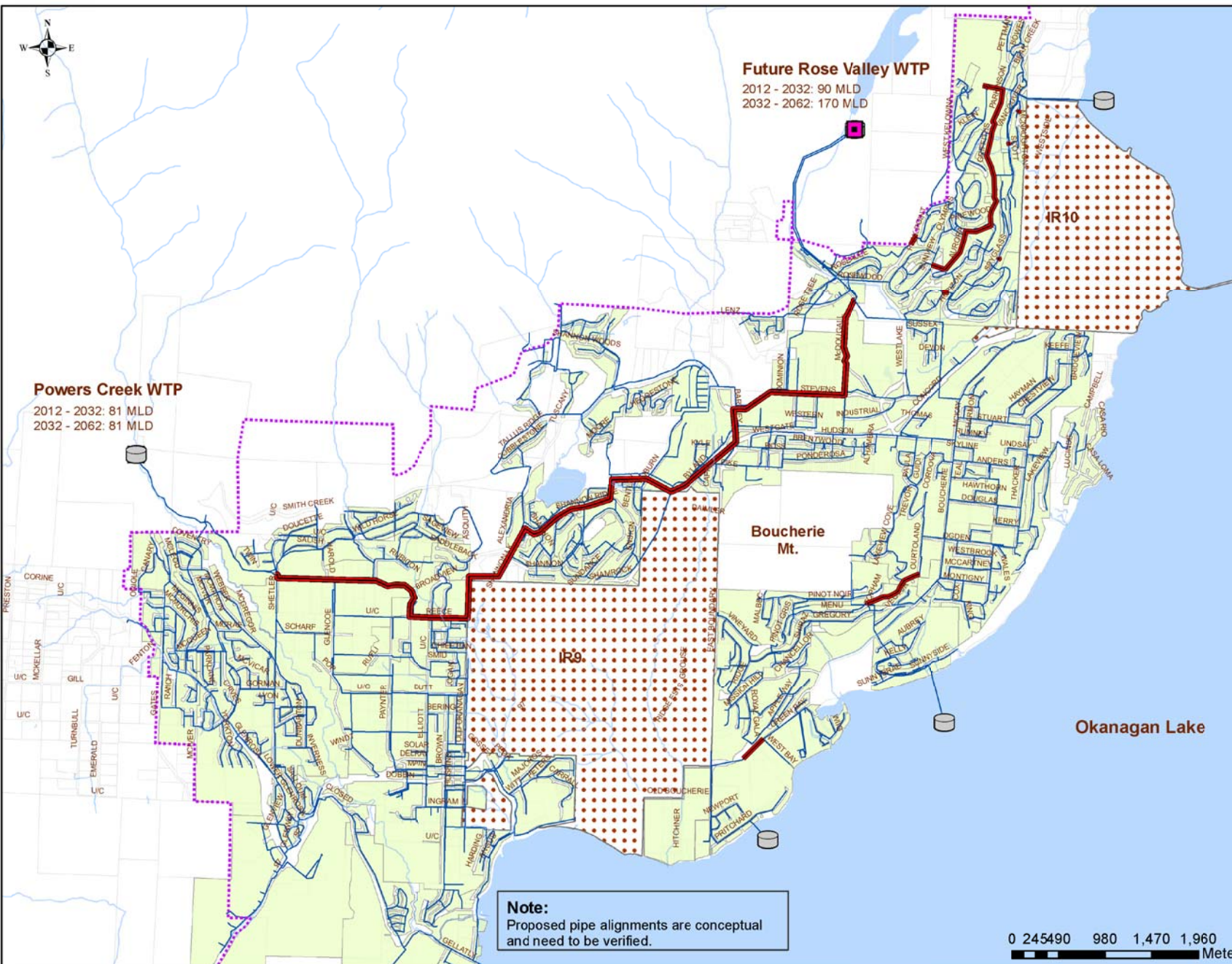
Figure 3

Project No:

60216671

Date:

September, 2012



**Note:**  
Proposed pipe alignments are conceptual  
and need to be verified.

0 245 490 980 1,470 1,960  
Meters

#### Option 4 – Complete System Separation

Option 4 relies on the treatment plant located at Powers Creek and a new plant at Rose Valley Reservoir dam site. This option is similar to Option 2 presented in the Master Water Plan but examines the impact of separating the domestic and agricultural distribution systems in order to reduce the cost at the Water Treatment Plants. In this option Powers Creek WTP will supply water to the Westbank Irrigation District (WID) and Rose Valley WTP will provide water to LID, Sunnyside, Pritchard, West Kelowna Estates (WKE) as well as supply water to WID.

**Figure 4** shows the conceptual design of the new agricultural water distribution system for the DWK. Lots with agricultural water allocation were noted in light green with green triangles denoting lots in the Rose Valley source area and blue triangles denoting lots in the Powers Creek source area.

For the Lakeview Service Area, allocation is based on 70 litres per minute per hectare (as per the former LID bylaw). For the Sunnyside and Pritchard service areas, allocations were not provided by the District. Allocations were assigned based on OCP-designated agricultural parcels, and whether the GIS database included the parcel in the respective service area (for example, some agricultural lots on Okanagan Lake are service by private intakes). The allocation of 70 litres per minute per hectare was used for Sunnyside and Pritchard parcels. The Rose Valley source areas have a total agricultural allotment of 19.7ML/d.

For the WID Service Area, agricultural allotment is governed by the dole valve size of each service. The agricultural lots west of Powers Creek have not been included in system separation due to the length of pipe required to provide service to only five parcels. These lots account for 7.5% for the agricultural allotment in WID, the remaining allotment was divided between the lots on the east side of Powers Creek. System separation reduces treated water demand to 25.3 ML/d of the total 27.6 ML/d of agricultural demand in WID.

In summary the key infrastructure being added for this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Maintain the existing Powers Creek water treatment plant;
  - Construct a new conventional water treatment plant and treated water clearwell at the Rose Valley Reservoir site;
  - Install a transmission main to convey treated water from the new Rose Valley water treatment plant site to WKE. This allows the existing WKE pump station to be abandoned;
  - Install separate agricultural distribution network to convey non-potable water from Powers Creek to agricultural lots within WID;
  - Install separate agricultural distribution network to convey non-potable water from Powers Creek to agricultural lots within Lakeview, Sunnyside and Pritchard.
- Future Upgrades (2032 to 2062):
  - Further expand the Rose Valley water treatment plant;
  - If demand requires, re-rate the basins at Powers Creek WTP to slightly increased capacity;
  - Provide a pipeline sized to convey 6,650 ML to Rose Valley WTP to supplement the raw water storage shortage in the upland watershed during a drought. In addition to the transmission main a pump station is necessary to convey Okanagan Lake water to the Rose Valley water treatment plant;
  - Install an interconnecting gravity transmission main to feed the WID system from Rose Valley. This transmission main is a 600mm pipe 9.2km long and is designed to reduce the maximum daily flow required at the Powers Creek facility by 40 ML/d;
  - Provide a gravity transmission main to improve the transmission capacity of the network from the Rose Valley reservoir to the Sunnyside area.



**District of West Kelowna**  
**Water Utility Master Plan Supplement**

**Option 4**  
 Rose Valley Treatment /  
 Interconnect /  
 Full Agricultural Twinning

- Legend**
- Future Water Treatment Plant
  - Existing Water Treatment Plant
  - Raw Water Supply Intake
  - Inactive Intake (Emergency)
  - Raw Water Supply PS
  - Proposed Transmission Mains
  - Proposed Raw Water Supply Main
  - Proposed Ag Transmission Main
  - Service Boundary
  - Existing Watermain
  - Streams
  - OCP Agricultural Zoning
  - Parcels with Ag Allocation Powers Creek Source
  - Parcels with Ag Allocation Rose Valley Source

Figure No:  
 Figure 4

Project No: 60216671	Date: July, 2013
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**Future Rose Valley WTP**  
 2012 - 2032: 68 MLD  
 2032 - 2062: 150 MLD

Proposed Transmission Mains  
 are connected to the Existing Watermain  
 (Not to the Proposed Raw Water Main)

**Powers Creek WTP**  
 Existing Facility: 54 MLD  
 2012 - 2032: 54 MLD  
 2032 - 2062: 56 MLD

Okanagan Lake

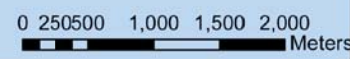
Boucherie Mt.

IR9

Sunnyside  
 Raw Water Intake

Ag Parcels on West side of  
 Powers Creek not Serviced  
 in Separation Plan  
 but which have an  
 Agricultural Allocation

**Note:**  
 Proposed pipe alignments and pump station  
 are conceptual and need to be verified.



### Option 5 – System separation of Sunnyside Only

Option 5 is a variation of Option 4. In this option system separation is implemented only in Sunnyside. This is done by using the existing Sunnyside lake intake to convey agricultural water. System separation in Sunnyside reduces the treated water demand by 5ML/d.

**Figure 5** shows the conceptual design of the Sunnyside agricultural system. Lots with agricultural water allocation were noted in light green with green triangles denoting lots to be serviced by the Sunnyside agricultural distribution system.

In summary the key infrastructure being added for this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Maintain the existing Powers Creek water treatment plant. Depending on the actual demands some expansion may be required prior to the 20 year design horizon;
  - Construct a new conventional water treatment plant and treated water clearwell at the Rose Valley Reservoir site;
  - Install a transmission main to convey treated water from the new Rose Valley water treatment plant site to WKE. This allows the existing WKE pump station to be abandoned;
  - Install separate agricultural distribution network to convey non-potable water from Okanagan Lake to agricultural lots within Sunnyside.
- Future Upgrades (2032 to 2062):
  - Further expand the Rose Valley water treatment plant;
  - Provide a pipeline sized to convey 6,650 ML to Rose Valley WTP to supplement the raw water storage shortage in the upland watershed during a drought. In addition to the transmission main a pump station is necessary to convey Okanagan Lake water to the Rose Valley water treatment plant;
  - Install an interconnecting gravity transmission main to feed the WID system from Rose Valley. This transmission main is a 600mm pipe 9.2km long and is designed to reduce the maximum daily flow required at the Powers Creek facility by 40 ML/d;
  - Provide a gravity transmission main to improve the transmission capacity of the network from the Rose Valley reservoir to the Sunnyside area.

### Option 6 – Complete System Separation with Early Upgrade at Powers Creek

Option 6 is a variation of Option 4 in which Powers Creek is upgraded to a capacity of 81ML/d immediately and is used to supply treated water to the entire DWK through a low lift pump station that would be constructed in WID. Upgrading Powers Creek makes it possible to delay the construction of the Rose Valley WTP by 5 years. Complete system separation throughout the DWK reduces treated water demand sufficiently to make this option possible. As in Option 4, WID will have 92.5% of its agricultural demand serviced by the agricultural distribution system.

**Figure 6** shows the conceptual design of the new agricultural water distribution system for the DWK. Lots with agricultural water allocation were noted in light green with green triangles denoting lots in the Rose Valley source area and blue triangles denoting lots in the Powers Creek source area



**District of West Kelowna  
Water Utility Master Plan  
Supplement**

**Option 5  
Rose Valley Treatment /  
Interconnect /  
Partial Agricultural Twinning**

**Legend**

- Future Water Treatment Plant
- Existing Water Treatment Plant
- Raw Water Supply Intake
- Inactive Intake (Emergency)
- Raw Water Supply PS
- Proposed Transmission Mains
- Proposed Raw Water Supply Main
- Proposed Ag Transmission Main
- Service Boundary
- Existing Watermain
- Streams
- OCP Agricultural Zoning
- Ag Parcels Serviced by Sunnyside Intake

Figure No:  
**Figure 5**

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**Future Rose Valley WTP**  
2012 - 2032: 83 MLD  
2032 - 2062: 165 MLD

Proposed Transmission Mains  
are connected to the Existing Watermain  
(Not to the Proposed Raw Water Main)

**Powers Creek WTP**  
2012 - 2032: 81 MLD  
2032 - 2062: 81 MLD

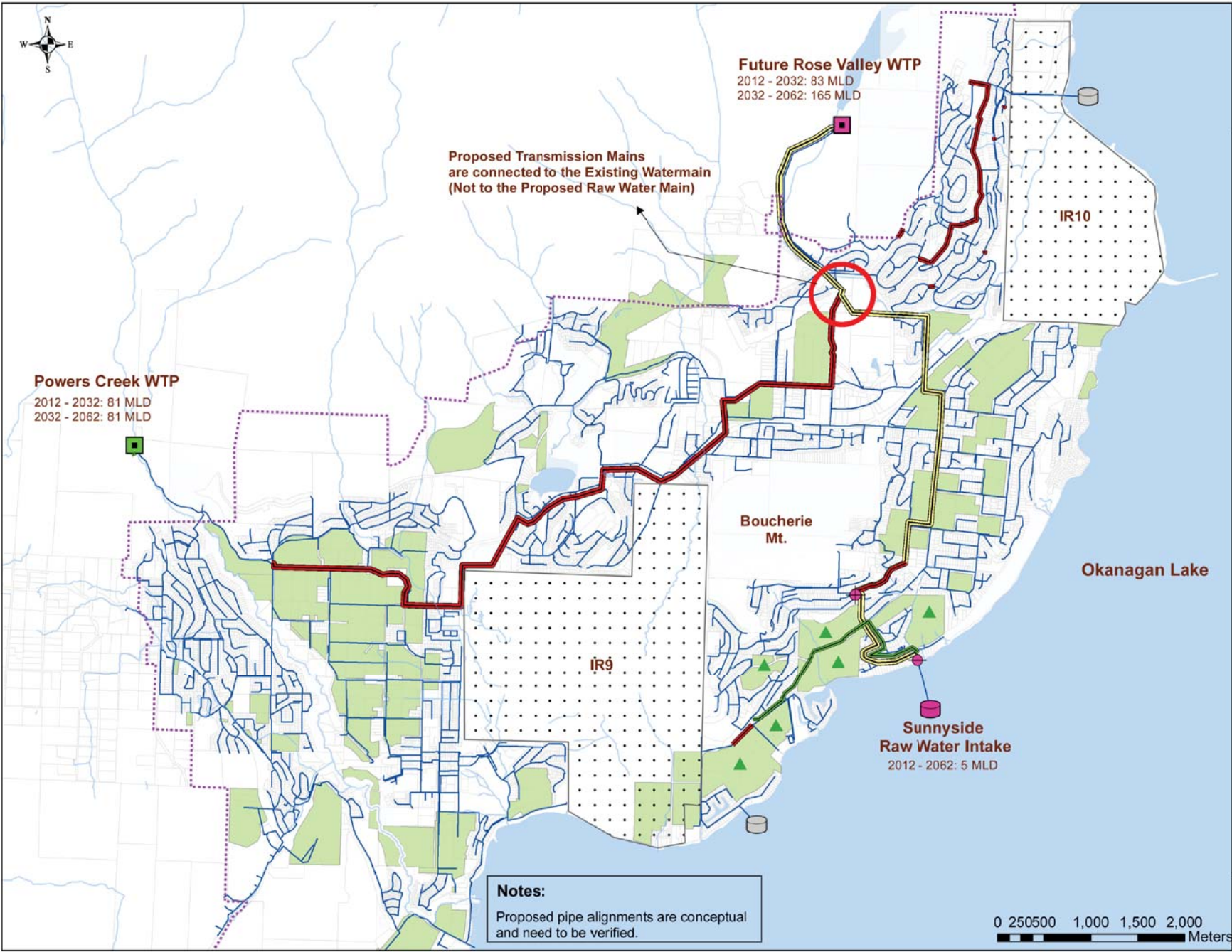
Okanagan Lake

Boucherie Mt.

**Sunnyside Raw Water Intake**  
2012 - 2062: 5 MLD

**Notes:**  
Proposed pipe alignments are conceptual  
and need to be verified.

0 250500 1,000 1,500 2,000  
Meters





**District of West Kelowna**  
**Water Utility Master Plan**  
**Supplement**

**Option 6**  
 Expand WID / Interconnect /  
 Full Agriculture Twinning /  
 Defer Rose Valley

**Legend**

- Future Water Treatment Plant
- Existing Water Treatment Plant
- Raw Water Supply Intake
- Inactive Intake (Emergency)
- Raw Water Supply PS
- Proposed Transmission Mains
- Proposed Raw Water Supply Main
- Proposed Ag Transmission Main
- Service Boundary
- Existing Watermain
- Streams
- CCP Agricultural Zoning
- Parcels with Ag Allocation Powers Creek Source
- Parcels with Ag Allocation Rose Valley Source

Figure No:  
 Figure 6

Project No: 60216671	Date: July, 2013
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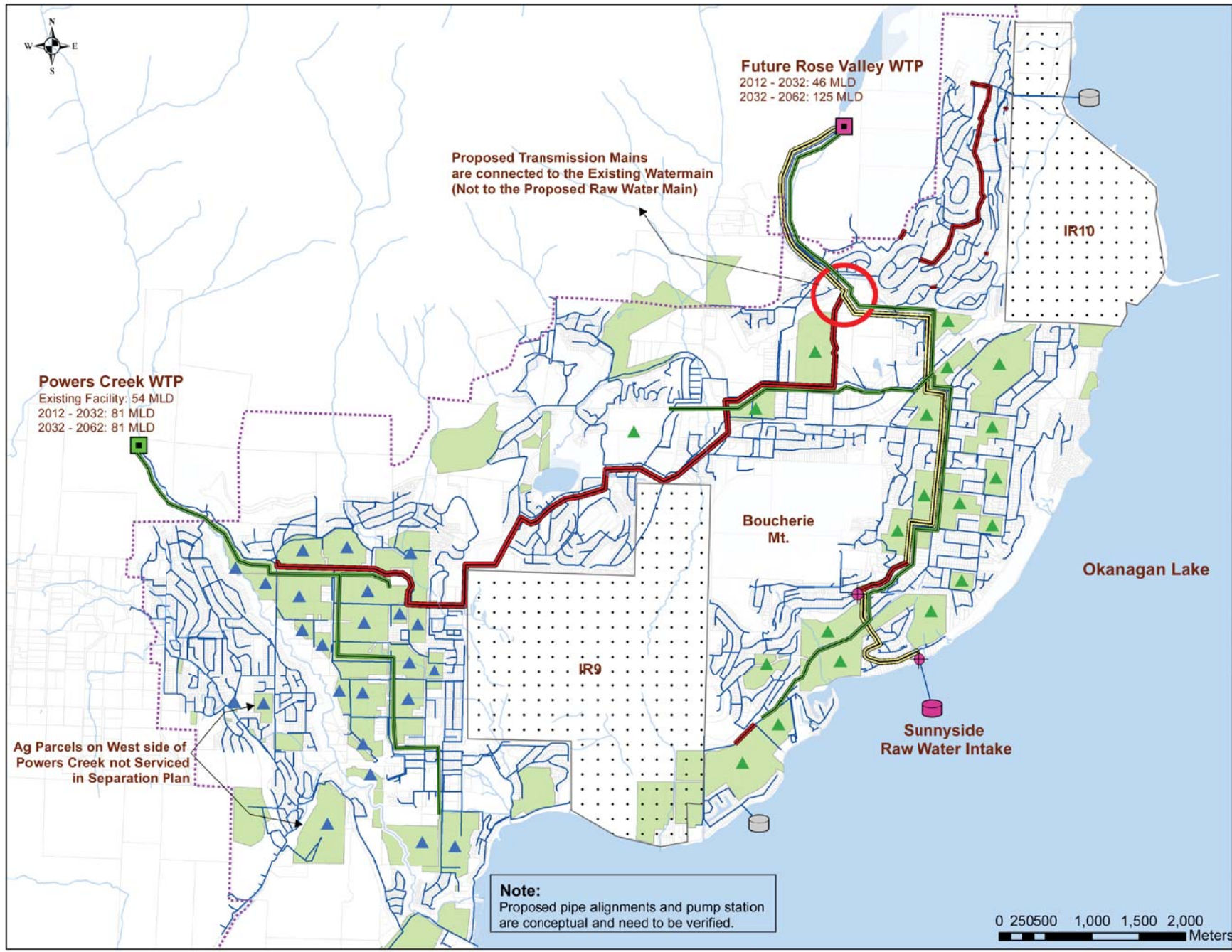
**Future Rose Valley WTP**  
 2012 - 2032: 46 MLD  
 2032 - 2062: 125 MLD

Proposed Transmission Mains  
 are connected to the Existing Watermain  
 (Not to the Proposed Raw Water Main)

**Powers Creek WTP**  
 Existing Facility: 54 MLD  
 2012 - 2032: 81 MLD  
 2032 - 2062: 81 MLD

Ag Parcels on West side of  
 Powers Creek not Serviced  
 in Separation Plan

**Note:**  
 Proposed pipe alignments and pump station  
 are conceptual and need to be verified.



In summary the key infrastructure being added for this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Expand the Powers Creek WTP;
  - Install a low lift pump station in WID to supply treated water from Powers Creek to the rest of the DWK;
  - Install a transmission main to connection WID to Rose Valley. This transmission main is a 600mm pipe 9.2km long. In the short term it will convey water treated at Power Creek and pumped to Rose Valley. In the long term it will provide gravity transmission from Rose Valley to WID;
  - Construct a new conventional water treatment plant and treated water clearwell at the Rose Valley Reservoir site in 2019;
  - Install a transmission main to convey treated water from the new Rose Valley water treatment plant site to WKE. This allows the existing WKE pump station to be abandoned;
  - Install separate agricultural distribution network to convey non-potable water from Okanagan Lake to agricultural lots within Sunnyside.
- Future Upgrades (2032 to 2062):
  - Further expand the Rose Valley water treatment plant;
  - Provide a pipeline sized to convey 6,650 ML to Rose Valley WTP to supplement the raw water storage shortage in the upland watershed during a drought. In addition to the transmission main a pump station is necessary to convey Okanagan Lake water to the Rose Valley water treatment plant;
  - Provide a gravity transmission main to improve the transmission capacity of the network from the Rose Valley reservoir to the Sunnyside area.

#### Option 7 – Rose Valley Filtration Deferral Using Okanagan Lake as Raw Water Source

Option 7 relies on the treatment plant at Powers Creek and a new ultraviolet treatment plant at Rose Valley Reservoir dam site. This option uses Okanagan Lake as the sole water source for Rose Valley to defer filtration. This reduces the initial capital and O&M cost of treatment while increasing pumping costs. Filtration cannot be deferred indefinitely and a filtration plant will be required at some point in the future.

The pipeline to convey raw water from Okanagan Lake in Options 2 is sized to convey 55 ML/d to supplement raw water from the upland watershed. For this option the pipeline must convey 90 ML/d to reach the 2032 horizon when it is assumed that filtration will be constructed a Rose Valley. After filtration is constructed, this pipeline will be used to supplement upland raw water as in Option 2.

**Figure 7** shows the conceptual design of the water distribution system for the DWK with deferred filtration.



**District of West Kelowna  
Water Utility Master Plan  
Supplement**

**Option 7**  
Current System /  
Increase Okanagan  
Lake Water /  
Defer Rose Valley

- Legend**
- Future Water Treatment Plant
  - Existing Water Treatment Plant
  - Raw Water Supply Intake
  - Inactive Intake (Emergency)
  - Raw Water Supply PS
  - Proposed Transmission Mains
  - Proposed Raw Water Supply Main
  - Service Boundary
  - Existing Watermain
  - Streams

Figure No:  
Figure 7

Project No:  
60216671

Date:  
July, 2013



**Future Rose Valley WTP**  
2012 - 2032 (or while filtration is deferred): 90 MLD  
2032 - 2062: 170 MLD

Proposed Transmission Mains  
are connected to the Existing Watermain  
(Not to the Proposed Raw Water Main)

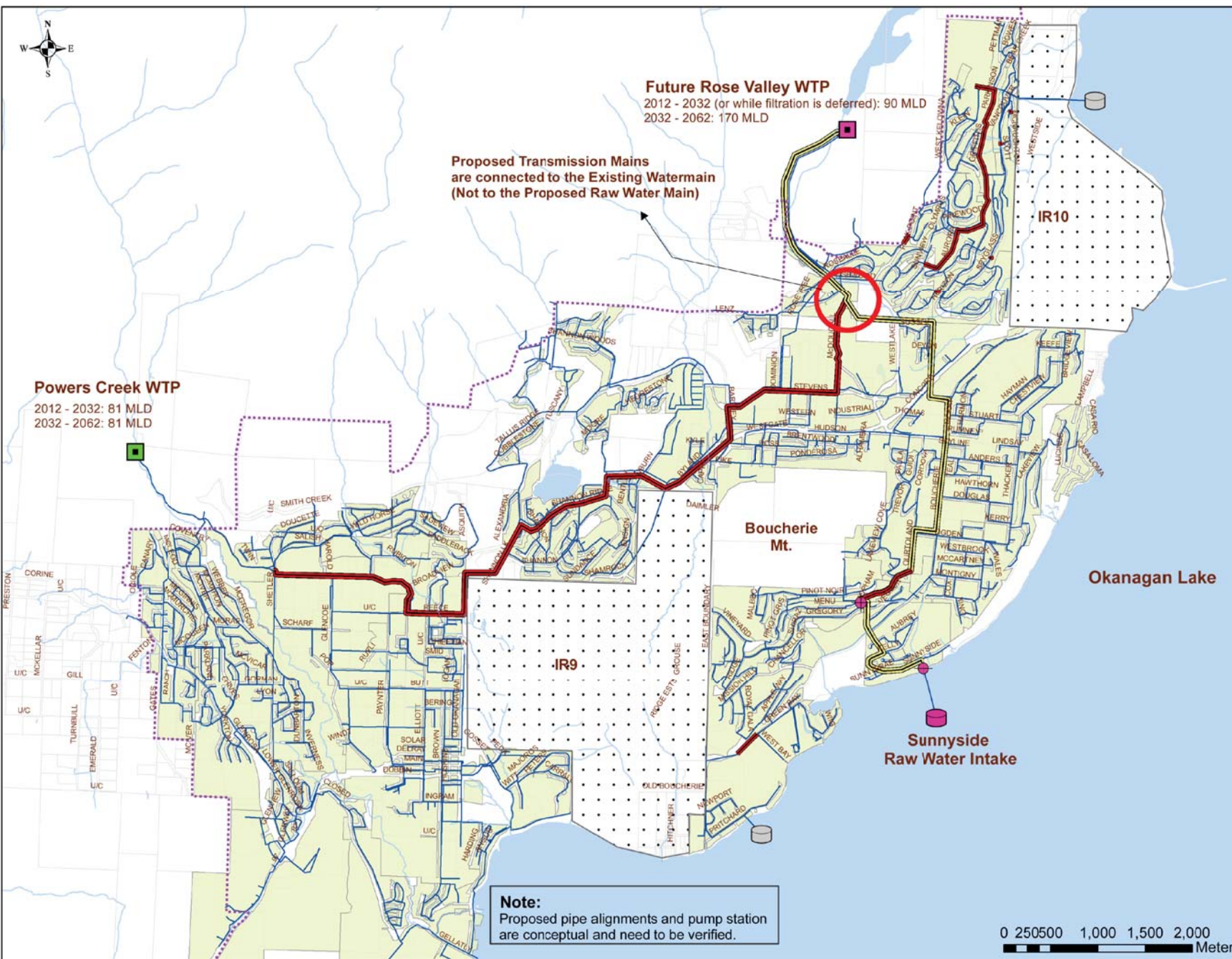
**Powers Creek WTP**  
2012 - 2032: 81 MLD  
2032 - 2062: 81 MLD

**Sunnyside  
Raw Water Intake**

**Boucherie  
Mt.**

**Okanagan Lake**

**Note:**  
Proposed pipe alignments and pump station  
are conceptual and need to be verified.



In summary the key infrastructure being added for this option is:

- Immediate Infrastructure Upgrades (Now – 2032):
  - Maintain the existing Powers Creek water treatment plant. Depending on the actual demands some expansion may be required prior to the 20 year design horizon;
  - Construct a new ultraviolet water treatment plant and treated water clearwell at the Rose Valley Reservoir site;
  - Provide a pipeline sized to convey 90 ML/d to Rose Valley WTP. In addition to the transmission main a pump station is necessary to convey Okanagan Lake water to the Rose Valley water treatment plant;
  - Install a transmission main to convey treated water from the new Rose Valley water treatment plant site to WKE. This allows the existing WKE pump station to be abandoned;
  - Install separate agricultural distribution network to convey non-potable water from Powers Creek to agricultural land within WID;
  - Install separate agricultural distribution network to convey non-potable water from Rose Valley to agricultural land within Lakeview, Sunnyside and Pritchard;
- Future Upgrades (2032 to 2062):
  - Construct a filtration plant a Rose Valley dam site and abandon the ultraviolet water treatment plant;
  - Install an interconnecting gravity transmission main to feed WID system from Rose Valley. This transmission main is a 600mm pipe 9.2km long and is designed to reduce the maximum daily flow required at the Powers Creek facility by 40 ML/d;
  - Provide a gravity transmission main to improve the transmission capacity of the network from the Rose Valley reservoir to the Sunnyside area;

### ***Review of the Non-Cost Considerations***

Cost alone should not drive the recommendation so a decision modeling process was conducted to evaluate all the candidate options. The first step in the development of a decision model is to determine the evaluation factors and the associated importance of evaluation factors in the decision making process. The non-cost evaluation factors and the weighting of each factor is presented within **Table 1**.

**Table 1 Summary of the Evaluation Factors**

Evaluation Factor	Weighting
System Operational Ease & Flexibility – For each option the ease of water delivery will vary. This issue will be considered in this item.	25%
Emergency Preparedness – The ability to respond to emergency conditions, such as the loss of a facility due to earthquake, fire, etc	25%
Average Finished Water Quality – All the options result in the supply of Interior Health compliant acceptable treated water. However, there are some treated water variations between Power Creek, Lambly Creek and Okanagan Lake. This consideration will be reviewed in this valuation item.	5%
Reliability & Availability of Supply – The likelihood that one or more sources will be unable to yield the required volumes of raw water under regular expected operating conditions.	25%
Ease of Implementation – The ability to implement the solution in a timely manner resulting in the customers receiving Interior Health compliant treated water will vary between the options.	5%
Future Expansion – The ability of the system to respond/adjust to changing future needs in a cost effective and operationally efficient manner. Also, the ability option to provide high quality treated water to support economic development and the OCP growth targets.	10%
Environmental Impacts – This factor considers the overall environmental impacts of the various options such as residual production, energy minimization, impact to natural water course, etc. All the	5%
<b>Total Weighting</b>	<b>100%</b>

Provided below is a more detailed explanation of the non-cost considerations and how they impact the 7 long term water supply options developed for the District water utility.

**1.1.1 System Operational Ease & Flexibility**

This evaluation item addresses the non-cost items related to the long term ease, flexibility and resiliency of operating the complete water system. Some of the items considered within this evaluation category are:

1. The integration and operation of several independent water systems into a single system.
2. The number of sources and the challenges associated with each raw water source are considered. The options that rely on more raw water sources and more pumping will provide more operational burden than options that rely on a single gravity source of water.
3. For the system separation options the conveyance of water through a single distribution network versus two completely separate distribution systems. The additional infrastructure necessary to support the implementation of 2 separate water distribution systems will add to the operational burden associated with ensuring the supply of water to all the customers.

### **1.1.2 Emergency Preparedness**

Vulnerability to failure during an emergency is a key consideration. Under this criterion, higher scores were provided to Options which increased the number of facilities available to the District which would essentially increase flexibility to react to catastrophic loss of a key water supply facility due to unforeseen events, such as earthquake or fire. Furthermore, options that maximize the use of the gravity flow of water complete with interconnects to allow for the delivery of treated during an emergency are rated higher than options that rely on pumping.

Options that rely on the deferral of filtration result in these options being more susceptible to treated water quality compliance issues if there was a catastrophic event in Okanagan Lake such as a fuel spill or some other contaminate.

### **1.1.3 Average Finished Water Quality**

All the options result in the supply of treated water that is compliant with the Provincial Drinking Water Objectives being delivered to the District customers; however, given the raw water characteristics of the available sources there will be subtle variations in the treated water characteristics of the water. Given that all the options result in the supply of compliant treated water this criterion is weighted low.

The raw water sources relied on for the long term water supply options and the associated treated water quality considerations are:

1. Okanagan Lake offers the lowest level of natural organic material meaning disinfection by-products will be the lowest with this source. The potential challenge with Okanagan Lake is the long term impact of the numerous discharges and the human activity within the watershed. Currently, these impacts result in acceptable treated water, but the combination of long water residence time in the lake and numerous pollutant source provides the potential for invasive species and other emerging contaminants negatively impacting the drinking water quality from this source.
2. The Powers Creek and Lamby Creek sources offer higher levels of natural organic matter and lower alkalinity. This means that this water source will naturally produce the higher levels of disinfection by-products and offer a water supply that is more corrosive to the distribution network than Okanagan Lake. The impact of the disinfection by-products will vary nominally based on the operation of the water system with each option.

Okanagan Lake offers lower disinfection by-products but a higher potential for exposure to emerging contaminants. Conversely the upland water sources provide high potential levels of disinfection by-products that are known long term health concerns. Options that offer operational flexibility for the raw water source were ranked the higher in this category.

#### **1.1.4 Reliability and Availability of Supply**

This criterion refers to the possibility that some or all of the rated capacity of each source used for each option might be lost due to short term unforeseen circumstance, such as drought. Some of the specific items considered during the evaluation of the options are:

1. Options with 2 sources instead of 1 are preferred;
2. The reliability of a water supply during a prolonged drought;
3. The impact of climate change to raw water quality – warmer temperatures will potentially support more frequent and large algae blooms;
4. The ability to interconnect the potable distribution network to different treated water sources will improve the long term ability of the utility to supply treated water;
5. The ability to supply gravity water during an electrical power outage.

Options that include the use of the most raw water sources and maximized the ability to distribute the water within the supply network were ranked the highest in this category.

#### **1.1.5 Ease of Implementation**

This item assesses the ease of implementing the supply of treated water to all the domestic customers in a timely manner. For each of the potential long term water supply options, the specific items considered within this item are:

1. Land acquisition can be time consuming and often results in more cost than expected;
2. Disruption to the public from construction;
3. Conflicts and coordination with other utilities and agencies;
4. Transferring of water licenses;
5. Provincial and Federal agency approvals;
6. Changes made to the existing system as the more changes the more challenging the option will be to implementation.

This means options that rely on water treatment plants installed at locations compatible with the existing water system are ranked the highest. Conversely, options that consist of complete system separation, the reliance on alternate raw water sources and the re-configuration of the current water distribution system are ranked lower.

#### **1.1.6 Future Expansion**

There is not a discernible difference between the options for future expansion. All the options can be planned to meet the estimated water demands for the next 50 years. Depending on the actual growth rate and the level of water conservation that can be achieved at some point in the vicinity of 50 years

in the future an alternate raw water source will need to be developed. This issue is common and comparable to all options. The items considered during the comparison of the options include:

1. Ability to expand domestic supply system;
2. Deferral of capital cost;
3. Ability to change as new technology is developed in the future;
4. Ability to support community growth as stated within the Official Community Plan;
5. Ability to adjust in the future to changing political or economic conditions.

Based on the above points, options that use 2 water treatment plants, multiple water sources and included full system separation were ranked the highest. Options with full system separation offer more flexibility for the use of alternate or new sources of agricultural water in the future.

### **1.1.7 Environmental Issues**

All the options result in the construction of new infrastructure resulting in some level of impact to the environment. The completion of the construction work and the associated ongoing operation will all be completed following local bylaws and the senior government regulations. The cost implications of mitigating the environmental impacts is included within the capital cost estimates so this item should not be further considered during this evaluation. This means environmental protection and proper mitigation during construction is important but for the evaluation of the non-cost review of the options this item was provided a low weighting.

Under this criterion, each of the options were rated against the following key environmental considerations:

1. Annual mass of solids generated by water treatment for each of the Options;
2. Estimated annual power consumption;
3. Chemical usage;
4. Carbon footprint;
5. Amount of space distributed during construction; and
6. Impacts to natural water courses and other undeveloped areas.

Sources that rely on the upland water sources will need more chemical to support effective treatment resulting in the production of more sludge than options that use more water from Okanagan Lake. Conversely, options that rely on the upland water sources will consume less power resulting in the options that use the upland sources being ranked slightly lower. Options that include system separation are ranked lower given the space impacted during construction and the amount of construction activity is higher resulting in more impact to the environment.

## **Evaluation of the Options**

To select a long term water supply option all the options were evaluated and ranked independently by

the stakeholder groups represented in the Technical Steering Committee. For each non-cost consideration the options were evaluated and provided a ranking. This evaluation was completed by each stakeholder during or soon after the option review workshop held in July 2013. The results of the option evaluation are provided within **Table 2** below.

The ranking of the options was summarized based on the weighted importance of each non-cost consideration to generate a relative benefit of each option. This relative benefit score was then compared to the calculated total net present value of each long term water supply option. The values used for the net present value of the life cycle cost are a discount rate of 3% and an inflation rate of 2% over a period of 50 years.

Using the benefit ranking and the net present value of each option the benefit-to-cost of each option was determined. This evaluation resulted in Option 2 being the highest ranked option based on the average ranking of all the stakeholders. Furthermore, individually all the stakeholders ranked Option 2 either highest or second highest.

The results of the non-cost evaluation were discussed with the stakeholders and there was consensus that Option 2 offered the appropriate balance of cost versus benefit resulting in Option 2 being the recommended option for the long term supply of water for the DWK.



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## Minutes of Meeting

**Table 2 – Evaluation Model of the Long Term Water Supply Options**

Primary Factor	Option Number						
	Option 1 - Current Water System + Treatment	Option 2 - Centralized Treatment + Use all Three Raw Water Sources	Option 3 - Centralized Treatment + Upland Raw Water Sources Only	Option 4 - Centralized Treatment + Complete System Separation	Option 5 - Centralized Treatment + Sunnyside System Separation Only	Option 6 - Powers Creek + Complete System Separation	Option 7 - Centralized Treatment + Defer Rose Valley WTP by Supplying Okanagan Lake
System Operational Ease & Flexibility	3.6%	25.0%	21.4%	17.9%	14.3%	10.7%	7.1%
Emergency Preparedness	3.6%	25.0%	7.1%	17.9%	14.3%	10.7%	21.4%
Raw Water Quality Impacts on Treated Water	0.7%	4.3%	1.4%	3.6%	2.9%	2.1%	5.0%
Reliability & Availability of Supply	3.6%	17.9%	7.1%	25.0%	21.4%	10.7%	14.3%
Ease of Implementation	5.0%	3.6%	4.3%	0.7%	1.4%	2.1%	2.9%
Future Expansion	1.4%	7.1%	4.3%	10.0%	8.6%	5.7%	2.9%
Environmental Impacts	0.7%	2.1%	1.4%	4.3%	3.6%	2.9%	5.0%
<b>Total Benefits (as Measured by the Decision Model)</b>	<b>18.6%</b>	<b>85.0%</b>	<b>47.1%</b>	<b>79.3%</b>	<b>66.4%</b>	<b>45.0%</b>	<b>58.6%</b>
<b>Life Cycle Cost</b>	<b>\$ 219,330,000.00</b>	<b>\$ 161,670,000.00</b>	<b>\$ 177,925,000.00</b>	<b>\$ 175,586,000.00</b>	<b>\$ 164,102,000.00</b>	<b>\$ 176,427,000.00</b>	<b>\$ 173,730,000.00</b>
<b>Benefit-to-Cost Ratio (with cost measured in millions)</b>	<b>0.08</b>	<b>0.53</b>	<b>0.26</b>	<b>0.45</b>	<b>0.40</b>	<b>0.26</b>	<b>0.34</b>



Appendix F

Water System Analysis

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To Rob Hillis, P. Eng., District of West Kelowna Page 1

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Subject Water Utility Master Plan – Water Distribution & Hydraulic Model

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From John Van Andel, AECOM

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Date October 15, 2012 Project Number 60216671

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## 1. Hydraulic Model Development

Water distribution system hydraulic model for the entire District of West Kelowna was built by combining five (5) separate water hydraulic models from the former Service Areas: Lakeview, Westbank, West Kelowna Estate, Sunnyside and Pritchard. Four of these former models were built in EPANET modeling software, while one model, for Sunnyside service area, was built in WaterCAD.

The main challenge combining the hydraulic models was the absence of a coordinate system in the former hydraulic models built in EPANET. Consequently when the networks were brought together, their locations, scales and orientation were not geographically correct. By using the available cadastral and road layout GIS as the reference points, the system network was stretched and rotated to represent the actual situation as closely as possible. As the District continues to improve the accuracy of the GIS the hydraulic model data should be update to further improve the geographic accuracy of the hydraulic model.

All model components (pipes, nodes, valves (PRV), pumps, tanks, reservoirs), including their modeling attributes were imported from the former hydraulic models to the new and combined model. In general the system is connected properly. The update process for each system component is discussed briefly below:

- Pipes: all modeling attributes (diameter, C-factor, length) were obtained from the former models. The pipe C-factors were field verified with hydrant testing, which is described in a subsequent section of the report;
- Tanks and Reservoirs: all modeling attributes (area, height) were obtained from the former models. This information was verified and when necessary updated based on available record information;
- Pressure Reduce Valve (PRV): PRV setting were obtained from the former models and verified based on the checklist information provided by the District;
- Pump: modeling information for the pumps was obtained from the former models.

Additionally, Pressure Zone boundaries were created based on the figure obtained from the *Drought Response Plan* report by Aqua Consulting (2005). The pressure zone boundaries were then verified with record drawing checks and based on review comments from the District operational staff.

The hydraulic model developed as part of this assignment is a Steady State model used to analyze the distribution system during defined hydraulic flow conditions. This means that the model does attempt to simulate the hydraulic function of the network during an entire day for the design condition, but instead the model analyzes a single “snap-shot” of the water system as it pertains to demands, pumping and tank information. As a result, Steady State simulations are able to identify hydraulic deficiencies, but not predict tank cycling, water age and other associated items that are typically analyzed with an extended period simulation.

It should be noted that the connectivity around Shannon Lake Tank and its surrounding pressure zone boundary still needs to be confirmed by the District. The existing information based on the former model shows that there is a PRV as well as a Flow Control Valve on the main that is feeding the tank. This condition creates problem in filling the tank. Therefore some adjustments had been made in the current model to resolve the problem.

## 2. Existing Demand Allocation

The hydraulic water model is a tool for determining if the water system has adequate capacity to meet the customer's needs and determine required system improvements where adequate service is not being maintained. Therefore, it is critical that water demands in the hydraulic model be distributed in a manner that closely represents the distribution of real demand in the field.

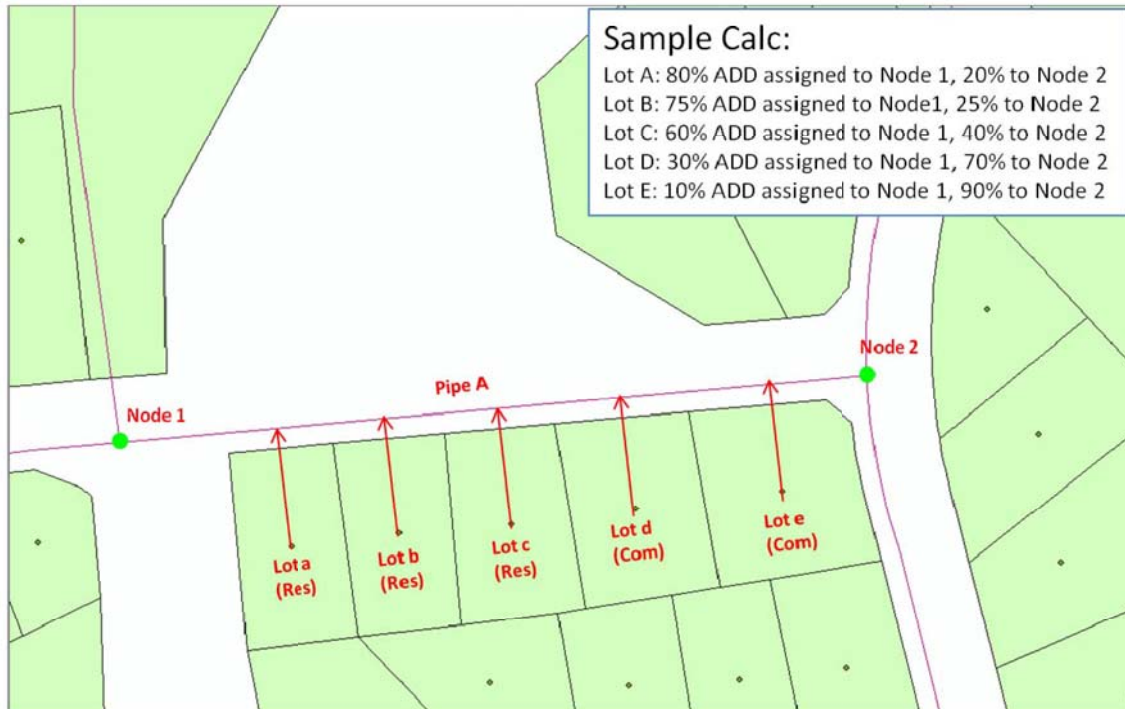
Water demand scenarios generated for this project include Average Day Demand (ADD), Maximum Day Demand (MDD), and Peak Hour Demand (PHD) for both existing (2011) and future (2032) time horizons. ADD is the basic demand scenario in the model. MDD and PHD scenarios are generated through multiplying ADD by Peaking Factors.

The method and approach used in estimating total water consumption within the District had been discussed in Section 4.3 of this report. Based on this approach, the ADD water consumption for each parcel within the system was estimated. Subsequently, the Demand Allocator tool available in InfoWater was used to distribute and allocate the demand from each parcel to the closest node in the system. The following steps were followed during demand allocation process:

1. Linked the Folio No. available in the Billing Record to that available in the Parcel Fabric (cadastral) shapefile. By developing this link, each parcel in the system was assigned ADD as well as Zoning information;
2. Converted each parcel into its centroid;
3. Allocated each parcel centroid to the closest pipe in the system;
4. Distributed the allocated ADD to the connected nodes proportionally based on distance;
5. Summed up ADD for each node in the system based on Zoning information.

**Figure 1** shows the process graphically.

**Figure 1 - Demand Allocation Process**



Total demand allocated in the hydraulic model within the entire District of West Kelowna is presented in **Table 1 - Table 3** below.

**Table 1 - Average Day Demand Allocated in Model (Existing System – 2011)**

Zoning	Demand in Model	LID	PI	SS	WID	WKE	Total (L/s)
Res-SF	Demand 1	81.7	2.9	21.5	78.6	21.3	205.9
Res-MF	Demand 2	4.3	1.4	0.3	9.5	0.2	15.7
Industrial	Demand 3	2.1	0.0	0.1	0.6	0.0	2.9
Commercial	Demand 4	12.6	0.0	2.7	10.1	0.0	25.4
Institutional	Demand 5	7.1	0.0	0.0	8.7	0.5	16.2
Ag	Demand 6	33.8	6.3	4.0	55.7	0.0	99.8
Leakage	Demand 7	33.4	1.4	8.1	34.7	9.8	87.4
<b>TOTAL</b>		<b>175.0</b>	<b>12.0</b>	<b>36.7</b>	<b>197.8</b>	<b>31.8</b>	<b>453.3</b>

**Table 2 - Maximum Day Demand Allocated in Model (Existing System – 2011)**

Zoning	Demand in Model	LID	PI	SS	WID	WKE	Total (L/s)
Res-SF	Demand 1	274.2	9.6	72.2	263.4	71.6	691.0
Res-MF	Demand 2	14.6	4.8	0.9	31.9	0.6	52.7
Industrial	Demand 3	7.0	0.0	0.5	2.2	0.0	9.7
Commercial	Demand 4	42.3	0.0	9.2	33.7	0.0	85.2
Institutional	Demand 5	23.6	0.0	0.0	29.1	1.6	54.3
Ag	Demand 6	184.7	34.3	21.6	304.8	0.0	545.4
Leakage	Demand 7	33.4	1.4	8.1	34.6	9.8	87.4
<b>TOTAL</b>		<b>579.9</b>	<b>50.0</b>	<b>112.5</b>	<b>681.6</b>	<b>83.6</b>	<b>1525.7</b>

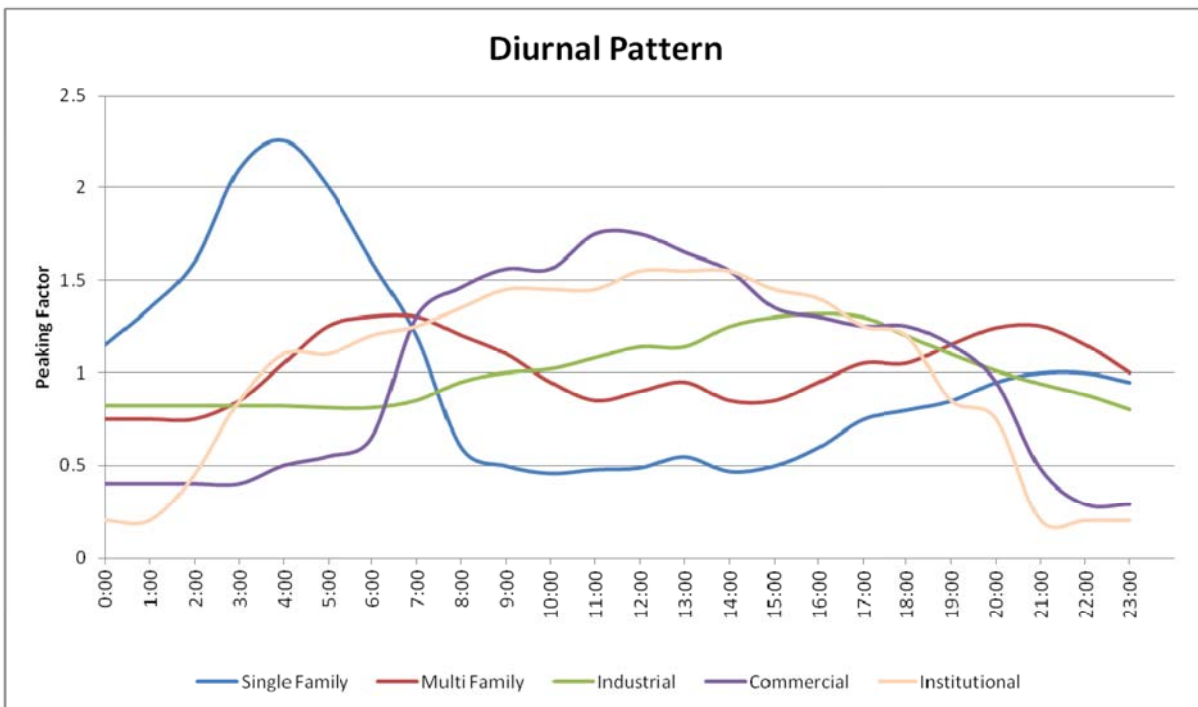
**Table 3 - Peak Hour Demand Allocated in Model (Existing System – 2011)**

Zoning	Demand in Model	LID	PI	SS	WID	WKE	Total (L/s)
Res-SF	Demand 1	402.0	14.1	106.1	387.5	105.2	1014.9
Res-MF	Demand 2	21.4	7.0	1.3	46.8	1.0	77.5
Industrial	Demand 3	10.3	0.0	0.7	3.2	0.0	14.2
Commercial	Demand 4	62.1	0.0	13.5	49.6	0.0	125.2
Institutional	Demand 5	34.7	0.0	0.0	42.8	2.3	79.8
Ag	Demand 6	271.5	50.4	31.8	448.0	0.0	801.7
Leakage	Demand 7	33.4	1.4	8.1	34.7	9.8	87.4
<b>TOTAL</b>		<b>835.4</b>	<b>72.9</b>	<b>161.5</b>	<b>1012.7</b>	<b>118.2</b>	<b>2200.7</b>

In the model diurnal patterns were assigned for each Zoning/Landuse type to allow hourly fluctuation of demand in the system throughout the day. This diurnal pattern information was not required under Steady State analysis; however, it was incorporated for future usage of the model when an Extended Period Simulation (EPS) would be required.

Since there was no hourly data available to be used, the diurnal patterns developed for the City of Kelowna in their most recent Water Master Plan study that AECOM conducted. However, no diurnal pattern is assigned to the Agricultural zone as no information is available. The diurnal pattern for each Zoning type is shown in **Figure 2**.

**Figure 2 - Diurnal Pattern Assigned in the Model**



**3. Future Demand Allocation**

Based on the discussion with the District, the following method was followed when calculating future (2032) population and water demand projection within the District:

- 2% per year population growth was assumed, where 1.5% was assumed to be expansion and 0.5% was assumed to be infill equally distributed throughout the District;
- For this additional population, the legacy Lakeview Irrigation District’s water consumption rate recommended By-Law was applied. The recommended By-Law states the following rates:
  - Average Day Demand: 900 L/cap/d
  - Maximum Day Demand: 2,400 L/cap/d
  - Peak Hour Day Demand: 4,000 L/cap/d
- The existing population and its water consumption allocated in the model was kept as is.

Following the above noted approach, total additional population and water consumption to make up the 2032 scenario is summarized in **Table 6**.

**Table 6 - Additional Population and Water Consumption (2032)**

Growth Location	Population	Demand in Model	Water Consumption (L/s)		
			Ave Day	Max Day	Peak Hour
Infill	3,585	Demand 8	37.3	99.6	166.0
Expansion	10,755	Demand 9	112.0	298.8	497.9
Total	<b>14,340</b>		<b>149.3</b>	<b>398.4</b>	<b>663.9</b>

It is important to note that the infill population is equally distributed throughout the District in the model even though this may not represent the actual future population growth distribution in the system. This simplistic modelling approach likely will not precipitate any capacity issues since there will be a significant population increase at any particular area in the system. However, it is more typical to expect nodes of development associated with discrete parcels of land being developed. A defined node of population growth within the system resulting in a measurable increase in the water demand could require water distribution upgrades not identified within this master planning document. As future development occurs, further system capacity analysis will be required to ensure the existing distribution system assets can sustainably supply water.

**4. Model Calibration**

A computer model of a water distribution system is a mathematical representation of a physical system. To ensure the hydraulic model bears close resemblance to reality the results from the hydraulic model simulations must be compared to actual measured parameters within a certain level of accuracy. The comparison and calibration process is completed using hydrant flow tests.

In 1999 the American Water Works Association (AWWA) Engineering Computer Applications committee posted the following general calibration guidelines:

- Long Range Planning ± 10%
- Infrastructure Design ± 5%
- Operational Improvements ± 5%

Based on this guideline, the overall goal of calibration is to be within the ± 10% error of observed field conditions.

The scope of this project is to develop and calibrate a Steady State model, not an Extended Period Simulation (EPS). Typically, extensive operational data from the SCADA would be used to calibrate an EPS model, but, unfortunately this information is not available. Given the limited SCADA and the need to calibrate a steady state model it was determined that hydrant flow testing would provide sufficient information. The goal of the hydrant flow testing is to confirm the static pressure at discreet locations in the distribution network and the pressure loss experienced during different flow conditions.

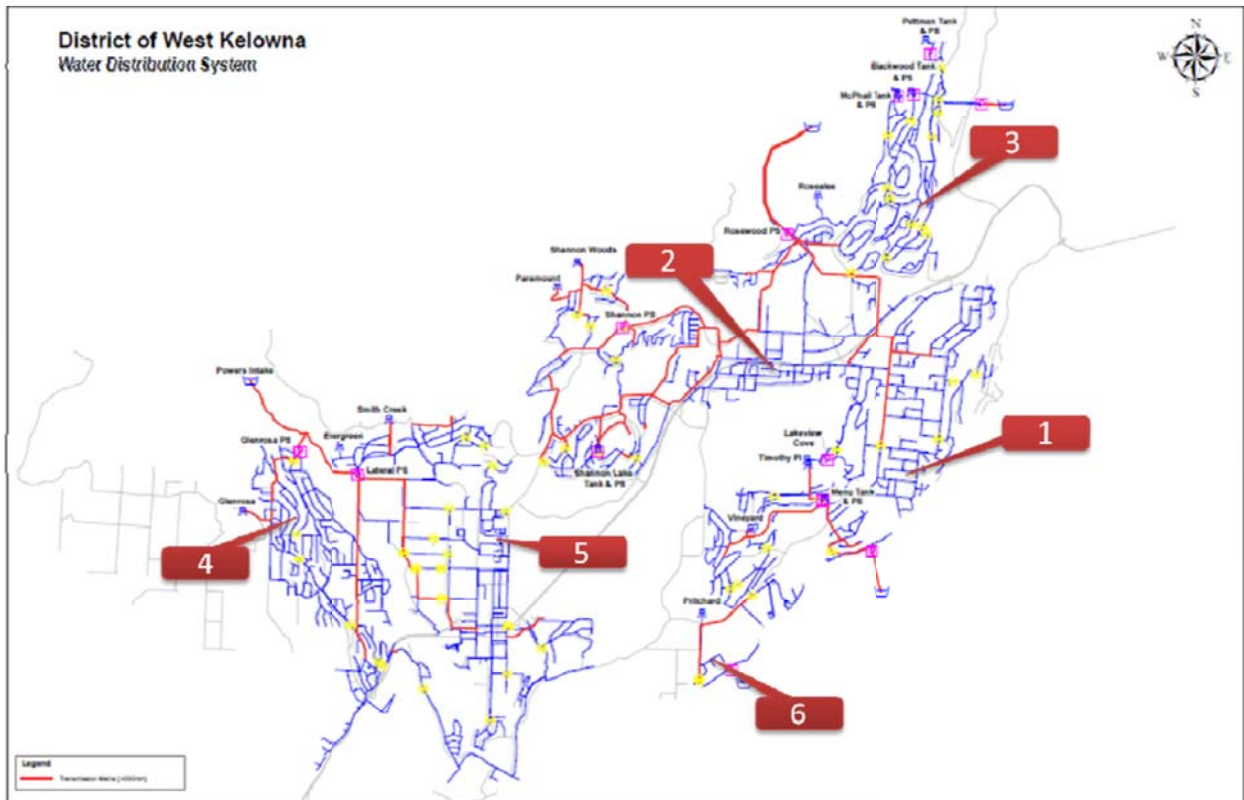
Field data collection program through Hydrant Flow testing are required mainly for the following reasons:

- To estimate C-Factor
- To perform system hydraulic test

To help determine system's Hazen-William C-factor, it is important to have the field testing done strategically and proportionally based on diameter, material type, age, and location. Hydrant test was conducted at six (6) representative locations out of the nine locations previously selected due to timing constraint. The hydrant flow test locations were listed below and shown in **Figure 3**:

1. Thacker Road: 150mm/DI/1972
2. Ross Street (at Brentwood Street): 150mm/DI/1968S
3. Spyglass Way: 150mm/PVC/Unknown
4. MacLeod Road: 150mm/AC/1975
5. Chieftian Road: 150mm/PVC-AC/1975-1985
6. Newport Road: 150mm/AC/1970

**Figure 3 - Hydrant Flow Test Locations**



During model calibration process, the model was run and the pressure reading results at hydrant testing points were compared to that observed in the field, and adjustment were made to the C-factor for the pipes in the vicinity of the testing points. Other necessary adjustments were also made in the model to bring the model results closer to the observed pressure value, for example there is a permanently closed valve that has not been identified before in the model at Location 5 (Chieftain Rd).

Pressure reading comparison between the model and observed flow test data is summarized in **Table 7** below.

**Table 7 - Model Calibration Results**

Test No.	Location	Flow Hydrant	Flow @ Hyd (L/s)	Pressure Before Hyd Test (psi)			Pressure During Hyd Test (psi)		
				Actual	Model	Diff	Actual	Model	Diff
1	Thacker Rd	Thacker & McCartney	33.8	110	117.9	7.2%	95	106.3	11.9%
				115	120.6	4.9%	95	96.6	1.7%
				120	126.2	5.2%	97	101.6	4.7%
2	Ross @ Brentwood	Ross @ Brentwood	99.1	173	166.2	-3.9%	141	133.3	-5.4%
				165	161.6	-2.1%	125	114.4	-8.5%
3	Spyglass Way	2044 Spyglass Way	58.1	96	90.7	-5.5%	53	48.7	-8.1%
				65	58	-10.8%	37	40.9	10.6%
4	McLeod Rd	McLeod Rd @ McGinnis	69.1	90	91.9	2.1%	80	86.0	7.5%
				94	98.3	4.6%	68	71.0	4.4%
5	Chieftian Rd	Chieftian Rd @ Logan	63.7	120	120.4	0.3%	75	74.5	-0.7%
				125	123.1286	-1.5%	55	50.4	-8.3%
6	Newport Rd	Newport Rd @ Camano	42.3	65	64.65	-0.5%	35	39.1	11.7%
				64	59.3	-7.3%	34	33.8	-0.6%
				72	64.6	-10.3%	42	39.1	-6.9%

As can be observed in the table above, for most locations, the model’s pressure reading is within 10% of that observed in the field. Some hydrant locations have marginally higher error percentage. It is important to keep in mind that model calibration accuracy is dependent on the accuracy of numerous factors including: the initial modeling data, as well as instrumentation of flow testing done by the District. The following factors must be considered in model calibration:

- Accuracy of the pressure gauge used during flow testing – it was assumed to be calibrated;
- Model input data accuracy – as discussed above some of the information was obtained from the former (old) hydraulic model without any available/additional information to confirm its accuracy;
- PRV setting accuracy – these were obtained from the District’s information checklist;
- Pump curve accuracy – there were no additional information to verify the data obtained from the former (old) hydraulic model;
- Storage facility geometry/volume accuracy – the dimensions obtained from the former models were reviewed by AECOM to ensure they corresponded with the as-builts;

- Accuracy of headloss assumptions, reflected in C-factor estimations;
- Accuracy of nodal demand allocation, developed using actual billing meter records. This distribution of nodal demands was not adjusted during calibration;
- Accuracy of initial state/boundary condition, including pump operation (On/Off) and initial tank level – no information was available, adjusted as necessary during calibration to better match flow testing results.

In general, the model accurately predicts the system performance for the conditions and locations tested and simulated under steady state condition. Therefore, for purposes of this study, the model calibration accuracy for the District water system is considered to be sufficient. For this reason, the average of the calibrated C-factors from the six hydrant test locations was applied to other corresponding areas. The C-factor adjustment made in the model is as follows:

- C-factor of 135 was applied to all PVC pipes.
- C-factor of 137.5 was applied to all DI pipes.
- C-factor of 125 was applied to all AC pipes.
- C-factor of 100mm was applied to all pipes within Pritchard.

The available pipe material information covers approximately 90% of the entire pipes within the system. Consequently the calibrated C-factor listed above was applied to the pipes with known material information. For the rest of the system, the existing C-factor obtained from the former models was retained.

## **5. Steady State (SS) vs. Extended Period Simulation (EPS)**

The current combined model has been built with a diurnal pattern for each zoning type (except for Agricultural as explained above) and pumps' on/off control (estimated only, no verification data is available). With this information, the model is fully equipped to run an Extended Period Simulation (EPS), where tanks' level fluctuation and pumps on/off can be observed and optimized.

An EPS model would be expected to be useful for analysis of the areas that require additional storage since an EPS model could be used to predict the response of any new or larger storage tank to an existing or future maximum day or fire flow condition. While there are several standards and guidelines for calculating the volume of storage required, an EPS model could provide the confidence that the water system storage could be drawn down under higher demand portions of the day and refill during lower demand hours (typically overnight).

It is recommended that the District to conduct calibration under EPS in addition Steady State. The hydraulic model built as part of this project is configured to function as an EPS model, but to obtain meaningful results EPS calibration needs to be completed. A calibrated EPS model will allow for the review of tanks cycling, regulating pumps and valves operation, differing control strategies, as well as conducting water quality analysis.

In order to perform EPS calibration, the same approach as above would be adopted however the calibration process will be based on a representative 7-day time period (calibration period) selected around the historic Maximum Day Demand during summer (MDDs). Another fundamental requirement is the availability of hourly data at key connection points (eg., pump, tank, PRV) throughout the system.

**6. System Capacity Assessment & Deficiencies**

The calibrated model was utilized to analyze the performance of the District’s existing water system and identify potential deficiencies under the existing (2011) as well as future (2032) water demand scenarios. The water system performance was analyzed for MDD + FF and PHD demand conditions. System performance was rated utilizing the criteria in **Table 8**.

**Table 8 - System Performance Criteria**

Measurement	Criteria
Minimum Pressure during PHD	275 kPa (40 psi)
Minimum Pressure during MDD + FF	140 kPa (20 psi)
Maximum Headloss gradient	3.0 m/km
Maximum Water Velocity during PHD	2.0 m/s
Single Family Fire Flow requirement	60 L/s
Multi Family Fire Flow requirement	90 L/s
Industrial Fire Flow requirement	225 L/s
Commercial Fire Flow requirement	150 L/s
Institutional Fire Flow requirement	150 L/s

The application of minimum pressure criteria listed above was limited to nodes that directly service water customers. There are a number of nodes at reservoirs and pump stations that do not meet the above minimum pressure criteria by design and that these criteria were not intended as a test for such nodes. The same is true for the pipes connected to a pump or a control valve where water velocity and/or headloss gradient does not meet the above criteria since they are not intended for such pipes.

The pressure conditions under MDD + Fire and PHD for both existing and future systems are presented in **Figure 4 - Figure 7**.

In general the District’s water system performs adequately under PHD as well as MDD + FF demand conditions. However, there are some areas that do not meet their fire flow requirements as noted in the figures. With regards to headloss gradients, the figures show that a significant number of pipes in the system do not meet the 3 m/km maximum headloss gradient criteria, while their velocity is at or below 2 m/s. It is important to note that even though these pipes act as a restriction in the system, the majority of them do not significantly impact or reduce pressure conditions in the system. Therefore, not all of the pipes with high headloss gradient are recommended for upgrades. Nevertheless when it is time for those pipes to be replaced (ie., end of service life), upsizing of these mains should be considered.

In order to determine the required upgrades, the following conditions are typically considered:

- Low pressure during Max Day + Fire
- Low pressure during peak hour

- Age & Material (where available)
- Operational input, or records of breaks/leakages or other related issues (no information is available)
- Areas with high static pressure, this may increase leakage or introduce higher risk if something should happen
- Major supply line in the system



**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution Existing  
System**

**Existing Peak Hour Demand  
Pressure & Headloss Condition**

**Legend**

- Pump Station
- Intake
- Storage Tank
- Pressure Reducing Valve
- Service Boundary
- Un-irrigated Park Space

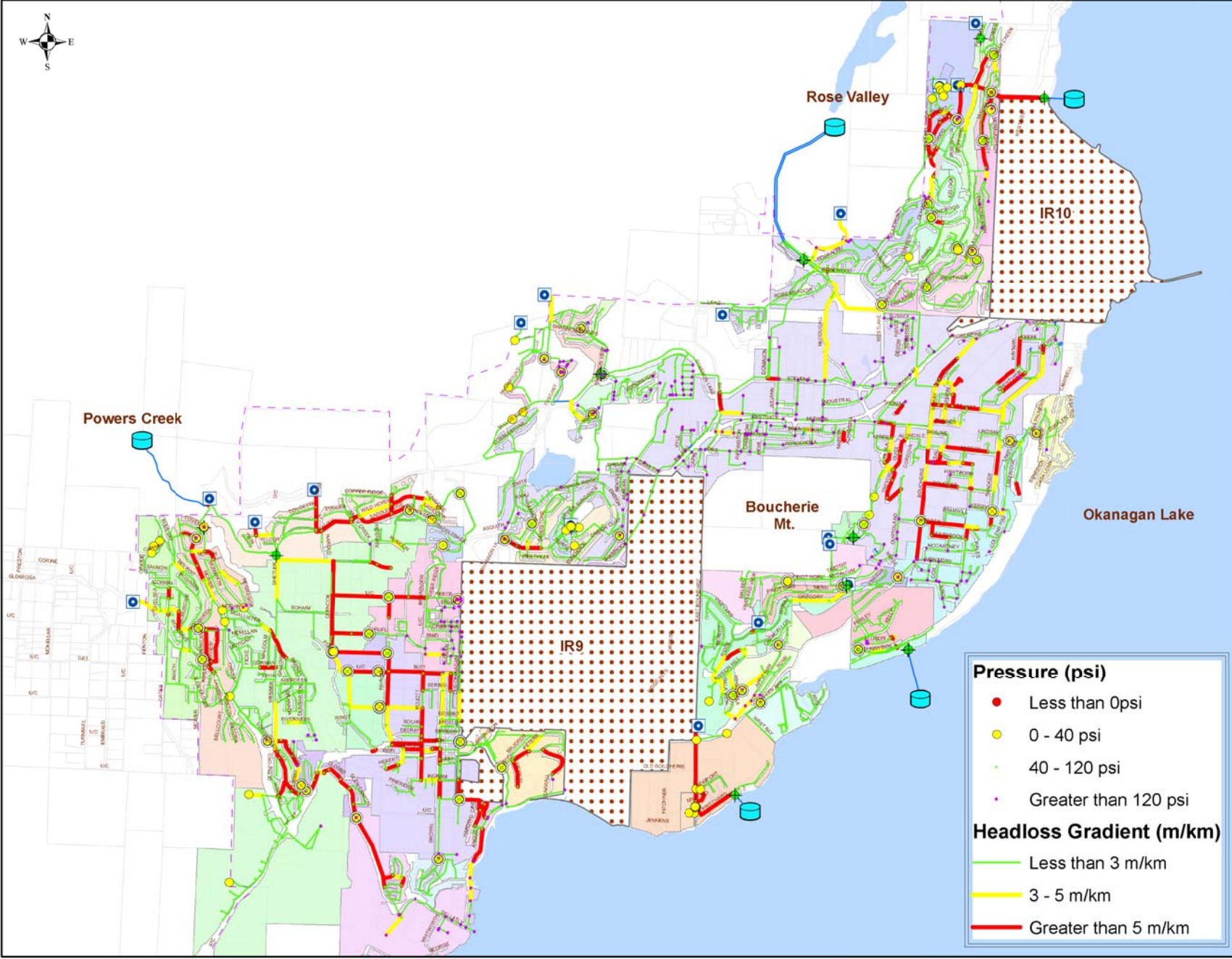
**Pressure (psi)**

- Less than 0psi
- 0 - 40 psi
- 40 - 120 psi
- Greater than 120 psi

**Headloss Gradient (m/km)**

- Less than 3 m/km
- 3 - 5 m/km
- Greater than 5 m/km

Figure No: Figure 4	
Project No: 60216671	Date: September, 2012





**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution Existing System**

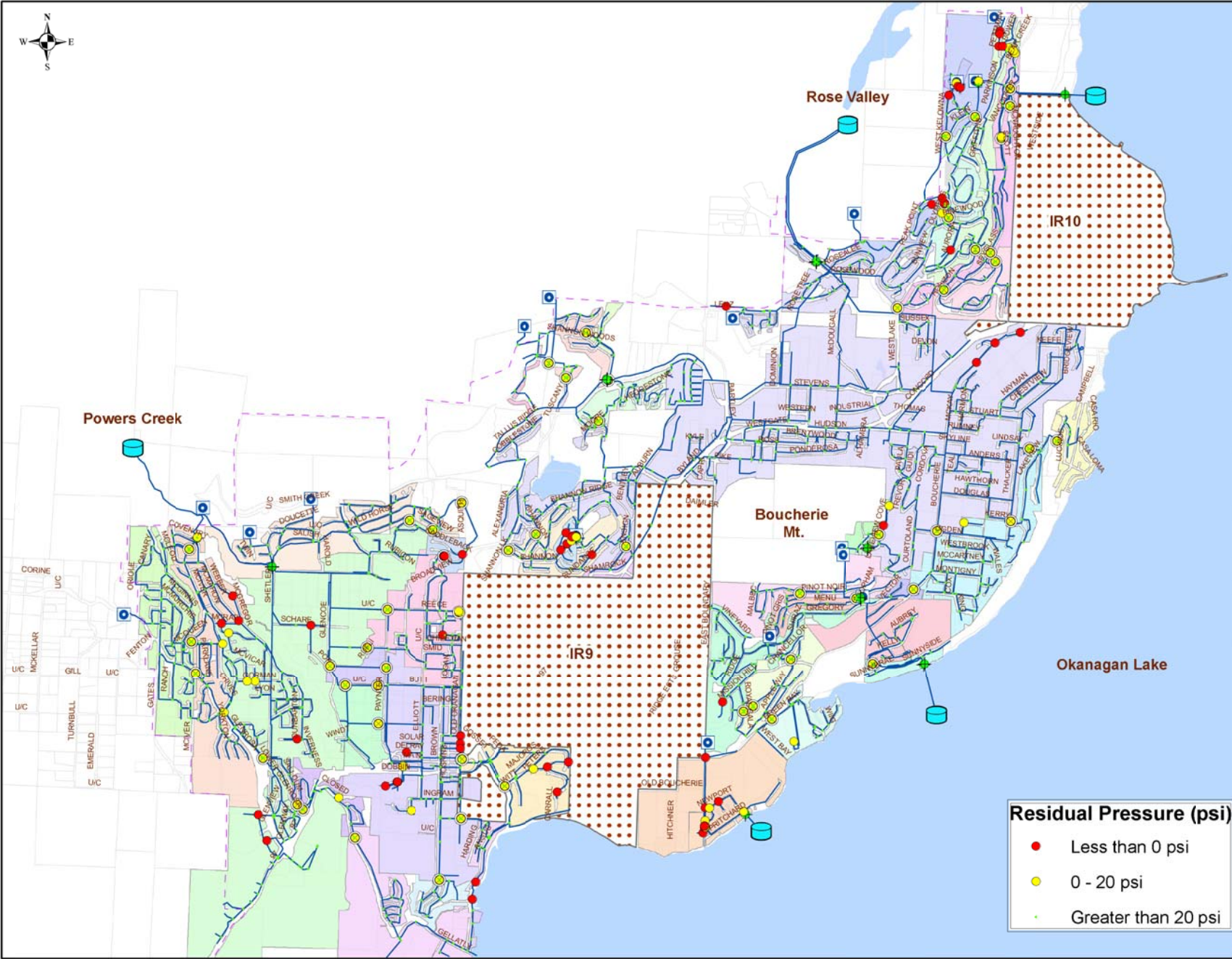
**Existing Max Day + Fire  
Residual Pressure Condition**

**Legend**

- Pump Station
- Intake
- Storage Tank
- Pressure Reducing Valve
- Existing Watermain
- Service Boundary
- Un-irrigated Park Space

Figure No:  
Figure 5

Project No: 60216671      Date: September, 2012



**Residual Pressure (psi)**

- Less than 0 psi
- 0 - 20 psi
- Greater than 20 psi



**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution With  
Proposed Upgrades**

**Existing Peak Hour Demand  
Minimum Pressure Condition**

**Legend**

- Pump Station
- Intake
- Inactive Intake
- Storage Tank
- Pressure Reducing Valve
- Proposed Watermain Upgrade
- Existing Watermain
- Service Boundary
- Un-irrigated Park Space

Figure No:

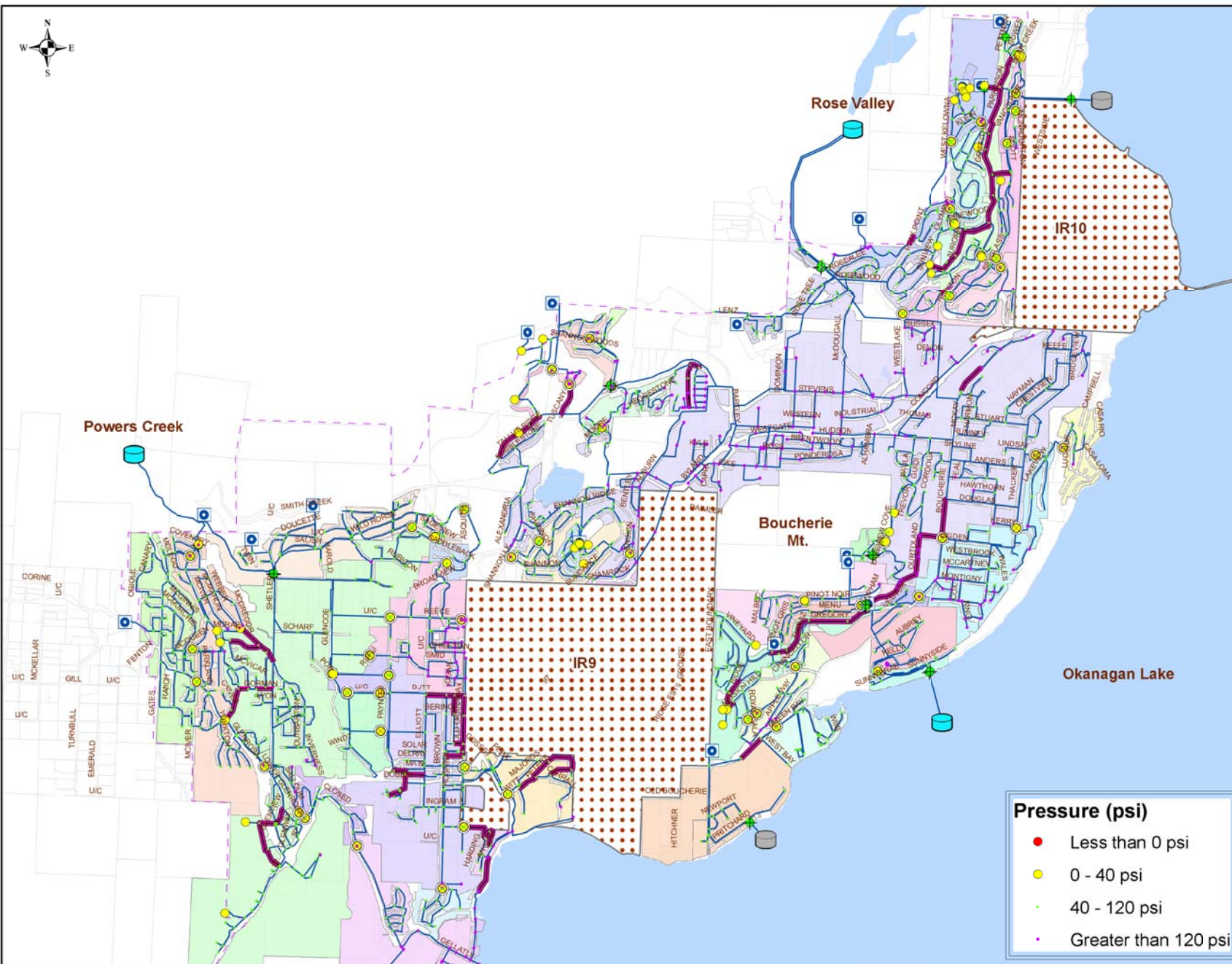
Figure 6

Project No:

60216671

Date:

September, 2012



**Pressure (psi)**

- Less than 0 psi
- 0 - 40 psi
- 40 - 120 psi
- Greater than 120 psi



**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution With  
Proposed Upgrades**

**Existing Max Day + Fire  
Residual Pressure Condition**

**Legend**

- Pump Station
- Intake
- Inactive Intake
- Storage Tank
- Pressure Reducing Valve
- Proposed Watermain Upgrade
- Existing Watermain
- Service Boundary
- Un-irrigated Park Space

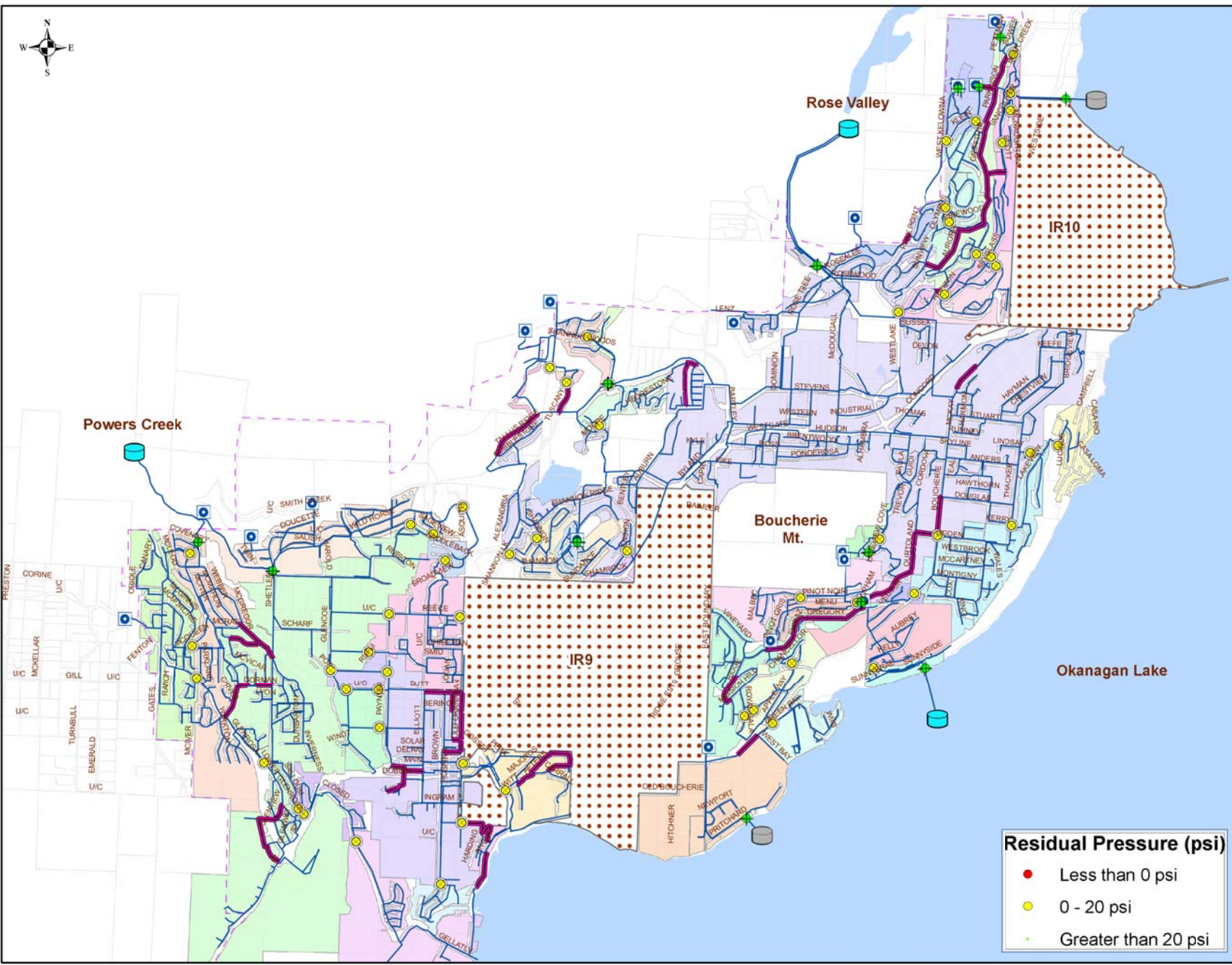
Figure No:  
Figure 7

Project No: 60216671      Date: September, 2012



**Residual Pressure (psi)**

- Less than 0 psi
- 0 - 20 psi
- Greater than 20 psi



Additionally, in order to support the core intent of the Master Plan which is to ultimately combine, operate and maintain the different water utilities under one operating utility - District of West Kelowna, proposed transmission mains to connect the former water utilities were also part of the system upgrades recommendation. The locations of the proposed watermain upgrades as well as the resulted pressure conditions under MDD + Fire and PHD for both existing and 2032 demand conditions are presented in **Figure 8 – Figure 11**.



**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution Existing System**

**2032 Peak Hour Demand  
Pressure & Headloss Condition**

**Legend**

- ★ 2032 Growth Location
- ⊕ Pump Station
- 🛢 Intake
- 📍 Storage Tank
- ⊙ Pressure Reducing Valve
- - - Service Boundary
- ☐ Un-irrigated Park Space

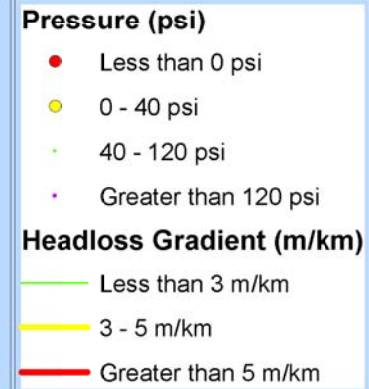
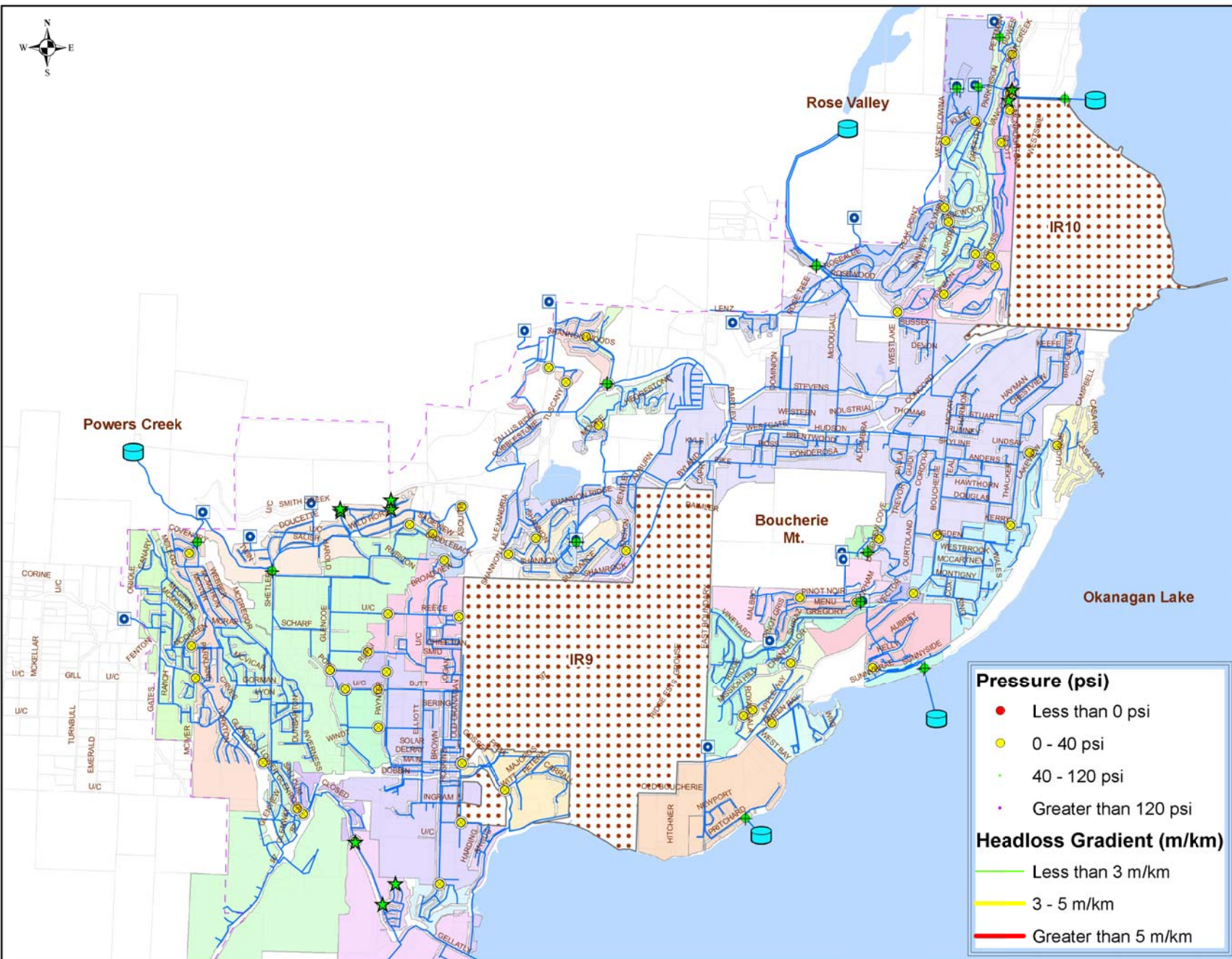


Figure No: Figure 8

Project No: 60216671 Date: September, 2012





### District of West Kelowna Water Utility Master Plan

### Water Distribution Existing System

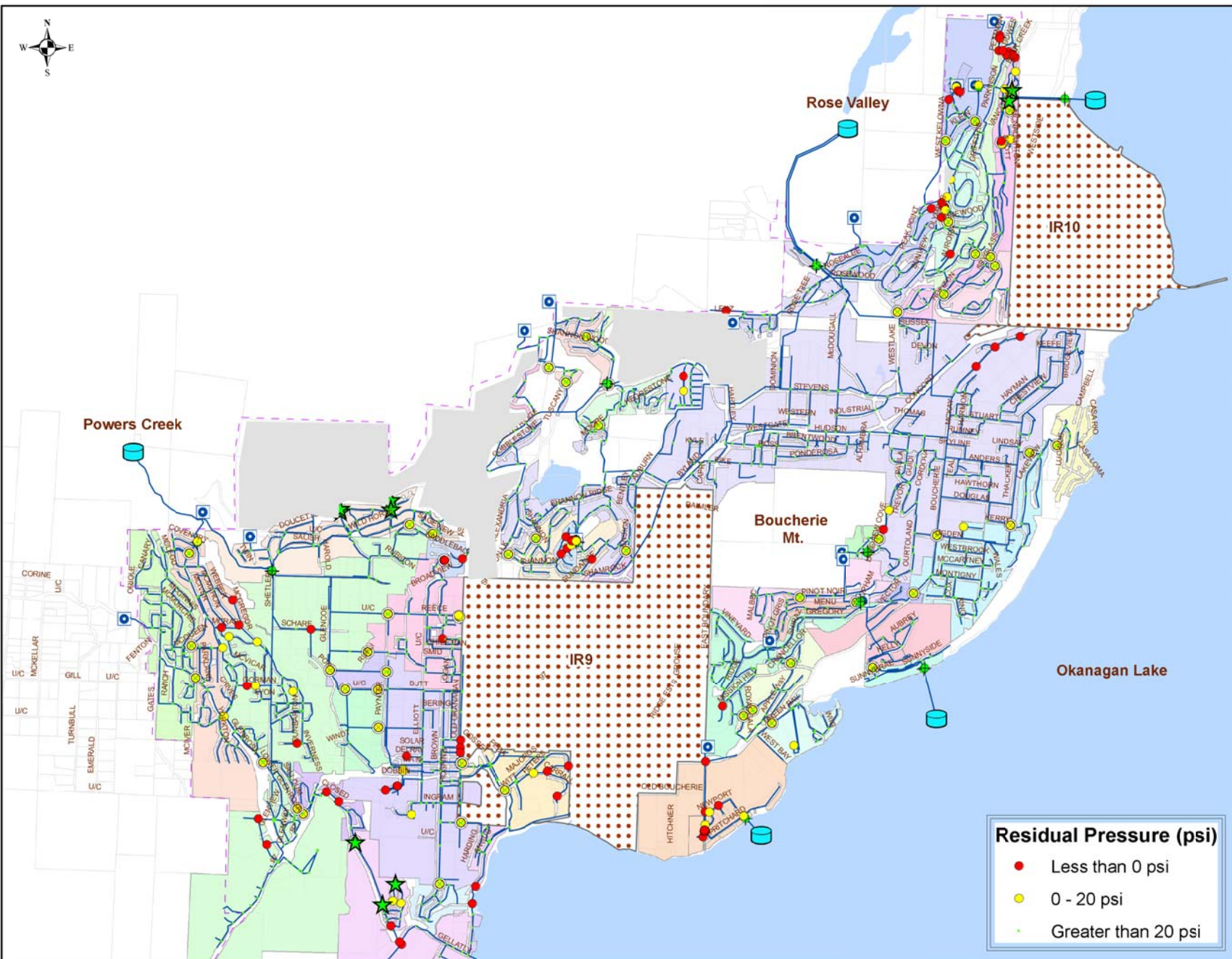
2032 Max Day + Fire  
Residual Pressure Condition

### Legend

- 2032 Growth Location
- Pump Station
- Intake
- Storage Tank
- Pressure Reducing Valve
- Existing Watermain
- Service Boundary
- Un-irrigated Park Space

Figure No:  
Figure 9

Project No: 60216671	Date: September, 2012
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**Residual Pressure (psi)**

- Less than 0 psi
- 0 - 20 psi
- Greater than 20 psi



**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution With  
Proposed Upgrades**

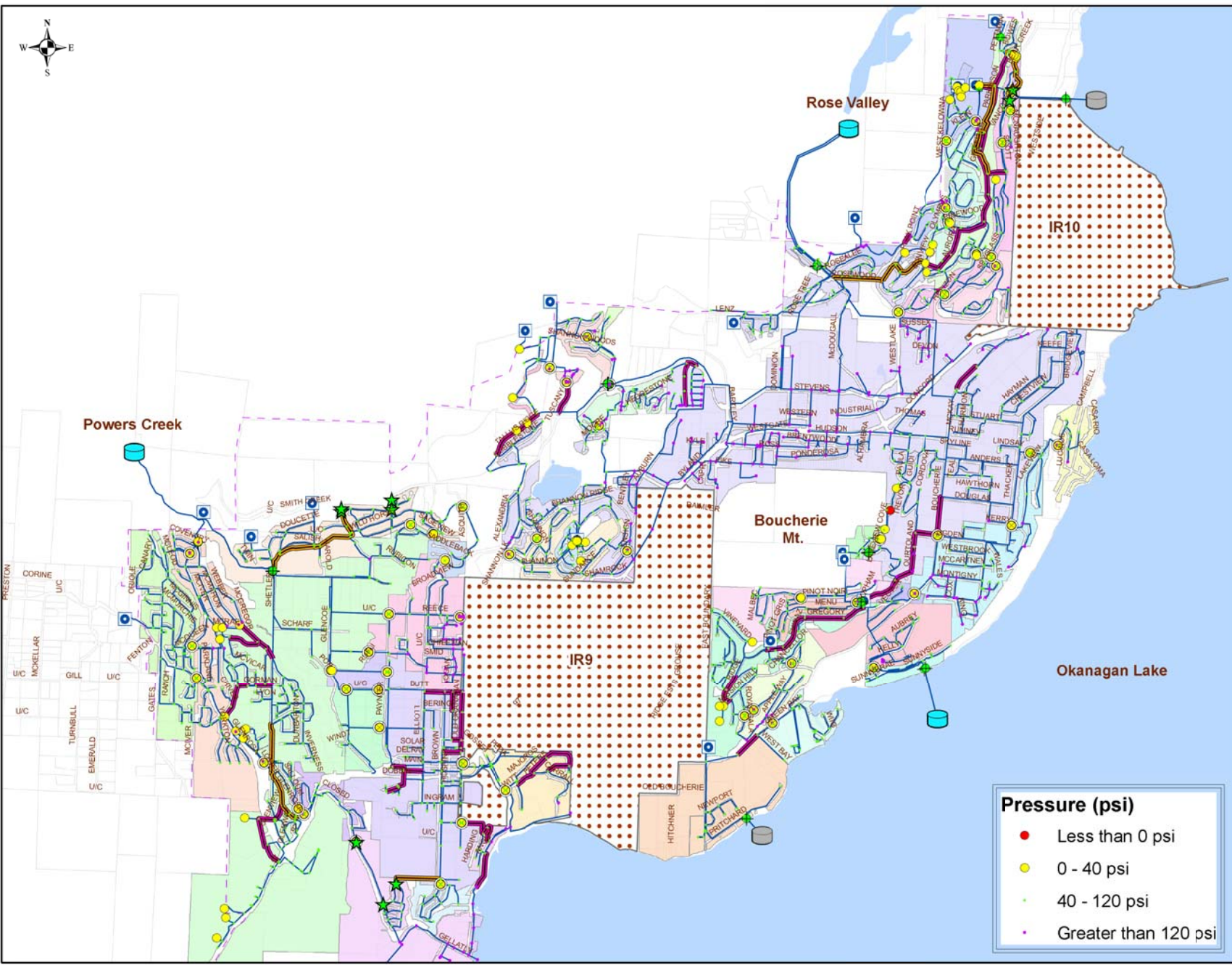
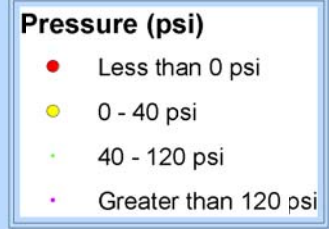
**2032 Peak Hour Demand  
Minimum Pressure Condition**

**Legend**

- ★ 2032 Growth Location
- ⊕ Pump Station
- ⊖ Inactive Intake
- ⊕ Intake
- ⊕ Storage Tank
- ⊕ Pressure Reducing Valve
- Proposed Watermain Upgrade 2032
- Proposed Watermain Upgrade
- Existing Watermain
- - - Service Boundary
- Un-irrigated Park Space

Figure No:  
Figure 10

Project No: 60216671	Date: September, 2012
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**District of West Kelowna  
Water Utility Master Plan**

**Water Distribution With  
Proposed Upgrades**

**2032 Max Day + Fire  
Residual Pressure Condition**

**Legend**

- ★ 2032 Growth Location
- ◆ Pump Station
- Inactive Intake
- Intake
- Storage Tank
- Pressure Reducing Valve
- Proposed Watermain Upgrade 2032
- Proposed Watermain Upgrade
- - - Service Boundary
- Existing Watermain
- Un-irrigated Park Space

Figure No:

Figure 11

Project No:

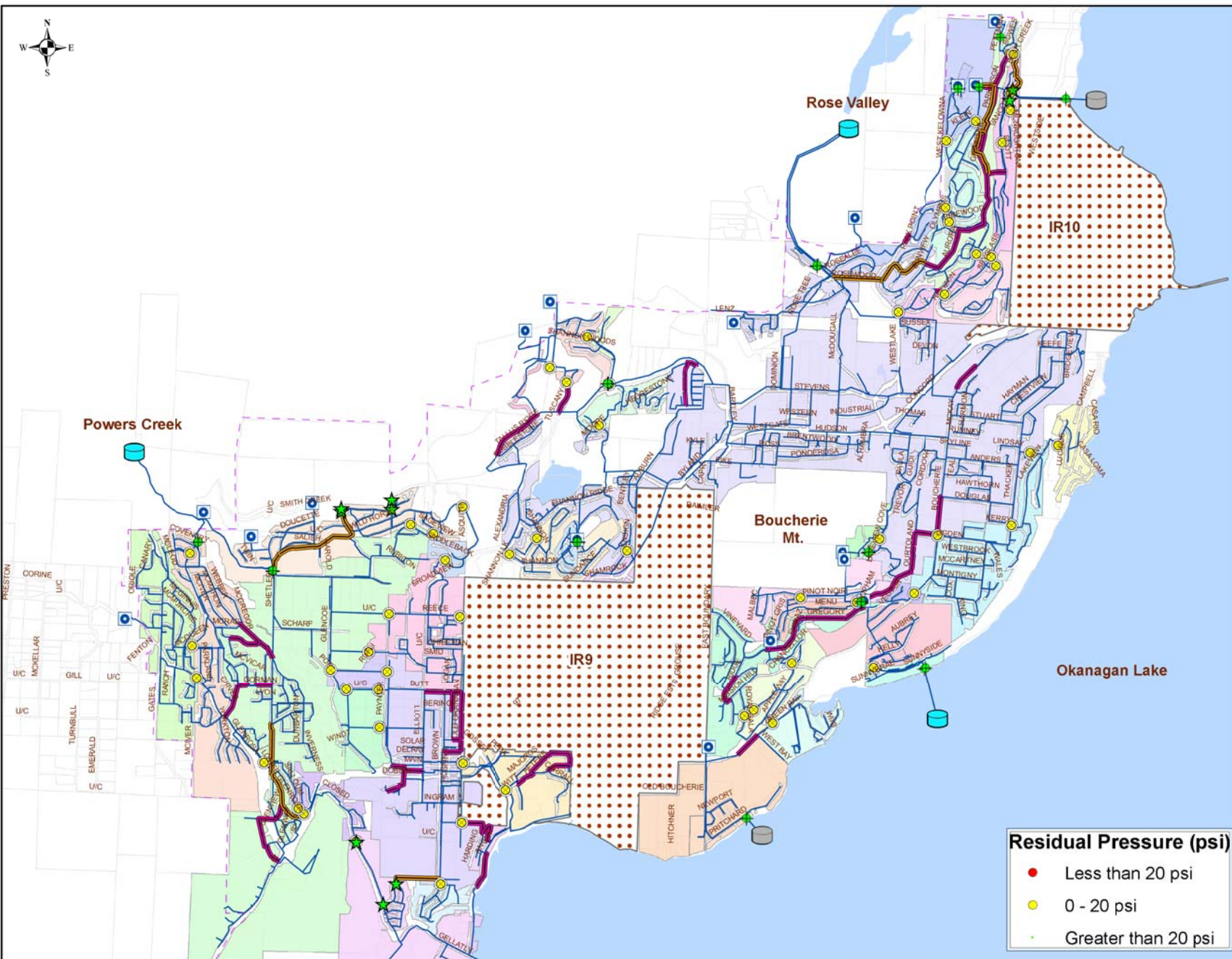
60216671

Date:

September, 2012

**Residual Pressure (psi)**

- Less than 20 psi
- 0 - 20 psi
- Greater than 20 psi



## Appendix G

Water Conservation

# Memorandum

To	Rob Hillis, P. Eng., District of West Kelowna	Page 1
CC		
Subject	Water Utility Master Plan – Background Water Conservation Information	
From	John Van Andel, AECOM	
Date	October 15, 2012	Project Number 60216671

## 1. Water Conservation

### 1.1 *Benefits of Water Conservation*

Water conservation offers many benefits to a water utility, including delaying or avoiding capital expenditure on source expansion, decreasing operating costs, avoiding environmental impacts and obtaining public recognition and participation. In addition, water conservation could present certain “co-benefits”, such as reductions in the energy required to treat and distribute drinking water and to collect and treat wastewater, as well as related reductions in greenhouse gas emissions that result from using less energy. AWWA Manual No. M52 on Water Conservation Programs<sup>1</sup> provides the following benefits of water conservation:

- **Cost savings:** lowering costs of water production, distribution, collection and treatment. Deferring of capital investment. Conservation is often an important part of a least-cost future water supply plan.
- **Environmental benefits:** less water could be removed from the environment for human purposes and more water could be available for e.g., the protection of an endangered species.
- **Competing beneficial uses:** more water could be available for competing beneficial uses such as agriculture, recreation or power generation.
- **Stewardship:** utilities that conserve water demonstrate leadership in resource management.
- **Energy savings:** reducing water production will save energy and reduce greenhouse gas emissions.
- **Customer benefits:** customers that conserve water will have lower water utility bills, and potentially lower wastewater and energy bills.
- **Regulatory compliance:** some state regulatory agencies require water conservation plans and / or progress to qualify for permits, grants and loans.
- **Public perception:** the public often insists on a demonstration of efficient use of existing water supplies before supporting expansion of supplies to meet new water needs.

## **1.2    *The Evolution of Water Conservation***

According to the Pacific Institute<sup>2</sup>, water conservation has evolved since the 1970s firstly through the adoption of technologies and methods that were the least expensive and easiest to implement. These methods focused on preventing waste, and typically included auto-sensors to turn off water when factory production lines were not in use, elimination of single-pass cooling, reuse of non-contact cooling water, and installation of low flow toilets. Most of these measures were fairly low technology and had a short pay-back period.

The 1980s and 1990s saw further equipment improvement such as the introduction of water efficient clothes washers, dishwashers, ultra-low flow toilets and pre-rinse nozzles. A more recent trend has seen the focus shifting to reducing overall fresh water demands by reusing treated wastewater streams through methods such as segregating effluent streams, identifying the characteristics of each waste stream, identifying processes that can potentially use water of a lower quality, and treating effluent streams with chemicals and/or membrane filtration to increase quality for reuse. This trend is expected to continue into the future with water-intensive industries moving towards “closed-loop” systems where all wastewater is re-used internally with only a limited amount of fresh water added to make up for water incorporated into the product or lost in evaporation.

**1.3 Municipal Options for Water Conservation**

AWWA Manual No. M52 on Water Conservation Programs provides municipal options for water conservation as presented in **Figure 1.1**.

**Figure 1.1 - Water Conservation Option**



Depending on local conditions and the objectives of water conservation for a particular utility, a water conservation program may contain some or all of the above conservation options. Each of the basic conservation measures is discussed in detail below.

**1.4 Water Conservation Measures**

**1.4.1 Water Distribution System Improvements – Water Loss and Leak Detection**

The International Water Association (IWA) “Best Practices” standard Water Balance model (**Figure 1.2** below) is widely used to assess Non-Revenue Water and its components, including water losses.

**Figure 1.2 - The IWA Standard Water Balance**

System Input Volume (Corrected for Known Errors)	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (including water exported)	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non- Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
		Real Losses	Leakage on Mains	
			Leakage on Overflows at Storage	
Leakage on Service Connections up to Point of Metering				

Since the recent implementation of universal metering, the DWK can now estimate water losses seen in their distribution system. Based on source production and metering data received from the DWK, water losses can be calculated at approximately 29% of total flows as seen in **Table 1.1** below.

**Table 1.1 - Source and Meter Flow Volumes – 3rd Quarter 2010 to 2nd Quarter 2011**

Total Flows – Sources (ML)	Total Flows – Meters (ML)	Δ (%)
9,488	6,749	2,739 (29%)

Water losses in a typical system are approximately 20-30% of production<sup>3</sup>. Given the apparent high percentage of water loss, it would be beneficial for the DWK to assess the type of losses – apparent or real – and implement programs to reduce these losses. Leakage on water systems can be difficult to identify or detect. Water system pipelines are generally buried and leaks do not generally appear at the ground surface until they become large or are in poorly draining soils. The following are three recommended steps for a targeted leak detection and repair program.

**1.4.1.1 Basic Steps of a Leak Detection and Repair Program**

**1. Quantify Real Losses**

Undertake an International Water Association (IWA) Water Balance or similar process to differentiate between apparent losses and real losses. When the nature and quantity of real losses is known a targeted and effective action plan for water loss reduction can be developed.

## 1. Water Loss Target

All potable water systems have water loss through leakage. It would be very difficult and prohibitively expensive to make a large potable water system “drip tight” as the pipelines are generally buried and hidden from view. Therefore, it is important to set a target for an acceptable level of water loss for the DWK system.

Typically, water loss targets are set by economic criteria. This is referred to as the economic level of leakage. Basically, leak detection and repair costs are compared to the value of water that is saved through these efforts.

## 2. Leak Detection and Repair

Leaks can be detected by the sound an active leak makes using techniques such as Leak Noise Correlation, Noise Loggers and Simple Acoustic methods. These techniques are generally non-intrusive, have a good track record, are locally available and are relatively inexpensive to apply. Each of these methods is briefly discussed below.

**Leak Noise Correlation:** Leak noise correlation works by picking up the noise of a leak at two sensors positioned either side of a suspected leak, and then determining the difference between the arrival times of the noise at each of the sensors. By knowing the distance between the sensors and the velocity of the sound in the pipe, the leak position may be accurately determined. Sensors can be fitted to the main or valves, or to specially adapted hydrant caps fitted to existing hydrants. Limitations of the technique occur due to the distance that the sound of the leak can travel along the pipe wall.

The attenuation of a signal in a metal pipe is relatively small; therefore sound correlation in a metal pipe is theoretically possible over several kilometres. However, the sensors require physical connection to the pipeline or an appurtenance attached to the pipeline. Additionally, ambient noise can be a factor in busy urban areas and it is often recommended that Leak Noise Correlation be performed at night when traffic levels are lowest.

**Noise Loggers:** Noise loggers are acoustic devices that are able to operate under conditions of high ambient background noise. Unlike noise correlators, the noise loggers do not rely on the same noise frequency arriving at two points with a short time delay. Rather, they will monitor noise levels over a period of approximately 2 hours during the period of minimum demand for the constant source of noise generated by a leak. By comparing the sound level and the spread recorded at each logger the user can identify the approximate location of the leak and then focus attention on that area. The noise loggers can be easily fitted to ferrous pipe fittings like valves or hydrants by a magnet.

**Simple Acoustic:** The simple acoustic method relies on the principle that water escaping through a hole or a break in a main creates a variable frequency of “leak noise” which is dependent upon water pressure, the size and nature of the leak, the pipe material and backfill material. Direct sounding on valves, hydrants, stop taps and other pipe fittings relies on transmission of the leak sound through the pipe material, and a simple wooden “listening stick” is commonly used by experienced inspectors to find leaks. When leak noise is detected directly, the leak is most likely to occur near the point of maximum sound and an experienced operator may be able to estimate the extent of the leak and whether it occurs on a main or service pipe. With indirect sounding, the leak noise will follow the acoustic path of least resistance to the surface. Extraneous noise will make both types of sounding difficult, therefore simple acoustic sounding is most effective if carried out at night.

Once leaks have been identified it is critical to repair them as quickly as possible. Having the necessary procedures in place to quickly repair leaks and using methods that ensure leaks do not recur, are vital components of a water loss reduction strategy. The InfraGuide Best Practice on “Speed and Quality of Linear System Repairs” provides a road map for water utility repair and improvement planning. It can be found at the following web-link:

[http://gmf.fcm.ca/files/InfraGuide/Potable Water/Speed quality linear syst repairs.pdf](http://gmf.fcm.ca/files/InfraGuide/Potable%20Water/Speed%20quality%20linear%20syst%20repairs.pdf).

#### 1.4.1.2 Leak Reduction Through Pressure Management

In addition to leak detection and repair, pressure management is increasingly being used as an effective tool to reduce water loss. Pressure management is the regulation of pressure in the water distribution network through the use of modulation controls to automatically change PRV control settings. The two key benefits to pressure management are reducing the leaks and reducing the frequency of new breaks.

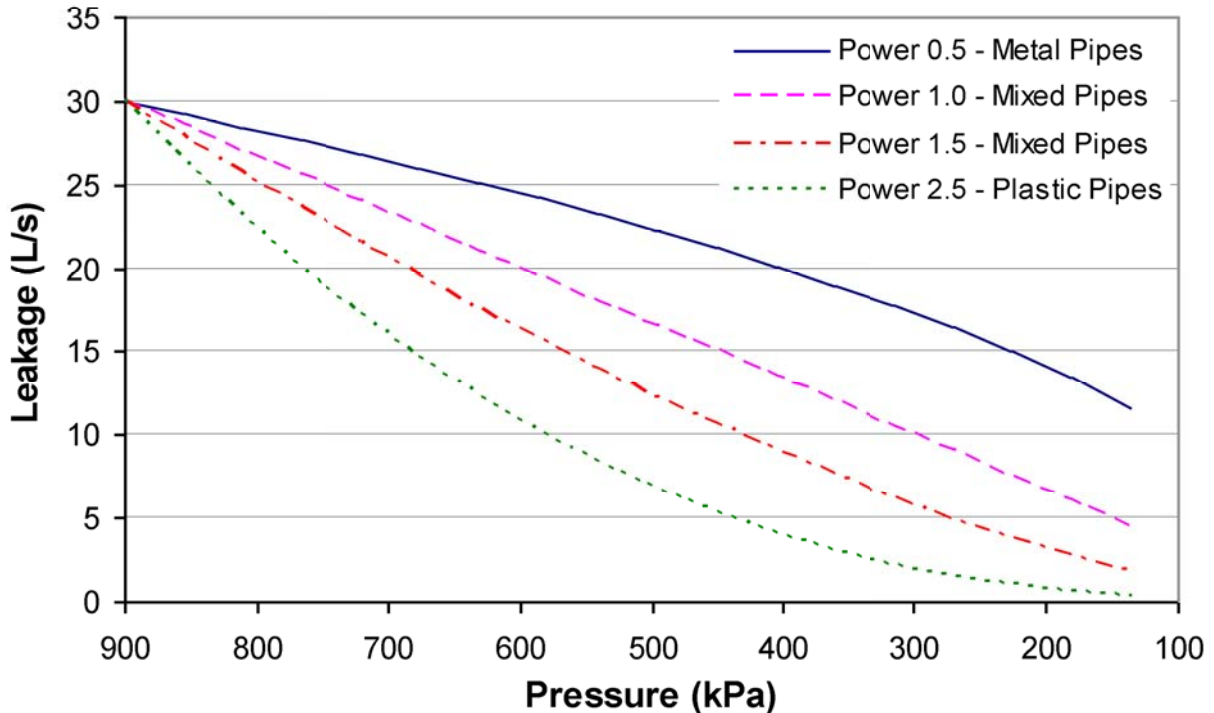


Source: City of Calgary

In addition, pressure management can reduce “normal” consumption through the reduction of pressure supplied to homes. The relationship between pressure and leakage will conform to a square-root relationship in cases where the size of the leakage path (i.e. hole) remains constant during the change in pressure. This is the typical situation when the leak is a small hole in an iron or steel pipe (i.e. a fixed area leak) in which case doubling pressure will result in approximately a 41% increase in leakage. In the case of leaks from plastic pipes or from cracks in asbestos cement pipes, the surface area of the leakage path does not remain constant when the pressure changes and such leaks will often open up to create a larger hole through which the water can leak. Such leaks are referred to as variable area leaks and if the pressure is doubled, the leakage will increase more than from a fixed area leak.

**Figure 1.3** is a graphical representation of the impact of pressure on leakage for systems with significant leakage.

**Figure 1.3 - Leakage Increases as a Function of Pressure**



When planning a pressure management program the following must be considered:

- Compliance with National Fire Protection Agency (NFPA) and Fire Underwriters Survey (FUS) guidelines;
- Level of service; and
- Operational issues, e.g. reservoir fill times.

Expert advice should be sought before undertaking a pressure management program.

**1.4.1.3 Leak Reduction through Infrastructure Renewal**

Renewal of infrastructure is a key consideration for long term leak reduction. Section 3 shows the estimated annual costs of infrastructure replacement within the DWK. It will be important from a leak reduction standpoint to replace these mains before they reach an age where leakage and breaks become a critical issue.

**1.4.1.4 Policy on Pipe Class for New Construction**

The pressure class (PC) rating of pipes is one of the primary factors in occurrences of breaks due to pressure. Currently, the DWK does not have a policy on minimum dimensional ratio (DR) requirements for new watermain installations. In 2007, the AWWA revised their C900 Standard for PVC pipe, reducing the safety factor to 2.0 from 2.5 and eliminating built-in surge allowances in favour of emergency and cyclic surges.

The following **Table 1.2** outlines the changes to the Standard and the corresponding PC ratings:

**Table 1.2 - Changes to AWWA C900 Standard**

Standard	Built-in Surge Allowances	Safety Factor	Resulting Dimensional Ratio & Pressure Class Ratings	
			DR	PC (psi)
AWWA C900-97 (pre-2007)	30-40 psi, based on DR	2.5	25	100
			18	150
			14	200
AWWA C900-07 (post-2007)	Eliminated in favour of emergency and cyclic surges	2.0	25	165
			18	235
			14	305

We recommend that the DWK implement a policy to require a minimum DR rating of 18 for all new watermain installations.

**1.4.2 Consumption-Based Metering and Billing**

Consumption-based metering and billing charges a higher rate to customers who use more water. Many municipalities in BC have recently moved towards consumption-based billing in order to reduce peak demands and promote water conservation.

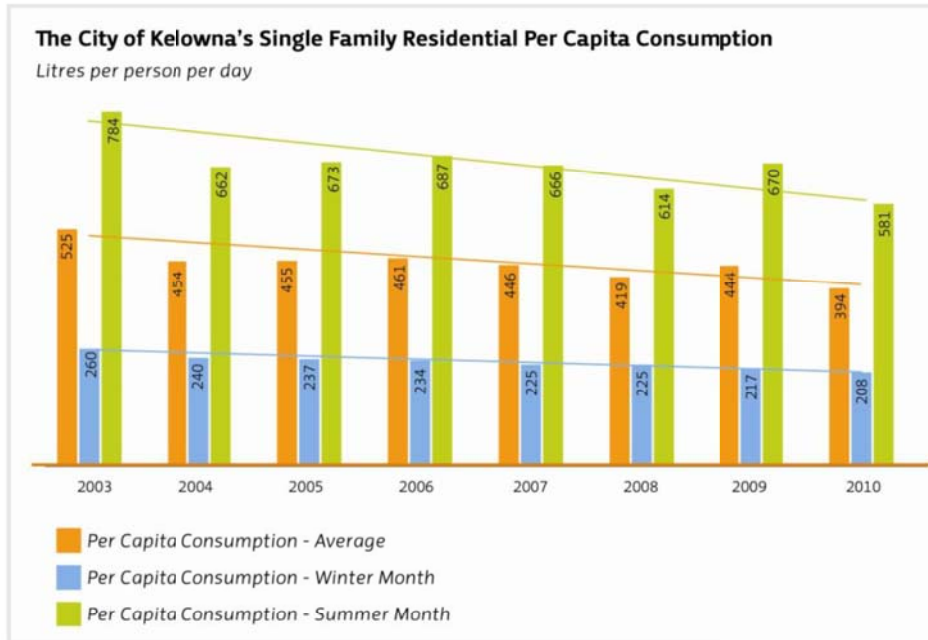
Consumption-based billing was first implemented in the Westbank Service Area after the former Westbank Irrigation District commissioned a water rate study in 2009. This increase was primarily related to supplementing the costs of constructing the 54 ML/d Powers Creek Water Treatment Plant. In 2011, DWK council supported implementation of consumption-based rates for the former Lakeview, West Kelowna Estates and Pritchard Service Areas. The former Sunnyside Service Area implemented revised metered rates at this time.

Implementation of consumption-based billing in the DWK was led by the Westside Joint Water Committee, a group of representatives from the major water utilities on the west side of Okanagan Lake. This group, started in 2006, recognized the need to conserve the limited supply of water and also to cover the operating and maintenance costs of operating a water utility.

**1.4.2.1 Example of Local Consumption-Based Metering and Billing**

The City of Kelowna implemented universal metering in 1996 and a consumption-based (user-pay) water rate in 1998. Since then, City of Kelowna residents have reduced per-capita water use by over 20%. Total water use in Kelowna has increased by just two per cent since 1995, despite a 30% increase in population over the same period.

**Figure 1.4 - City of Kelowna Historical Water Use**



Source: City of Kelowna Website <http://www.kelowna.ca/CM/Page2635.aspx>

**1.4.3 Water Waste Restrictions**

The reduction of water waste was one of the first methods of water conservation as these initiatives were typically the least expensive and easiest to implement. In the 1970s, this included auto-sensors in factories to turn off water when production lines were not in use, elimination of single-pass cooling, reuse of non-contact cooling water and low-flow toilets. These measures were low-technology and had a short pay-back period.

Today, water waste reduction efforts employed in municipalities include:

- Low-flow fixture requirements on new construction
- Irrigation system requirements on new construction
- Sprinkling restrictions

#### **1.4.4 Codes and Standards**

Many provinces, including British Columbia have written-in water efficiency strategies in their building code regulations. In BC, *Living Water Smart* (<http://www.livingwatersmart.ca/message.html>), the province's Water Plan, sets out principles, targets and actions to support water management in BC. Part of this Water Plan includes revisions to the BC Building Code (Fall 2008) which now mandates minimum water efficiency requirements for fixtures.

Some municipalities are also taking the initiative to adopt water efficiency bylaws. For example, the cities of Edmonton and Calgary have passed by-laws mandating water-efficient toilets and low-flow showerheads in all new residential developments. The City of Kelowna currently requires all homes constructed after 1994 to have low flow toilets and requires a Landscape Water Conservation report to be submitted prior to approval on all new residential and commercial irrigation system installations.

#### **1.4.5 Public Education**

While the financial benefit of public information and education programs are hard to quantify, these programs are critical to building the conservation ethic in water customers. Some examples of public education initiatives are outlined below.

- Towel Use Signs for Hotels/Motels: Production of a laminated sign requesting patrons to hang towels on racks for re-use or throw them in the tub to request replacement.
- Information Booths at Community Events: Distribute brochures, fridge magnets, dye tablets for leaking toilets and water-saver kits.
- Water Audit Workshops for Large ICI Water Users: ICI and Agriculture represents 33% of the DWK's water consumption. Within this water use sector there are often a few large users that have a noticeable impact on overall water demand. Reducing their water use or shifting their water use to lower demand periods can have a meaningful impact on the DWK's maximum day demand. Identify the largest water uses and invite them to a free water audit workshop where they can learn how to reduce their water consumption.
- Information to Local Landscaping and Irrigation Companies: Distribute information about water-wise gardening and water restrictions to local landscaping and irrigation companies.
- Schools: Develop programs for schools such as a poster contest, water conservation curriculum guides and videos to promote water conservation to young people.

### **1.5 Existing DWK Water Conservation Strategies**

#### **1.5.1 Consumption-Based Metering and Billing**

As discussed above, since 2011, consumption-based billing has been implemented in all Service Areas. This move was made for five key reasons:

- To ensure operations and maintenance costs are recovered;
- To create fairness and equity among all customers and customer classes;
- To maintain transparent and understandable water rates;
- To reflect the community's environmental stewardship and water conservation objectives;  
and
- To guarantee water revenue stability from year-to-year.

### **1.5.2 Watering Restrictions**

Currently, the DWK limits outdoor water use through sprinkling regulations. Throughout the irrigation season, Stage 1 Sprinkling Regulations are in effect, permitting outdoor sprinkling at non-agricultural properties based on property address and odd/even calendar days. Subsequent sprinkling regulations from Stage 2 – 4 are imposed when deemed necessary, with Stage 4 prohibiting outdoor water use for any purpose. Since the implementation of these regulations, the DWK has seen a reduction in peak flows and overall consumption.

### **1.5.3 Education**

#### **1.5.3.1 Okanagan Basin Water Board – Waterwise Initiative**

The DWK is a partner in the Okanagan Basin Water Board's (OBWB) Waterwise Initiative. This initiative aims primarily to educate residents of the Okanagan Valley about water issues in our region. This includes promoting water conservation and protecting water quality. There are also tips on how to conserve water in the home, yard and business. The Waterwise website is easily accessed through a link on the DWK website.

#### **1.5.3.2 DWK Website**

The DWK website's "Conservation" section provides water conservation tips for residents in the home and yard and also provides details on reading residential water meters.

### **1.6 Recommended Water Conservation Initiatives**

This section describes recommended water conservation measures that the DWK could employ in addition to the measures that they have already undertaken.

#### **Water Loss Management & Leak Reduction**

- Complete an International Water Association (IWA) Water Balance study to identify, and quantify water use and leakage within the DWK water system;
- Identify the acceptable level of leakage in the DWK water system (based on economic level of leakage or water demand management criteria) and move forward with a leak detection program if the acceptable level is being exceeded.
- Repair identified leaks as soon as they are identified; and
- Consider implementation of a pressure management within the DWK as a means to reduce overall leakage volumes.

#### **Residential Water Conservation Initiatives**

- Consider implementation of rebate programs for residents to replace existing low-efficiency fixtures low-flow models.

#### **Industrial, Commercial, Institutional and Agricultural Audits and Workshops**

- Identify the largest IC and Agricultural water users by using metering data.
- Hold a free water audit workshop where these users can learn how to reduce their water consumption.

- Communicate to these customers how much they have historically spent on water, their impact on overall municipal water demand and how they can take steps to reduce their water consumption and reduce total peak demands.

**Water Efficiency Bylaws**

- Consider implementation of bylaws mandating water-efficient fixtures in all new developments including low-flow fixtures

**Customer Education Programs**

- Consider customer education programs at schools, community events, and commercial users (landscape companies, hotels/motels)
1. Maddaus, W. and Maddaus, L. (2006): *Water Conservation Programs - A Planning Manual*, American Water Works Association, February 2006
  2. Gleick et al (2003): *Waste Not, Want Not: The Potential for Urban Water Conservation in California*, Oakland, California
  3. Cheong, L.C. Unaccounted for water and the economics of leak detection. Proceedings of the 18th International Water Supply Congress and Exhibition, 15-31 May 1991, Copenhagen, published in *Water Supply*, 9:3&4:1R1.1, 1991.

## Appendix H

Intake and Pump Station Photos



**Menu Road Reservoir**



**Menu Road Reservoir**



**Menu Road Reservoir**

*2-40 hp pumps; 2-75 hp pumps*



**Menu Road Reservoir**



**Menu Road Reservoir**



**Menu Road Reservoir**



**Menu Road Reservoir**

**Sunnyside Service Area**



**Sunnyside Intake Pump Station**



**Sunnyside Intake Pump Station**  
*2-200 hp pumps; 1-150 hp pump*



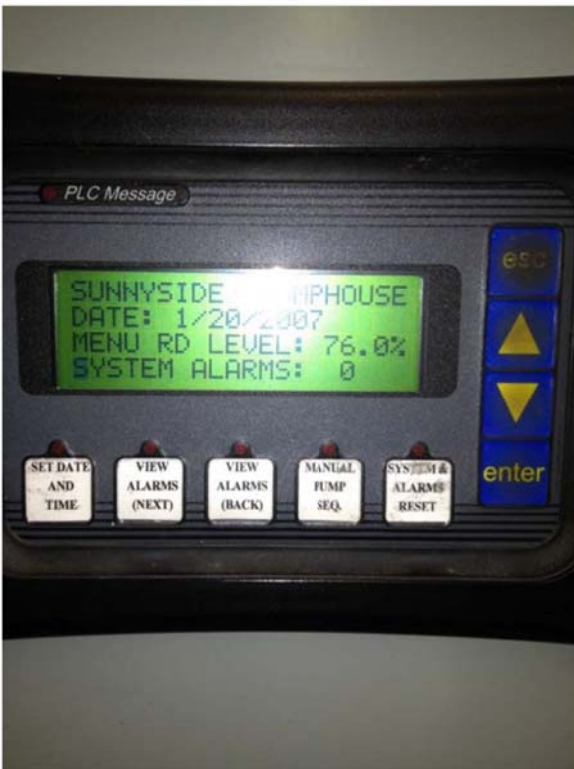
**Sunnyside Intake Pump Station**



**Sunnyside Intake Pump Station**



Sunnyside Intake Pump Station



Sunnyside Intake Pump Station



**Sunnyside Intake Pump Station**



**Sunnyside Intake Pump Station**

**West Kelowna Estates Service Area**



**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**

*2-200 hp pumps*



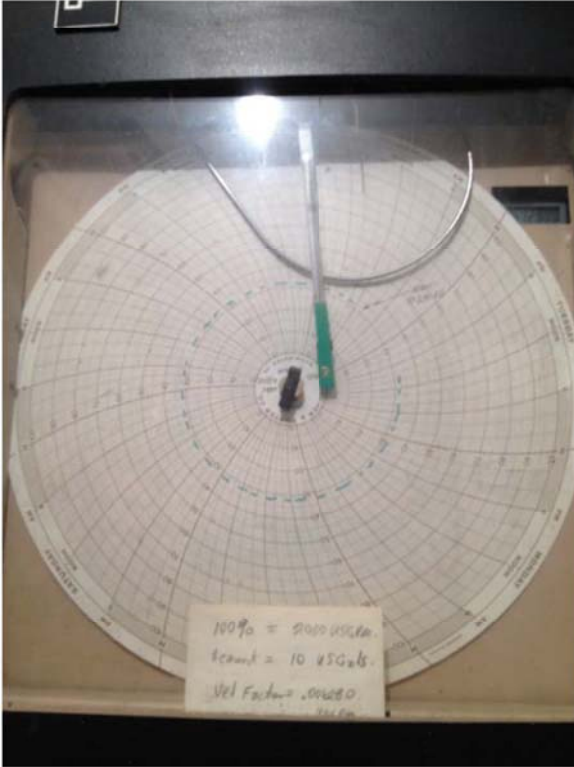
**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**



**West Kelowna Estates Intake Pump Station**



West Kelowna Estates Intake Pump Station



West Kelowna Estates Intake Pump Station



**Blackwoods Reservoir**



**Blackwoods Reservoir**

*2-40 hp pumps*



Blackwoods Reservoir



Blackwoods Reservoir



**McPhail Reservoir**



**McPhail Reservoir**



**McPhail Reservoir**



**McPhail Reservoir**

*2-3 hp pumps; 1-30 hp pump (for fire flows)*

McPhail Reservoir



**Pritchard Service Area**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**



**Pritchard Intake Pump Station**

Appendix I

Capital Projects

5-Year Capital Plan (Water Quality Improvements)

Project Number	Priority	Project Name	Subtotal	Engineering & Contingency	TOTAL (Rounded)
U-5	High	Dam Safety Review	\$315,000	\$126,000	\$450,000
TD-3	High	Pritchard Water Supply Modifications and Decommissioning of Lake Intake	\$2,500	\$1,000	\$3,500
TD-4	High	West Kelowna Estates (WKE) Transmission Main	\$1,758,250	\$703,300	\$2,470,000
D-13	Medium	Water Leak Detection Program	\$45,000	\$18,000	\$70,000
DF-1	High	Abandon West Kelowna Estates Intake	\$15,000	\$6,000	\$21,000
DF-2	High	Blackwoods Reservoir - Telemetry and Inlet Valve Improvements	\$50,000	\$20,000	\$70,000
DF-3	Medium	Sunnyside Intake Pump Control Upgrades	\$35,000	\$14,000	\$50,000
T-2	High	Rose Valley Water Treatment Plant	\$28,960,000	\$11,584,000	\$40,600,000
PZ-1	High	West Kelowna Estates Pressure Zone Adjustments	\$2,080,000	\$832,000	\$2,920,000
PZ-2	High	West Kelowna Estates/Lakeview Pressure Zone Adjustments I	\$74,000	\$29,600	\$110,000
PZ-3	High	West Kelowna Estates/Lakeview Pressure Zone Adjustments II	\$59,000	\$23,600	\$90,000
H-1	High (Fire Flows)	Fire Hydrant Coverage	\$1,305,000	\$522,000	\$1,830,000
ST-1	High	Development of a DCC Bylaw for all of DWK	\$15,000	\$3,000	\$20,000
ST-2	High (2013)	Water Rate Cost of Service Study	\$50,000	\$10,000	\$60,000
ST-3	Medium	Convert Steady State Hydraulic Model to Extended Period Simulation	\$50,000	\$10,000	\$60,000
ST-4	Medium	Water Conservation Program	\$500,000	\$100,000	\$600,000
<b>TOTAL - 5 YEAR CAPITAL PLAN</b>					<b>\$49,424,500</b>

20-Year Capital Plan (Fire Flow Requirements)

Project Number	Priority	Project Name	Subtotal	Engineering & Contingency	TOTAL (Rounded)
U-4	Medium	Lambly Lake Headgates Fuel Storage Improvements	\$100,000	\$40,000	\$140,000
TD-2	High	Sunnyside Transmission Main	\$405,750	\$162,300	\$570,000
D-1	High (Fire Flows)	Weber Road Watermain Upgrades	\$295,625	\$118,250	\$420,000
D-2	High (Fire Flows)	Glenora Industrial Area Watermain Upgrades	\$341,250	\$136,500	\$480,000
D-3	High (Fire Flows)	Old Okanagan/Butt Road Watermain Upgrades	\$606,500	\$242,600	\$850,000
D-4	High (Fire Flows)	Witt and Peters Road Watermain Upgrades	\$236,250	\$94,500	\$340,000
D-5	High (Fire Flows)	Angus Drive and Harding Road Watermain Upgrades	\$305,750	\$122,300	\$430,000
D-6	High (Fire Flows)	McIver and Gorman Road Watermain Upgrades	\$209,625	\$83,850	\$300,000
S-1	High (Fire Flows)	Connect Sunnyside and Pritchard - PZ401	\$1,288,000	\$515,200	\$1,810,000
S-2	High (Fire Flows)	Sunnyside Reservoir Storage Deficiencies - PZ475	\$324,000	\$129,600	\$460,000
S-3	High (Fire Flows)	Sunnyside Reservoir Storage Deficiencies - PZ503	\$1,080,000	\$432,000	\$1,520,000
S-4	High (Fire Flows)	West Kelowna Estates/Lakeview Storage Deficiencies - PZ657	\$135,500	\$54,200	\$190,000
S-5	High (Fire Flows)	West Kelowna Estates/Lakeview Storage Deficiencies - PZ710	\$228,000	\$91,200	\$320,000
S-6	High (Fire Flows)	West Kelowna Estates Storage Deficiencies - PZ626	\$220,000	\$88,000	\$310,000
S-7	High (Fire Flows)	West Kelowna Estates Storage Deficiencies - PZ504	\$468,000	\$187,200	\$660,000
S-8	High (Fire Flows)	Lakeview Storage Deficiencies - PZ539	\$1,140,000	\$456,000	\$1,600,000
S-9	High (Fire Flows)	Lakeview Storage Deficiencies - PZ597	\$4,880,000	\$1,952,000	\$6,840,000
S-10	High (Fire Flows)	Westbank Storage Deficiencies - PZ630	\$1,384,000	\$553,600	\$1,940,000
S-11	High (Fire Flows)	Westbank Storage Deficiencies - PZ673	\$444,000	\$177,600	\$630,000
S-12	High (Fire Flows)	Westbank Storage Deficiencies - PZ583	\$1,300,000	\$520,000	\$1,820,000
S-13	High (Fire Flows)	Westbank Storage Deficiencies - PZ503	\$4,840,000	\$1,936,000	\$6,780,000
<b>TOTAL - 20 YEAR CAPITAL PLAN</b>					<b>\$28,410,000</b>

Growth-Related/DCC Projects

Project Number	Priority	Project Name	Subtotal	Engineering & Contingency	TOTAL (Rounded)
U-1	Low	Upland Storage Site - Lambly Creek Watershed	\$9,741,000	\$3,896,400	\$13,640,000
U-2	Low	Esperon Lake Dam Upgrades	\$35,000	\$14,000	\$50,000
U-3	Low	Big Horn Dam Automated Headgate	\$95,000	\$38,000	\$140,000
TD-1	Low (2032)	Transmission Main from Okanagan Lake to Rose Valley WTP	\$12,040,000	\$4,816,000	\$16,860,000
TD-5	Low (2036)	Transmission Main from Rose Valley WTP to Westbank Service Area	\$7,820,000	\$3,128,000	\$10,950,000
D-7	Low	Tallus Ridge Watermain Upgrades	\$313,125	\$125,250	\$440,000
D-8	Low	Auburn Road Watermain Upgrades	\$152,625	\$61,050	\$220,000
D-9	Low	Boucherie Road Watermain Upgrades	\$88,000	\$35,200	\$130,000
D-10	Low	Ridge Boulevard and Mission Hill Road Watermain Upgrades	\$161,500	\$64,600	\$230,000
D-11	Low	Lakeview Distribution Upgrades	\$502,000	\$200,800	\$710,000
D-12	Low	Sunnyside Distribution Upgrades	\$598,500	\$239,400	\$840,000
T-1	Low (Growth)	Powers Creek Water Treatment Plant Upgrades	\$9,000,000	\$3,600,000	\$12,600,000
T-3	Low (Growth)	Rose Valley Water Treatment Plant Upgrade	\$11,690,000	\$4,676,000	\$16,400,000
<b>TOTAL - GROWTH/DCC PROJECTS</b>					<b>\$73,210,000</b>
R-1	High	Annual Renewal and Replacement Requirements - 25 Year Average	\$1,280,000	\$512,000	\$1,800,000

Capital Improvement Projects - Summary Sheet

Project Number	Priority	Project Name	Subtotal	Engineering & Contingency	TOTAL (Rounded)
U-1	Low	Upland Storage Site - Lambly Creek Watershed	\$9,741,000	\$3,896,400	\$13,640,000
U-2	Low	Esperon Lake Dam Upgrades	\$35,000	\$14,000	\$50,000
U-3	Low	Big Horn Dam Automated Headgate	\$95,000	\$38,000	\$140,000
U-4	Medium	Lambly Lake Headgates Fuel Storage Improvements	\$100,000	\$40,000	\$140,000
U-5	High	Dam Safety Review	\$315,000	\$126,000	\$450,000
TD-1	Low (2032)	Transmission Main from Okanagan Lake to Rose Valley WTP	\$12,040,000	\$4,816,000	\$16,860,000
TD-2	High	Sunnyside Transmission Main	\$405,750	\$162,300	\$570,000
TD-3	High	Pritchard Water Supply Modifications and Decommissioning of Lake Intake	\$2,500	\$1,000	\$3,500
TD-4	High	West Kelowna Estates (WKE) Transmission Main	\$1,758,250	\$703,300	\$2,470,000
TD-5	Low (2038)	Transmission Main from Rose Valley WTP to Westbank Service Area	\$7,820,000	\$3,128,000	\$10,950,000
DF-1	High	Abandon West Kelowna Estates Intake	\$15,000	\$6,000	\$21,000
DF-2	High	Blackwoods Reservoir - Telemetry and Inlet Valve Improvements	\$50,000	\$20,000	\$70,000
DF-3	Medium	Sunnyside Intake Pump Control Upgrades	\$35,000	\$14,000	\$50,000
D-1	High (Fire Flows)	Weber Road Watermain Upgrades	\$295,625	\$118,250	\$420,000
D-2	High (Fire Flows)	Glenora Industrial Area Watermain Upgrades	\$341,250	\$136,500	\$480,000
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D-7	Low	Tallus Ridge Watermain Upgrades	\$313,125	\$125,250	\$440,000
D-8	Low	Auburn Road Watermain Upgrades	\$152,625	\$61,050	\$220,000
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D-10	Low	Ridge Boulevard and Mission Hill Road Watermain Upgrades	\$161,500	\$64,600	\$230,000
D-11	Low	Lakeview Distribution Upgrades	\$502,000	\$200,800	\$710,000
D-12	Low	Sunnyside Distribution Upgrades	\$598,500	\$239,400	\$840,000
D-13	Medium	Water Leak Detection Equipment	\$45,000	\$18,000	\$70,000
T-1	Low (Growth)	Powers Creek Water Treatment Plant Upgrades	\$9,000,000	\$3,600,000	\$12,600,000
T-2	High	Rose Valley Water Treatment Plant	\$28,960,000	\$11,584,000	\$40,600,000
T-3	Low (Growth)	Rose Valley Water Treatment Plant Upgrade	\$11,690,000	\$4,676,000	\$16,400,000
PZ-1	High	West Kelowna Estates Pressure Zone Adjustments	\$2,080,000	\$832,000	\$2,920,000
PZ-2	High	West Kelowna Estates/Lakeview Pressure Zone Adjustments I	\$74,000	\$29,600	\$110,000
PZ-3	High	West Kelowna Estates/Lakeview Pressure Zone Adjustments II	\$59,000	\$23,600	\$90,000
S-1	High (Fire Flows)	Connect Sunnyside and Pritchard - PZ401	\$1,288,000	\$515,200	\$1,810,000
S-2	High (Fire Flows)	Sunnyside Reservoir Storage Deficiencies - PZ475	\$324,000	\$129,600	\$460,000
S-3	High (Fire Flows)	Sunnyside Reservoir Storage Deficiencies - PZ503	\$1,080,000	\$432,000	\$1,520,000
S-4	High (Fire Flows)	West Kelowna Estates/Lakeview Storage Deficiencies - PZ657	\$135,500	\$54,200	\$190,000
S-5	High (Fire Flows)	West Kelowna Estates/Lakeview Storage Deficiencies - PZ710	\$228,000	\$91,200	\$320,000
S-6	High (Fire Flows)	West Kelowna Estates Storage Deficiencies - PZ626	\$220,000	\$88,000	\$310,000
S-7	High (Fire Flows)	West Kelowna Estates Storage Deficiencies - PZ504	\$468,000	\$187,200	\$660,000
S-8	High (Fire Flows)	Lakeview Storage Deficiencies - PZ539	\$1,140,000	\$456,000	\$1,600,000
S-9	High (Fire Flows)	Lakeview Storage Deficiencies - PZ597	\$4,880,000	\$1,952,000	\$6,840,000
S-10	High (Fire Flows)	Westbank Storage Deficiencies - PZ630	\$1,384,000	\$553,600	\$1,940,000
S-11	High (Fire Flows)	Westbank Storage Deficiencies - PZ673	\$444,000	\$177,600	\$630,000
S-12	High (Fire Flows)	Westbank Storage Deficiencies - PZ583	\$1,300,000	\$520,000	\$1,820,000
S-13	High (Fire Flows)	Westbank Storage Deficiencies - PZ503	\$4,840,000	\$1,936,000	\$6,780,000
H-1	High (Fire Flows)	Fire Hydrant Coverage	\$1,305,000	\$522,000	\$1,830,000
ST-1	High	Development of a DCC Bylaw for all of DWK	\$15,000	\$3,000	\$20,000
ST-2	High (2013)	Water Rate Cost of Service Study	\$50,000	\$10,000	\$60,000
ST-3	Medium	Convert Steady State Hydraulic Model to Extended Period Simulation	\$50,000	\$10,000	\$60,000
ST-4	Medium	Water Conservation Program	\$500,000	\$50,000	\$550,000
<b>TOTAL CAPITAL PROJECTS</b>					<b>\$150,994,500</b>
R-1	High	Annual Renewal and Replacement Requirements - 25 Year Average	\$1,280,000	\$512,000	\$1,800,000

Project Categories

Total Capital Cost by Category

U	Upland	\$13,970,000
TD	Transmission	\$30,853,500
DF	Distribution Facility	\$141,000
D	Distribution	\$5,390,000
T	Treatment	\$69,600,000
PZ	Pressure Zone	\$3,120,000
S	Storage	\$24,880,000
H	Hydrants	\$1,830,000
ST	Studies	\$690,000
R	Renewal*	\$1,800,000

\*Renewal costs shown are the estimated annual renewal requirements (based on a 25-Year average)



Revision 1  
Date Revised 14-Jun-12

**PROJECT NO. U-1**

**Upland Storage Site - Lambly Creek Watershed**  
**Additional Raw Water Storage in the Lambly Watershed**

Priority/Timing: Low



**Project Description**

- Construct an earth dam upstream of the Rose Valley Diversion Pipeline to provide additional 4,500 ML of raw water to the Rose Valley Reservoir

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Basin Clearing	228,000	m <sup>2</sup>	\$ 1	\$ 228,000
Stripping	29,000	m <sup>2</sup>	\$ 7	\$ 203,000
Fill	750,000	m <sup>3</sup>	\$ 12	\$ 9,000,000
Misc. Concrete	1	LS	\$ 100,000	\$ 100,000
Outlet Pipe	300	ea	\$ 700	\$ 210,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 9,741,000</b>
Engineering	15%			\$ 1,461,150
Construction Contingency	25%			\$ 2,435,250
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 13,640,000</b>



PROJECT NO. U-2

# Esperon Lake Dam Upgrades

New Headwall & Gate

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: Low



## Project Description

The existing Esperon Lake Dam headwall and gate is in poor condition. Upgrade to provide easier operation and improved functionality.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Install new headwall	1	ea	\$ 15,000	\$ 15,000
Install new manual gate	1	ea	\$ 20,000	\$ 20,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 35,000</b>
Engineering	15%			\$ 5,250
Construction Contingency	25%			\$ 8,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 50,000</b>



PROJECT NO. U-3

### Big Horn Dam Automated Headgate

Install automated headgate in place of existing manual headgate

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: Low



#### Project Description

- Retrofit existing manual headgate to automatic to improve operating efficiency.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Automated headgate	1	ea	\$ 70,000	\$ 70,000
SCADA Upgrades	1	ea	\$ 25,000	\$ 25,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 95,000</b>
Engineering	15%			\$ 14,250
Construction Contingency	25%			\$ 23,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 140,000</b>



PROJECT NO. U-4

# Lambly Lake Headgates Fuel Storage Improvements

Revision 2  
Date Revised 15-Oct-12

Priority/Timing: Medium



### Project Description

The existing power source for the Lambly Lake headgates (Powers Creek Watershed) is a combination of propane, wind and solar. Installing an adequately sized propane tank, stored in a lockable shed will reduce operational time and improve facility reliability.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Propane tank and lockable shed	1	LS	\$ 100,000	\$ 100,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 100,000</b>
Engineering	15%			\$ 15,000
Construction Contingency	25%			\$ 25,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 140,000</b>

Priority/Timing: High

**Project Description**

Dam safety regulations have changed in 2011. Under the new regulations the District has 13 dams that require Dam Safety Reviews.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Kerr Wood Leidel Dam Review	1	LS	\$ 315,000	\$ 315,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 315,000</b>
Engineering	15%			\$ 47,250
Construction Contingency	25%			\$ 78,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 450,000</b>

## PROJECT NO. TD-1

### Transmission Main from Okanagan Lake to Rose Valley WTP

Priority/Timing: Low (2032)



#### Project Description

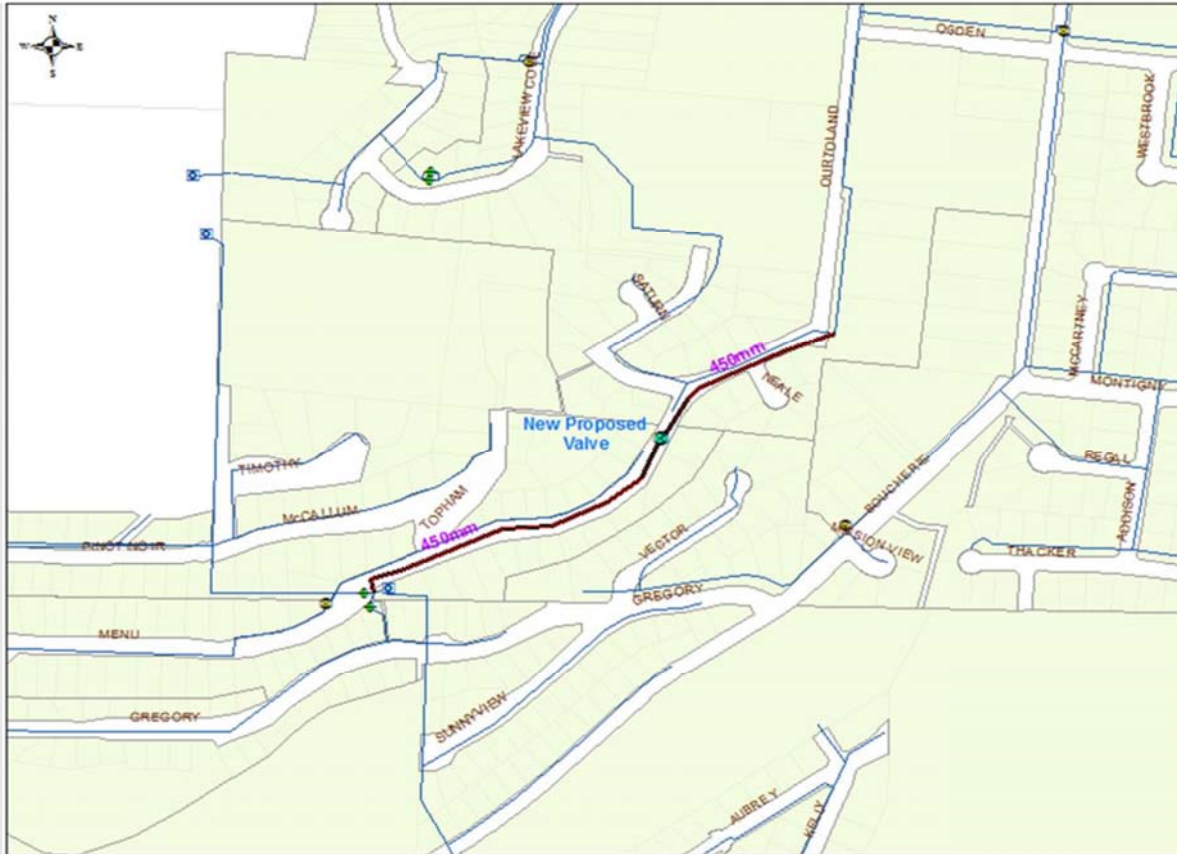
- Construct a 600 mm transmission main from Okanagan Lake to Rose Valley WTP to supplement Lambly Watershed
- In a 50-year drought, the transmission main will convey an additional 13,000 ML/year to the Rose Valley Treatment Plant

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
600 mm dia. Watermain	8,800	m	\$ 850	\$ 7,480,000
Lake Pump Station	1	LS	\$ 4,560,000	\$ 4,560,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 12,040,000</b>
Engineering	15%			\$ 1,806,000
Construction Contingency	25%			\$ 3,010,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 16,860,000</b>



**PROJECT NO. TD-2**  
**Sunnyside Transmission Main**  
**Transmission main to service Sunnyside from Rose Valley Reservoir**

Priority/Timing: High



**Project Description**

This project will allow the existing Sunnyside Lake Intake to be decommissioned and the Sunnyside Service Area to be fed by gravity from the Rose Valley Reservoir. A PRV (HGL=474.79) is also required.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Decommission Existing SS Lake Intake	1	LS	\$ 2,500	\$ 2,500
450mm Transmission Main	665	lm	\$ 450	\$ 299,250
PRV	1	ea	\$ 80,000	\$ 80,000
Connections	2	ea	\$ 12,000	\$ 24,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 405,750</b>
Engineering	15%			\$ 60,863
Construction Contingency	25%			\$ 101,438
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 570,000</b>

**Pritchard Water Supply Modifications and Decommissioning of Lake Intake**  
Transmission main to service Sunnyside and Pritchard from Rose Valley Reservoir

Priority/Timing: High



**Project Description**

This project will allow the existing Pritchard Lake Intake to be decommissioned and the Pritchard Service Area to be fed by gravity from the Rose Valley Reservoir via the Sunnyside Transmission Main (Project TD-2). The existing automated valve that connects the two systems should be opened.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Decommission Existing Pritchard Lake Intake	1	LS	\$ 2,500	\$ 2,500
Open valve that connects SS and PRI	1	LS		\$ -
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 2,500</b>
Engineering	15%			\$ 375
Construction Contingency	25%			\$ 625
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 3,500</b>



**West Kelowna Estates (WKE) Transmission Main (Alternative)**  
Transmission main to service WKE from Rose Valley Reservoir

Priority/Timing: High

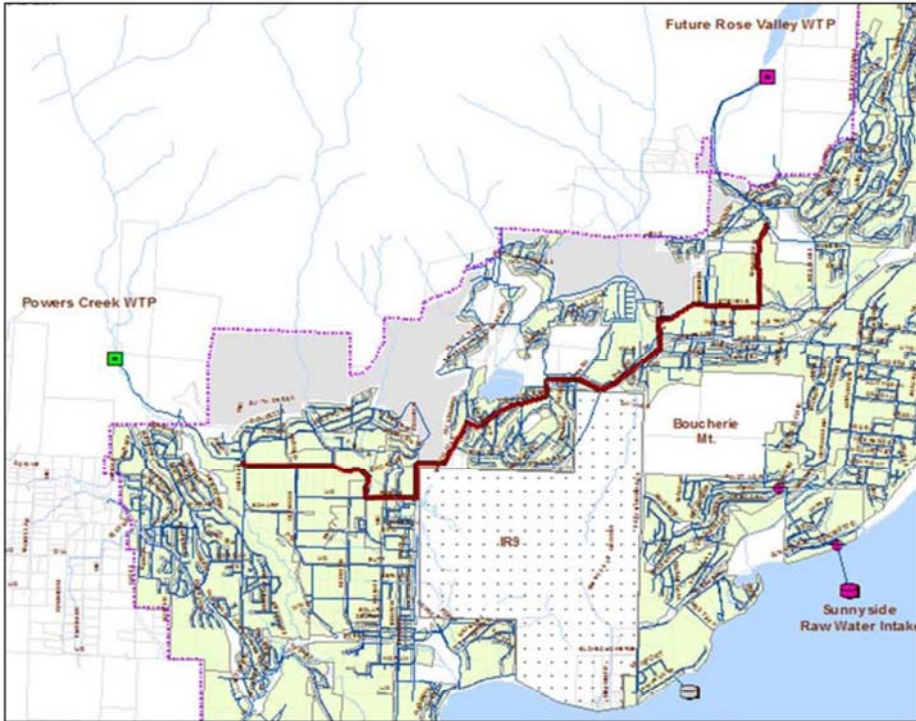
**Project Description**

This project will allow the existing WKE Intake to be decommissioned and the WKE Service Area to be fed by gravity from the Rose Valley Reservoir. Two PRVs (HGL = 582.73m - to Blackwoods Tank and 535.2m - to create new PZ boundary) are also required.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
200mm Transmission Main	1550	lm	\$ 375	\$ 581,250
300mm Transmission Main	2550	lm	\$ 425	\$ 1,083,750
36 Kilowatt Pump	1	ea	\$ 100,000	\$ 100,000
Connections	10	ea	\$ 12,000	\$ 120,000
PRV	2	ea	\$ 80,000	\$ 160,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 2,045,000</b>
Engineering	15%			\$ 306,750
Construction Contingency	25%			\$ 511,250
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 2,870,000</b>

Transmission Main from Rose Valley WTP to Westbank Service Area

Priority/Timing: Low (2038)



**Project Description**

- Construct a 600mm dia. transmission main from Rose Valley Water Treatment Plant to supplement Powers Creek supply to the Westbank Service Area

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
600 mm dia. Watermain	9,200	m	\$ 850	\$ 7,820,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 7,820,000</b>
Engineering	15%			\$ 1,173,000
Construction Contingency	25%			\$ 1,955,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 10,950,000</b>



PROJECT NO. DF-1

### Abandon West Kelowna Estates Intake

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High



#### Project Description

The existing WKE lake intake facility is in generally poor condition and at the end of its life cycle. In addition, the building is located on a leased easement within the Westbank First Nations' IR 10, which is set to expire in the next few years.

The reconfiguration of the system, with the WKE Service Area ultimately being serviced by the Rose Valley Reservoir, will allow this facility to be removed from the system.

The existing water licenses associated with this intake should be retained by the DWK.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Demolish existing facility	1	LS	\$ 15,000	\$ 15,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 15,000</b>
Engineering	15%			\$ 2,250
Construction Contingency	25%			\$ 3,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 21,000</b>



PROJECT NO. DF-2

### Blackwoods Reservoir - Telemetry and Inlet Valve Improvements

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High



#### Project Description

The existing Blackwoods Reservoir level controls are in poor condition and unreliable.

This project includes upgrading the radio telemetry at Blackwoods Reservoir. Telemetry upgrades are not required from the WKE Intake as this facility will be decommissioned and demolished as part of the ultimate servicing plan. Telemetry will be required to link to the Rose Valley Reservoir.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Upgrade radio telemetry	1	LS	\$ 50,000	\$ 50,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 50,000</b>
Engineering	15%			\$ 7,500
Construction Contingency	25%			\$ 12,500
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 70,000</b>



PROJECT NO. DF-3

# Sunnyside Intake Pump Control Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: Medium



### Project Description

The existing pumps at the Sunnyside Lake Intake pump station do not include pump controls, which, in addition to the lack of storage at the Menu Road Reservoir, causes the pumps to cycle. This project includes installation of a VFD on the existing 150hp pump which will allow the pump output to vary and reduce pump cycling.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Add VFD to 150hp pump	1	LS	\$ 35,000	\$ 35,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 35,000</b>
Engineering	15%			\$ 5,250
Construction Contingency	25%			\$ 8,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 50,000</b>



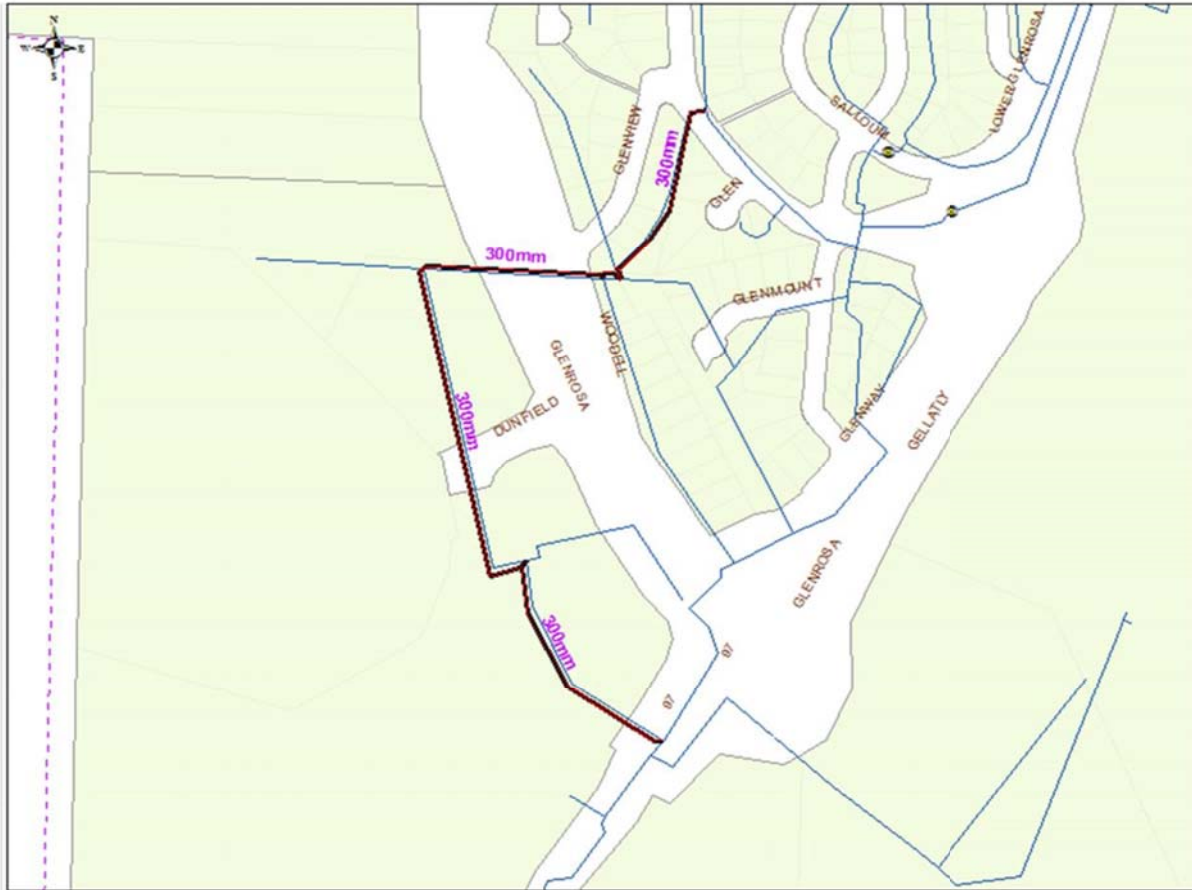


PROJECT NO. D-2

Glenrosa Industrial Area Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)



**Project Description**

The existing 150mm and 200mm dia. mains in the Glenrosa industrial area do not provide adequate flow for the MDD+Fire Flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
300mm dia. Watermain	910	LS	\$ 375	\$ 341,250
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 341,250</b>
Engineering	15%			\$ 51,188
Construction Contingency	25%			\$ 85,313
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 480,000</b>

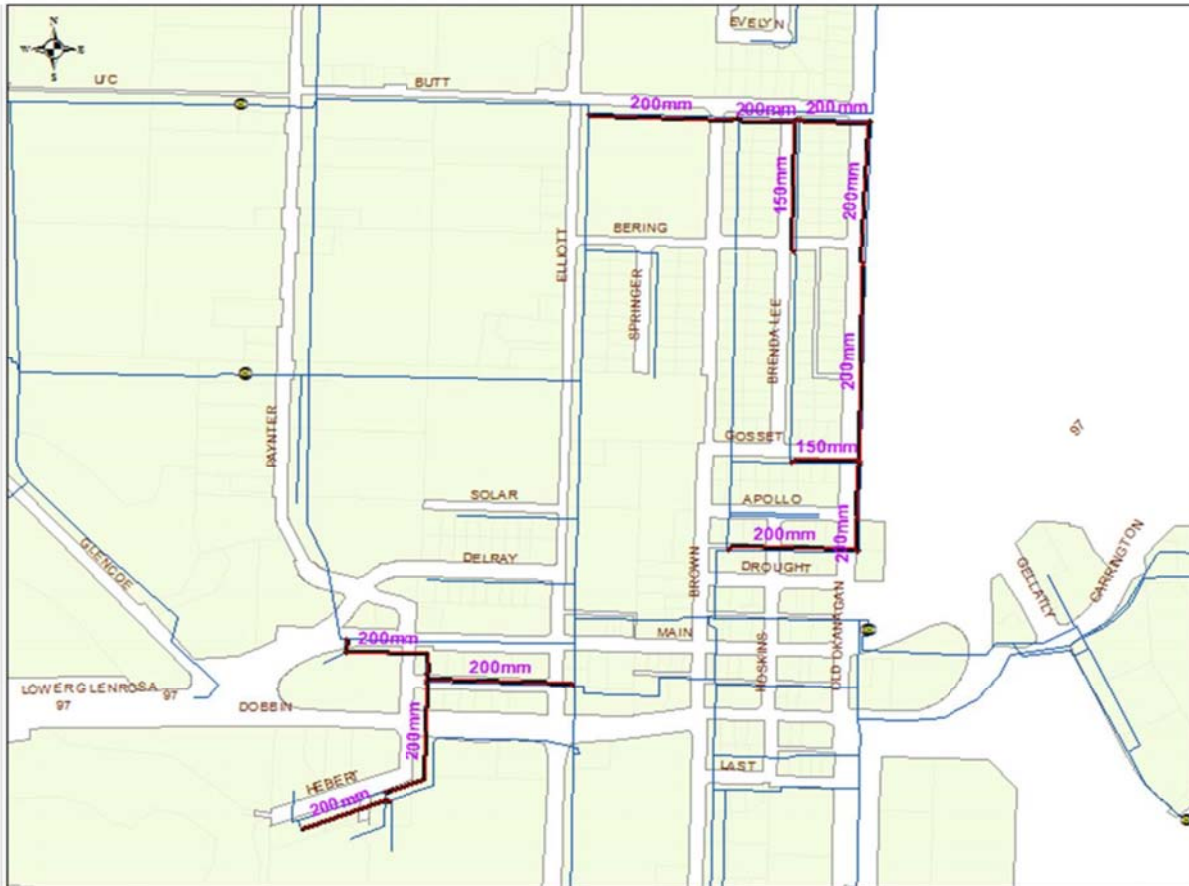


PROJECT NO. D-3

Old Okanagan/Butt Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)



**Project Description**

The existing 100mm and 150mm dia. mains in the Old Okanagan/Butt Road area do not provide adequate flow for the MDD+Fire Flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
150mm dia. Watermain	300	LS	\$ 225	\$ 67,500
200mm dia. Watermain	1,960	LS	\$ 275	\$ 539,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 606,500</b>
Engineering	15%			\$ 90,975
Construction Contingency	25%			\$ 151,625
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 850,000</b>

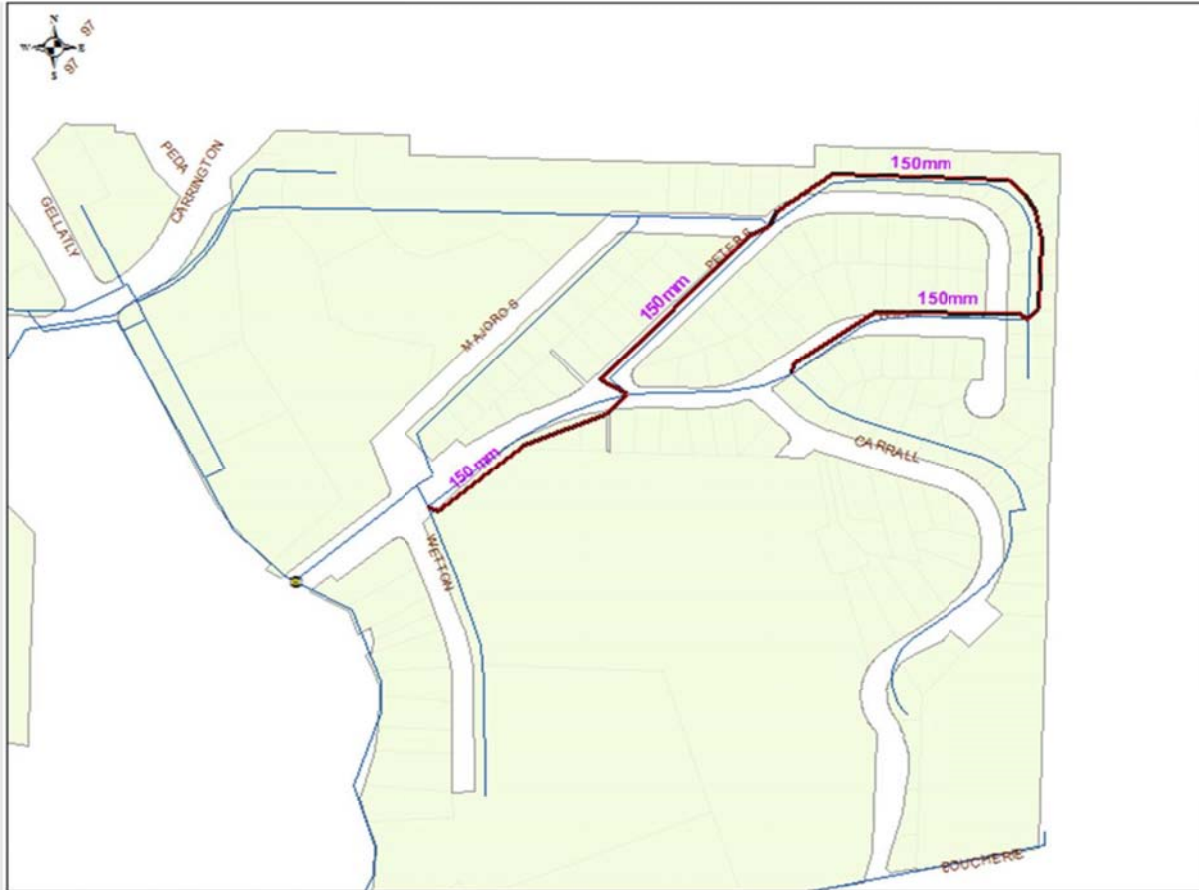


PROJECT NO. D-4

Witt and Peters Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)



**Project Description**

The existing 100mm dia. mains in the Witt/Peters Road area do not provide adequate flow for the MDD+Fire Flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
150mm dia. Watermain	1,050	LS	\$ 225	\$ 236,250
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 236,250</b>
Engineering	15%			\$ 35,437.50
Construction Contingency	25%			\$ 59,062.50
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 340,000</b>

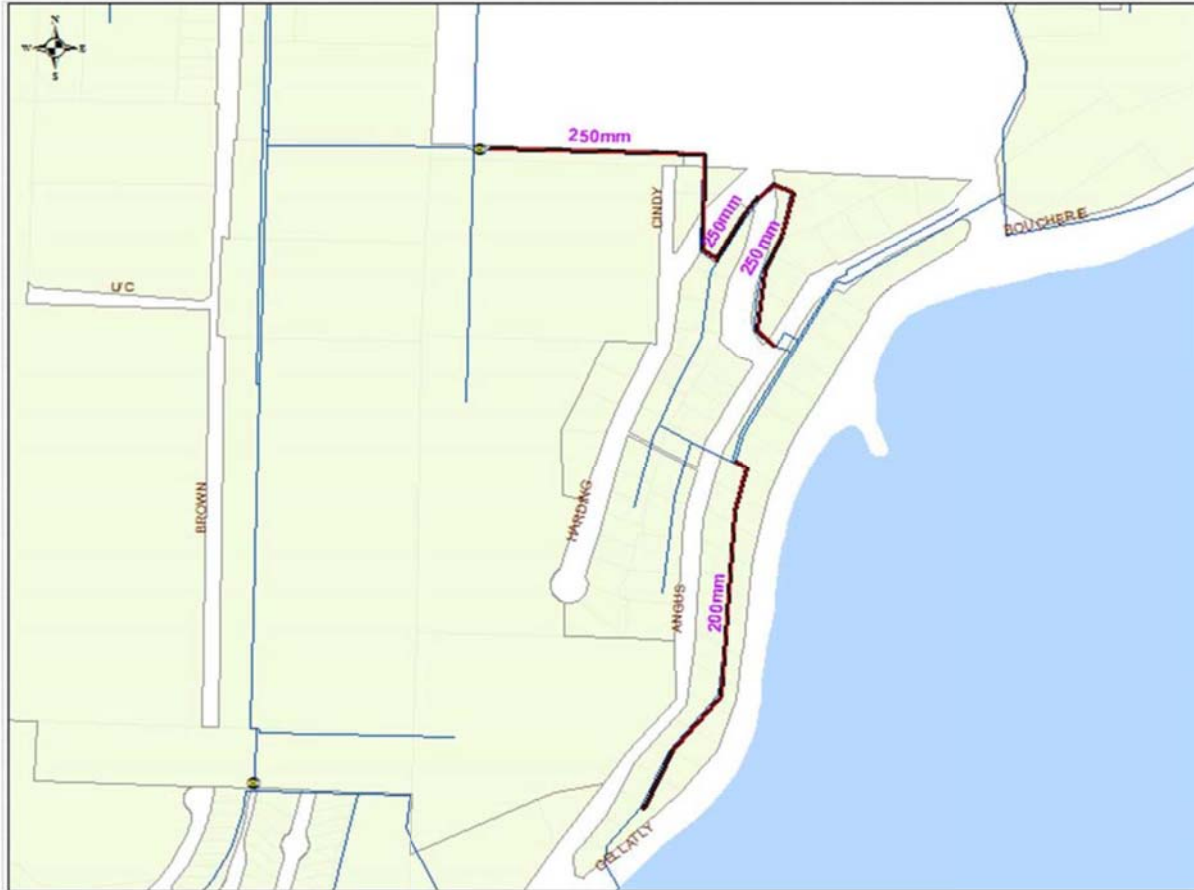


PROJECT NO. D-5

Angus Drive and Harding Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)



**Project Description**

The existing 150mm and 200mm dia. mains in the Angus Drive and Harding Road area do not provide adequate flow for the MDD+Fire Flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
200mm dia. Watermain	385	LS	\$ 275	\$ 105,875
250mm dia. Watermain	615	LS	\$ 325	\$ 199,875
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 305,750</b>
Engineering	15%			\$ 45,862.50
Construction Contingency	25%			\$ 76,437.50
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 430,000</b>

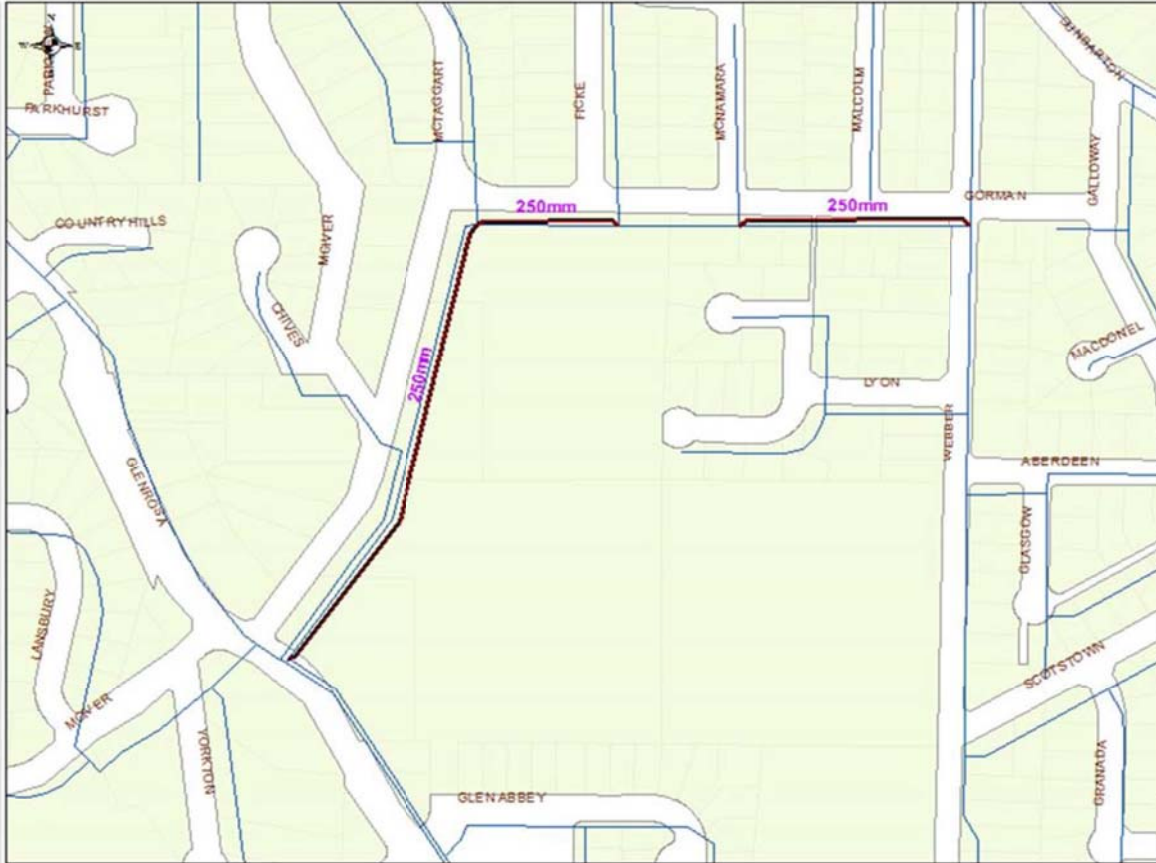


PROJECT NO. D-6

### Mclver and Gorman Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)



#### Project Description

The existing 150mm and 200mm dia. mains in the Mclver and Gorman Road area do not provide adequate flow for the MDD+Fire Flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
250mm dia. Watermain	645	LS	\$ 325	\$ 209,625
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 209,625</b>
Engineering	15%			\$ 31,443.75
Construction Contingency	25%			\$ 52,406.25
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 300,000</b>

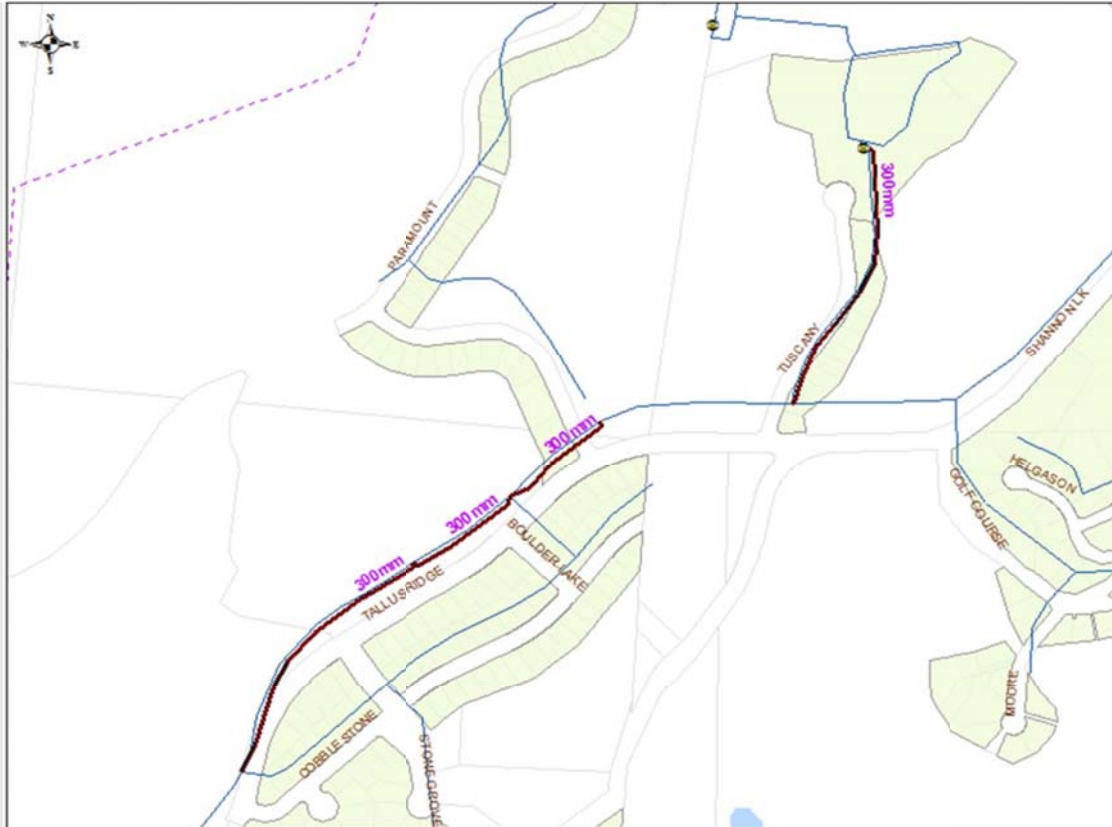


PROJECT NO. D-7

# Tallus Ridge Watermain Upgrades

Revision 2  
Date Revised 15-Oct-12

Priority/Timing: Low



### Project Description

The existing 200mm dia. mains in the Tallus Ridge area do not provide adequate flow for the PHD flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
300mm dia. Watermain	835	LS	\$ 375	\$ 313,125
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 313,125</b>
Engineering	15%			\$ 46,968.75
Construction Contingency	25%			\$ 78,281.25
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 440,000</b>



PROJECT NO. D-8

### Auburn Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: Low



#### Project Description

The existing 150mm dia. mains in the Auburn Road area do not provide adequate flow for the PHD flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
200mm dia. Watermain	555	LS	\$ 275	\$ 152,625
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 152,625</b>
Engineering	15%			\$ 22,893.75
Construction Contingency	25%			\$ 38,156.25
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 220,000</b>



PROJECT NO. D-9

# Boucherie Road Watermain Upgrades

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: Low



### Project Description

The existing 100mm dia. mains in the Boucherie Road area do not provide adequate flow for the PHD flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
200mm dia. Watermain	320	LS	\$ 275	\$ 88,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 88,000</b>
Engineering	15%			\$ 13,200
Construction Contingency	25%			\$ 22,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 130,000</b>



PROJECT NO. D-10

### Ridge Boulevard and Mission Hill Road Watermain Upgrades

Revision 2  
Date Revised 15-Oct-12

Priority/Timing: Low

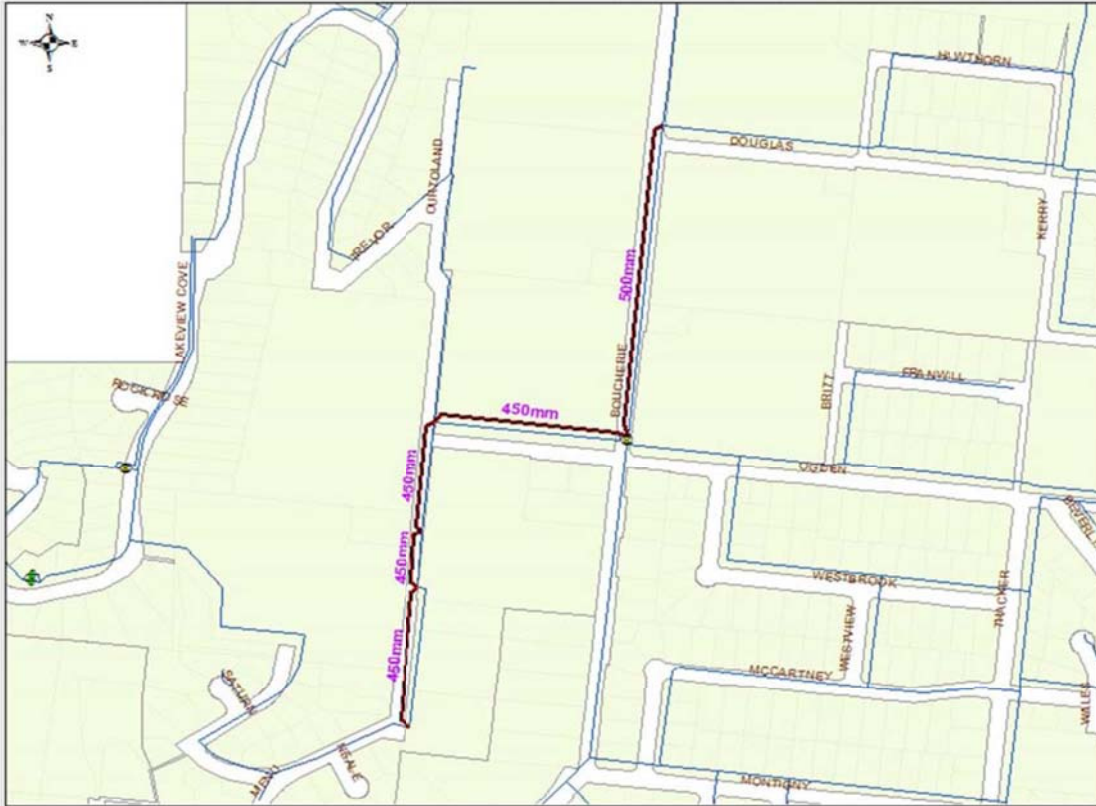


#### Project Description

The existing 250mm dia. mains in the Ridge Blvd and Mission Hill Road area do not provide adequate flow for the PHD flow scenario.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
350mm dia. Watermain	380	LS	\$ 425	\$ 161,500
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 161,500</b>
Engineering	15%			\$ 24,225
Construction Contingency	25%			\$ 40,375
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 230,000</b>

Priority/Timing: Low



**Project Description**

Once Sunnyside and Pritchard are serviced via the Rose Valley Reservoir, portions of the Lakeview distribution system require upgrading to convey adequate flows to Sunnyside and Pritchard.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
450mm dia. Watermain	660	LS	\$ 450	\$ 297,000
500mm dia. Watermain	410	LS	\$ 500	\$ 205,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 502,000</b>
Engineering	15%			\$ 75,300
Construction Contingency	25%			\$ 125,500
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 710,000</b>

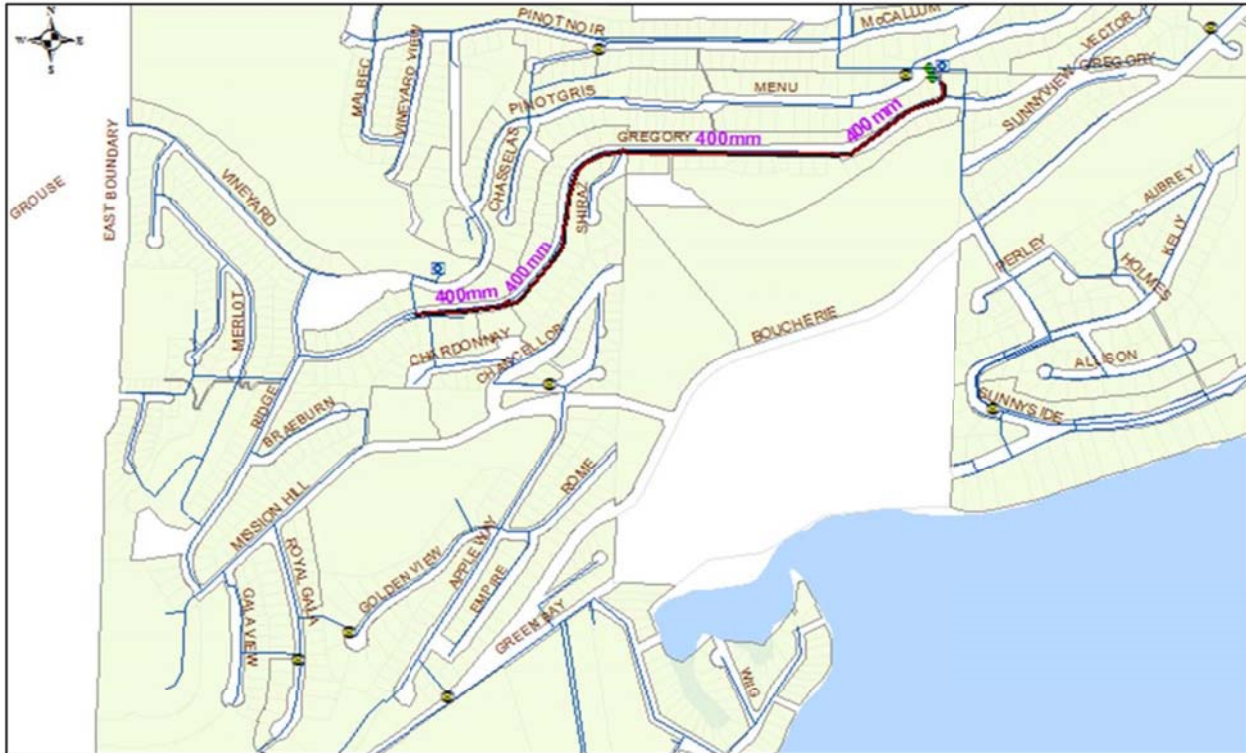


PROJECT NO. D-12

Sunnyside Distribution Upgrades

Revision 1  
Date Revised 15-Oct-12

Priority/Timing: Low



**Project Description**

Once Pritchard service area is supplied by Rose Valley Reservoir through Sunnyside, increased flow rates would be required to be supplied to Mission Tank at Sunnyside. Under this condition the existing 300mm dia. mains between Mission PS and Mission Tank will experience significantly high headloss and velocity and require upgrading.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
400mm dia. Watermain	1330	LS	\$ 450	\$ 598,500
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 598,500</b>
Engineering	15%			\$ 89,775
Construction Contingency	25%			\$ 149,625
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 840,000</b>



PROJECT NO. D-13

## Water Leak Detection Equipment

Revision 1  
Date Revised 18-Dec-13

Priority/Timing: Medium

### Project Description

This will give Operations staff the ability to detect leaks and repair them on a priority basis. Water losses are approximately 20% of production in water systems, so identifying and repairing leaks will provide savings when planning for future treatment, conveyance, and storage facilities.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Leak Detection Equipment	1	LS	\$ 45,000	\$ 45,000

<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 45,000</b>
Engineering	15%			\$ 6,750
Construction Contingency	25%			\$ 11,250
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 70,000</b>

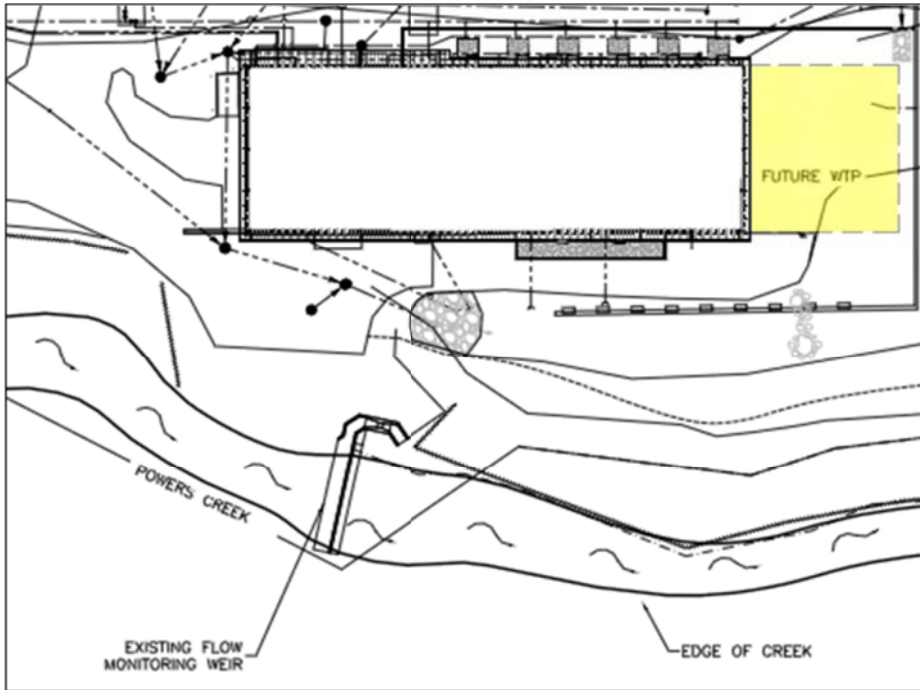


PROJECT NO. T-1

Powers Creek Water Treatment Plant Upgrades

Revision 1  
Date Revised 15-Oct-12

Priority/Timing: Low (Growth)



**Project Description**

- Upgrade Powers Creek Water Treatment Plant to build-out capacity of 81 ML/day
- Timing will be based on utilization of Agricultural water allotment

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Powers Creek WTP Upgrade	1	LS	\$ 9,000,000	\$ 9,000,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 9,000,000</b>
Engineering	15%			\$ 1,350,000
Construction Contingency	25%			\$ 2,250,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 12,600,000</b>



PROJECT NO. T-2

# Rose Valley Water Treatment Plant

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High



### Project Description

- Construct a Water Treatment Plant at Rose Valley Reservoir with a capacity of 90 ML/day
- Construct infrastructure to accommodate a build out capacity of 170 ML/day

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
General Requirements	1	LS	\$ 2,470,000	\$ 2,470,000
Civil and Site Work	1	LS	\$ 1,850,000	\$ 1,850,000
Architectural and Structural	1	LS	\$ 9,120,000	\$ 9,120,000
Process Equipment	1	LS	\$ 11,910,000	\$ 11,910,000
Building Mechanical	1	LS	\$ 450,000	\$ 450,000
Electrical	1	LS	\$ 3,160,000	\$ 3,160,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 28,960,000</b>
Engineering	15%			\$ 4,344,000
Construction Contingency	25%			\$ 7,240,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 40,600,000</b>



PROJECT NO. T-3

## Rose Valley Water Treatment Plant Upgrade

Revision 1  
Date Revised 15-Oct-12

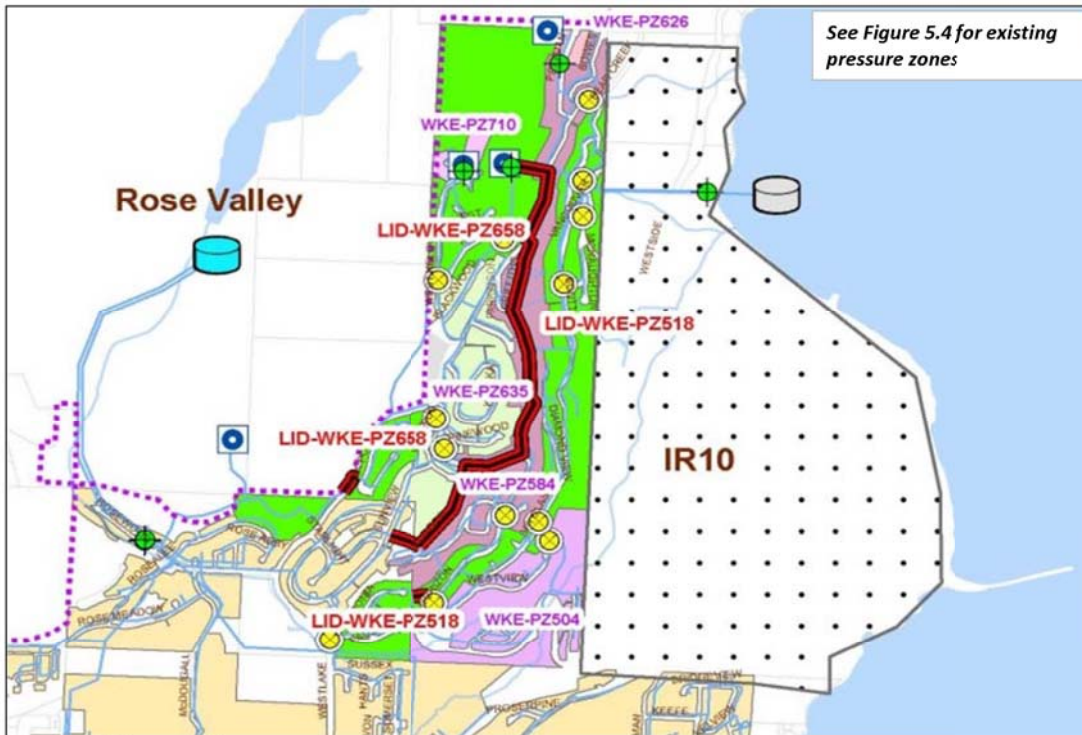
Priority/Timing: Low (Growth)

### Project Description

- Upgrade Rose Valley Water Treatment Plant constructed in Project T-2 to the build-out capacity of 170 ML/day

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
General Requirements	1	LS	\$ 2,470,000	\$ 2,470,000
Civil and Site Work	1	LS	\$ 80,000	\$ 80,000
Architectural and Structural	1	LS	\$ 3,300,000	\$ 3,300,000
Process Equipment	1	LS	\$ 3,790,000	\$ 3,790,000
Building Mechanical	1	LS	\$ 450,000	\$ 450,000
Electrical	1	LS	\$ 1,600,000	\$ 1,600,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 11,690,000</b>
Engineering	15%			\$ 1,753,500
Construction Contingency	25%			\$ 2,922,500
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 16,400,000</b>

Priority/Timing: High



#### Project Description

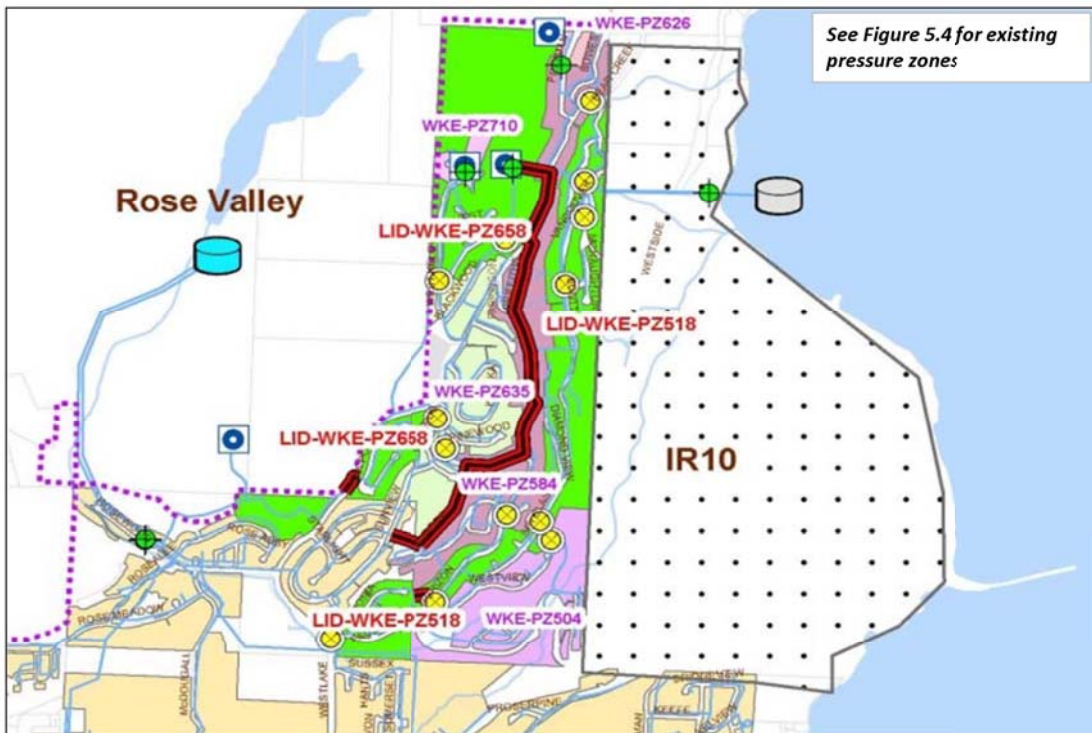
- Split PZ584 so that Diamond View Dr and Scott Crescent become Lower PZ7
- Combine what are currently PZ546, PZ494, PZ513 and PZ532 with Lower PZ584 at an HGL of 535m
- Upper PZ584 becomes a stand-alone pressure zone
- Construct 5000m<sup>3</sup> of additional reservoir storage in PZ584
- This project should be installed in conjunction with Project PZ-2

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
PRV	1	ea	\$ 80,000	\$ 80,000
Adjust PRV	5	ea	\$	\$ -
Reservoir Storage	5000	m <sup>3</sup>	\$ 400	\$ 2,000,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 2,080,000</b>
Engineering	15%		\$	\$ 312,000
Construction Contingency	25%		\$	\$ 520,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 2,920,000</b>

### West Kelowna Estates/Lakeview Pressure Zone Adjustments I

Combine Lakeview PZ518 with WKE PZ535 created in Project PZ-1

Priority/Timing: High



#### Project Description

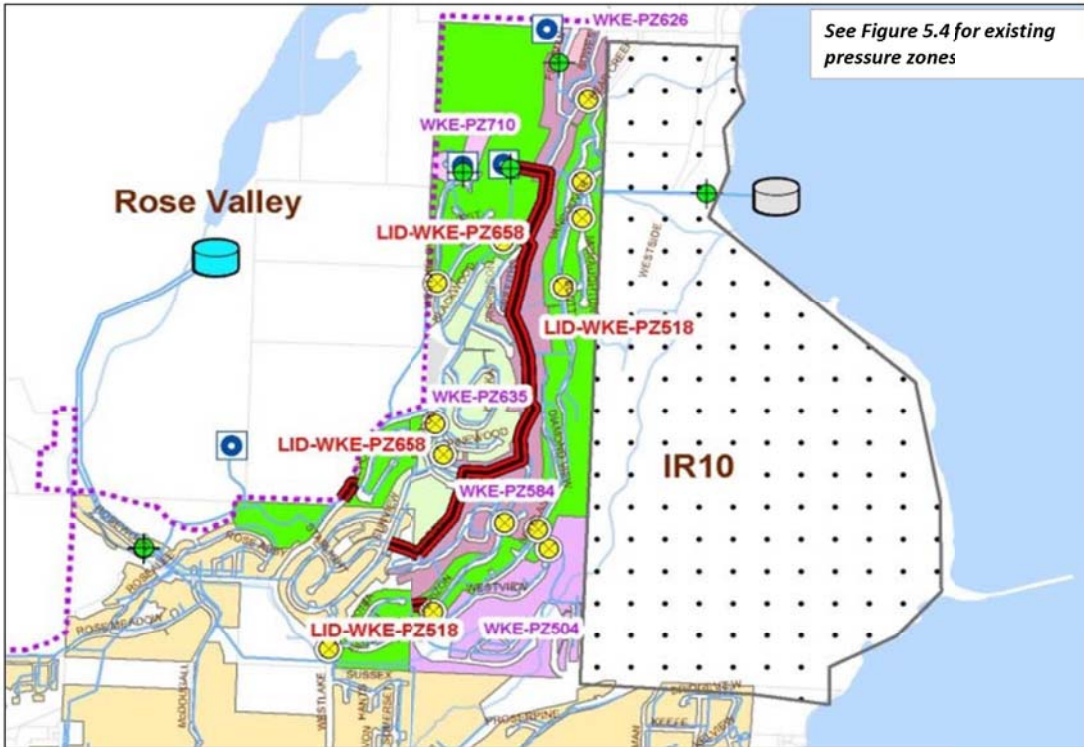
- Adjust the HGL in LID PZ10 to 535m
- Install a connection between Lakeview PZ518 and the new pressure zone in WKE with an HGL of 535m
- This project must be completed subsequent to Project PZ-1 and will provide fire storage for Lakeview PZ518

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
200mm Watermain	160	lm	\$ 275	\$ 44,000
200x200x200 Tee	2	ea	\$ 15,000	\$ 30,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 74,000</b>
Engineering	15%			\$ 11,100
Construction Contingency	25%			\$ 18,500
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 110,000</b>

### West Kelowna Estates/Lakeview Pressure Zone Adjustments II

Combine Lakeview PZ657 with West Kelowna PZ658

Priority/Timing: High



#### Project Description

- Install a connection between Lakeview PZ657 and West Kelowna Estates PZ658

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
250mm Watermain	120	lm	\$ 325	\$ 39,000
Connect to Existing	2	ea	\$ 10,000	\$ 20,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 59,000</b>
Engineering	15%			\$ 8,850
Construction Contingency	25%			\$ 14,750
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 90,000</b>



**PROJECT NO. S-1**

**Connect Sunnyside and Pritchard - PZ401**

**Combine Sunnyside PZ401 with Pritchard and Build Reservoir Storage**

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High (Fire Flows)

**Project Description**

- Adjust the HGL in Pritchard to 401
- Open PRV between PZ401 and Pritchard
- Construct 3,220 m<sup>3</sup> of reservoir storage for this pressure zone

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	3,220	m <sup>3</sup>	\$ 400	\$ 1,288,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,288,000</b>
Engineering	15%			\$ 193,200
Construction Contingency	25%			\$ 322,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 1,810,000</b>



**PROJECT NO. S-2**

**Sunnyside Reservoir Storage Deficiencies - PZ475**

**Increase Reservoir Storage in Sunnyside PZ475**

Revision 1  
Date Revised 20-Aug-12

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct 810 m<sup>3</sup> of additional storage in Sunnyside PZ475

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	810	m <sup>3</sup>	\$ 400	\$ 324,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 324,000</b>
Engineering	15%			\$ 48,600
Construction Contingency	25%			\$ 81,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 460,000</b>



Revision 1  
Date Revised 20-Aug-12

**PROJECT NO. S-3**

**Sunnyside Reservoir Storage Deficiencies - PZ503**

**Increase Reservoir Storage in Sunnyside PZ503**

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct 2,700 m<sup>3</sup> of additional storage in Sunnyside PZ503

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	2,700	m <sup>3</sup>	\$ 400	\$ 1,080,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,080,000</b>
Engineering	15%			\$ 162,000
Construction Contingency	25%			\$ 270,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 1,520,000</b>



**PROJECT NO. S-4**

**West Kelowna Estates/Lakeview Storage Deficiencies - PZ657**

**Combine Lakeview PZ657 and WKE PZ658 and Build Reservoir Storage**

Revision 1  
Date Revised 20-Aug-12

**Priority/Timing:** High (Fire Flows)

**Project Description**

- The amalgamated pressure zones PZ657 and PZ658 require an additional 270 m<sup>3</sup> of storage

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	270	lm	\$ 400	\$ 108,000
200mm dia. Watermain	100	lm	\$ 275	\$ 27,500
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 135,500</b>
Engineering	15%			\$ 20,325
Construction Contingency	25%			\$ 33,875
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 190,000</b>



Revision 1  
Date Revised 20-Aug-12

**PROJECT NO. S-5**

**West Kelowna Estates/Lakeview Storage Deficiencies - PZ710**

**Increase storage in new West Kelowna Estates PZ710**

**Priority/Timing:** High (Fire Flows)

**Project Description**

- West Kelowna Estates PZ710 currently has no reservoir storage and requires 570 m<sup>3</sup>

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	570	lm	\$ 400	\$ 228,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 228,000</b>
Engineering	15%			\$ 34,200
Construction Contingency	25%			\$ 57,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 320,000</b>



**PROJECT NO. S-6**

**West Kelowna Estates Storage Deficiencies - PZ626**

**Increase storage in West Kelowna Estates PZ626**

Revision 1  
Date Revised 20-Aug-12

**Priority/Timing:** High (Fire Flows)

**Project Description**

- West Kelowna Estates PZ626 currently has 11m<sup>3</sup> reservoir storage and requires 550 m<sup>3</sup>

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	550	lm	\$ 400	\$ 220,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 220,000</b>
Engineering	15%			\$ 33,000
Construction Contingency	25%			\$ 55,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 310,000</b>

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PROJECT NO. S-7

Revision 1  
Date Revised 20-Aug-12

## West Kelowna Estates Storage Deficiencies - PZ504

### Increase storage in West Kelowna Estates PZ504

**Priority/Timing:** High (Fire Flows)

### Project Description

- West Kelowna Estates PZ504 currently no reservoir storage and requires 1,170 m<sup>3</sup>

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Reservoir Storage	1,170	lm	\$ 400	\$ 468,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 468,000</b>
Engineering	15%			\$ 70,200
Construction Contingency	25%			\$ 117,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 660,000</b>



**PROJECT NO. S-8**

**Lakeview Storage Deficiencies - PZ539**

Increase storage in Lakeview PZ539

Revision 1  
Date Revised 20-Aug-12

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct 2,850 m<sup>3</sup> of storage in Lakeview PZ539
- Lakeview PZ489 and PZ442 will utilize this storage

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	2,850	lm	\$ 400	\$ 1,140,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,140,000</b>
Engineering	15%			\$ 171,000
Construction Contingency	25%			\$ 285,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 1,600,000</b>



Revision 1  
Date Revised 20-Aug-12

**Lakeview Storage Deficiencies - PZ597**  
Increase storage in Lakeview PZ597

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct an additional 12,200 m<sup>3</sup> of reservoir storage for Lakeview PZ597

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	12,200	lm	\$ 400	\$ 4,880,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 4,880,000</b>
Engineering	15%			\$ 732,000
Construction Contingency	25%			\$ 1,220,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 6,840,000</b>



**PROJECT NO. S-10**

**Westbank Storage Deficiencies - PZ630**

**Increase storage in Westbank PZ630**

Revision 1  
Date Revised 20-Aug-12

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct an additional 3,460 m<sup>3</sup> of reservoir storage for Westbank PZ630

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	3,460	lm	\$ 400	\$ 1,384,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,384,000</b>
Engineering	15%			\$ 207,600
Construction Contingency	25%			\$ 346,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 1,940,000</b>



Revision 1  
Date Revised 20-Aug-12

**Westbank Storage Deficiencies - PZ673**  
Increase storage in Westbank PZ673

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct an additional 1,110 m<sup>3</sup> of reservoir storage for Westbank PZ673

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	1,110	lm	\$ 400	\$ 444,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 444,000</b>
Engineering	15%			\$ 66,600
Construction Contingency	25%			\$ 111,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 630,000</b>



Revision 1  
Date Revised 20-Aug-12

**Westbank Storage Deficiencies - PZ583**  
Increase storage in Westbank PZ583

**Priority/Timing:** High (Fire Flows)

**Project Description**

- Construct an additional 3,250 m<sup>3</sup> of reservoir storage for Westbank PZ583

<b>Capital Cost Estimate</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Price</b>	<b>Extension</b>
Reservoir Storage	3,250	lm	\$ 400	\$ 1,300,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,300,000</b>
Engineering	15%			\$ 195,000
Construction Contingency	25%			\$ 325,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 1,820,000</b>

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**PROJECT NO. S-13**

Revision 1  
Date Revised 20-Aug-12

## Westbank Storage Deficiencies - PZ503

Increase storage in Westbank PZ503

Priority/Timing: High (Fire Flows)

### Project Description

- Construct an additional 12,100 m<sup>3</sup> of reservoir storage for Westbank PZ503

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Reservoir Storage	12,100	lm	\$ 400	\$ 4,840,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 4,840,000</b>
Engineering	15%			\$ 726,000
Construction Contingency	25%			\$ 1,210,000
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 6,780,000</b>

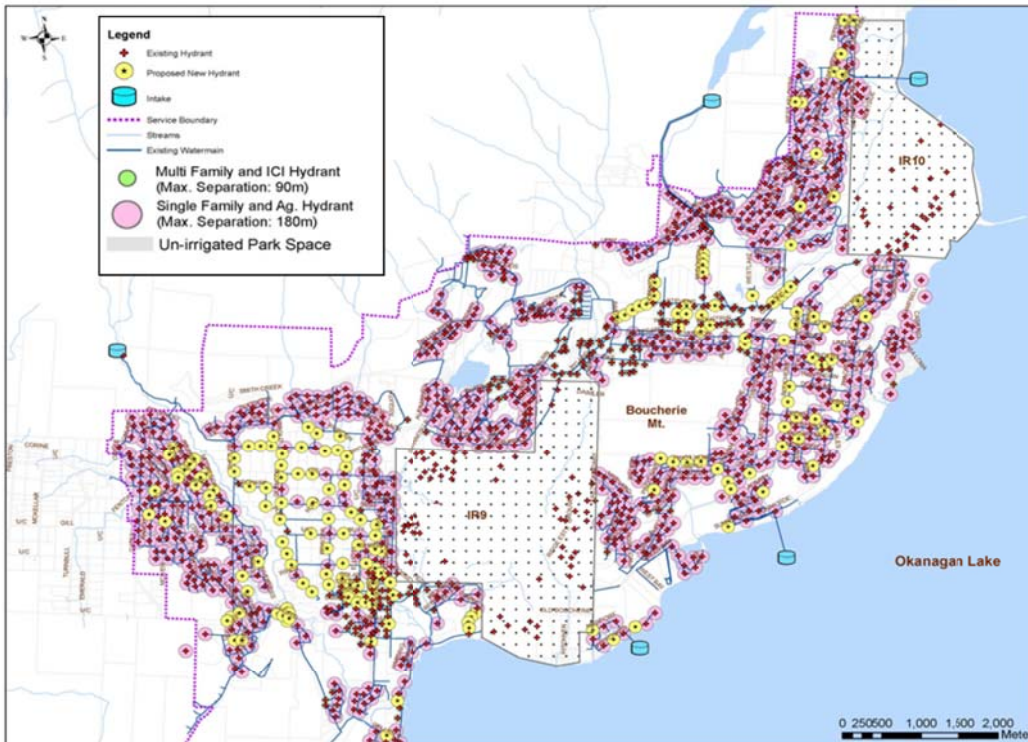
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## PROJECT NO. H-1

### Fire Hydrant Coverage

Revision 1  
Date Revised 17-Sep-12

Priority/Timing: High (Fire Flows)



#### Project Description

Based on mapping and hydrant coverage analysis, there are several areas where hydrant coverage is deficient, with requirement for approximately 174 additional hydrants to be installed. To address this deficiency, a hydrant installation program should be implemented, with location priority to be determined in conjunction with the fire department. It is recommended approximately seventeen (17) hydrants per year (over the next ten years) are installed to address deficiencies.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Yearly Hydrant Coverage Deficiencies	174	ea	\$ 7,500	\$ 1,305,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,305,000</b>
Engineering	15%			\$ 195,750
Construction Contingency	25%			\$ 326,250
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 1,830,000</b>

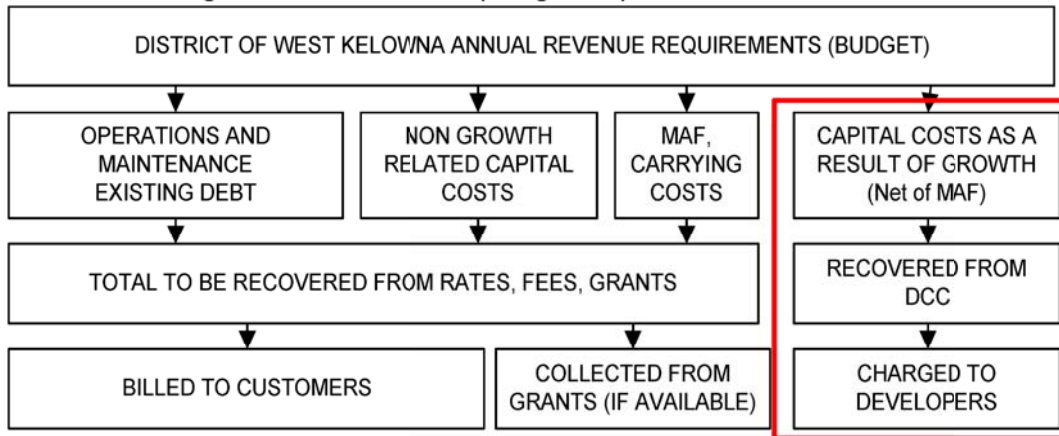


Revision 1  
Date Revised 29-Aug-12

Development of a DCC Bylaw for all of DWK

Priority/Timing: High

Allocation of Budget to Revenue Sources (using DCCs)



Project Description

Since it is anticipated that significant development will occur in the District over the next 20 years, it is recommended that new development pay their fair share of expanding the DWK water system to accommodate growth. It is therefore recommended that the revised DWK DCC bylaw include a provision to charge development for growth related costs as allowed by the Local Government Act. Best Practices for calculating development cost charges are presented in BC Community Services Development cost charges Best Practices Guide. See Section 10 of Report for details.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Development of DCC Bylaw	1	LS	\$ 15,000	\$ 15,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 15,000</b>
Contingency	15%			\$ 2,250
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 20,000</b>

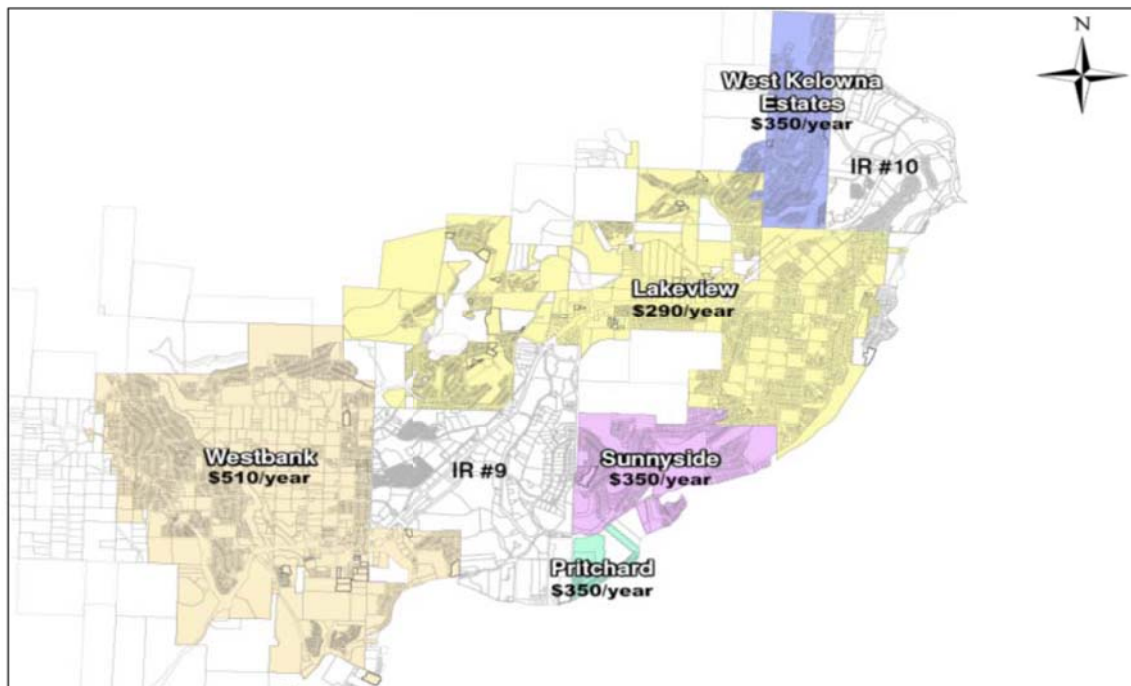


## PROJECT NO. ST-2

### Water Rate Cost of Service Study

Revision 1  
Date Revised 29-Aug-12

Priority/Timing: High (2013)



#### Project Description

Once DWK has determined a water utility integration and management strategy following 2014, it is recommended that a comprehensive water rate cost of service study be undertaken. This will be the first time that a standard rate model can be advanced for the entire DWK utility and will follow a period where DWK has had an opportunity to gather consolidated cost data to support the study. Provision for a stakeholder and public education plan should also be included in this study. See Section 10 of Report for details.

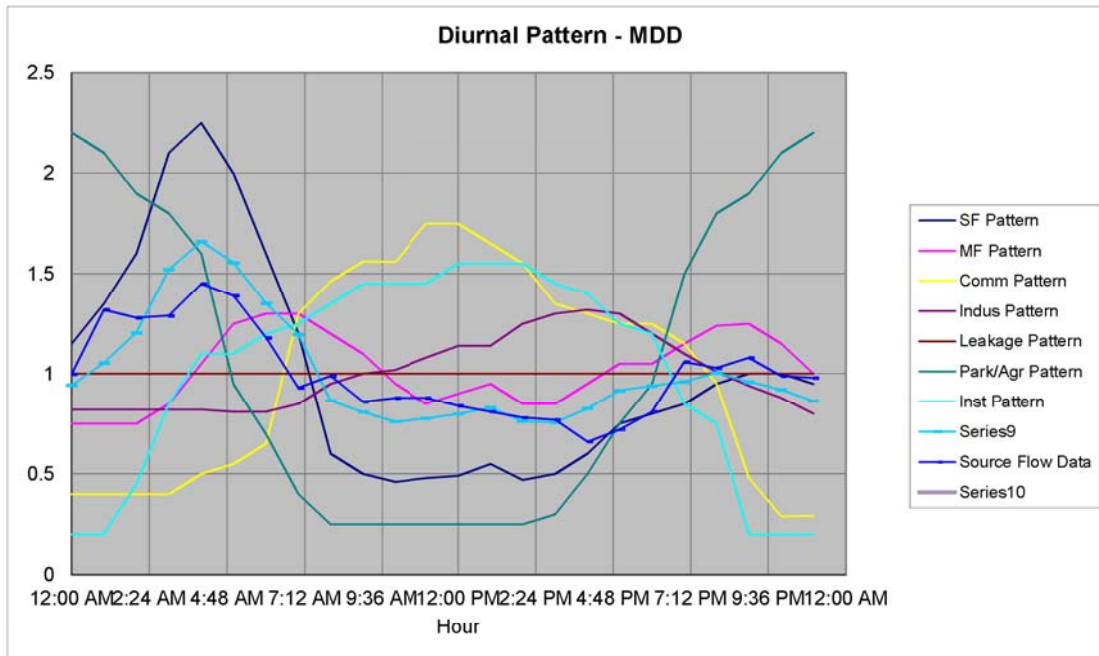
Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Water Rate Cost of Service Study	1	LS	\$ 50,000	\$ 50,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 50,000</b>
Contingency	15%			\$ 7,500
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 60,000</b>



Revision 1  
Date Revised 17-Sep-12

## Convert Steady State Hydraulic Model to Extended Period Simulation

Priority/Timing: Medium



### Project Description

It is recommended the District conduct model calibration under Extended Period Simulation (EPS) in addition to Steady State (SS). EPS calibration will provide more insight of the system conditions and capacity. A calibrated EPS model will allow us to model tanks cycle, regulating pumps and valves operation, try out different control strategies, as well as conducting water quality analysis. Future works would be required to calibrate the model under EPS so that the model's full capacity can be utilized. In the model diurnal patterns were assigned for each Zoning/Landuse type to allow hourly fluctuation of demand in the system throughout the day. This diurnal pattern information was not required under Steady State analysis; however, it was incorporated for future usage of the model when an Extended Period Simulation (EPS) would be required.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Development of an EPS Model	1	LS	\$ 50,000	\$ 50,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 50,000</b>
Contingency	15%			\$ 7,500
<b>TOTAL CAPITAL COST ESTIMATE</b> (Estimated in 2012 \$)				<b>\$ 60,000</b>

**AECOM**  
**PROJECT NO. ST-4**  
**Water Conservation Program**

Revision 1  
 Date Revised 17-Sep-12

Priority/Timing: Medium



**Project Description**

It is anticipated approximately \$100,000 per year will be required over the next five years to develop and implement a successful water conservation program.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Water Conservation Program	1	LS	\$ 500,000	\$ 500,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 500,000</b>
Contingency	10%			\$ 50,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 550,000</b>

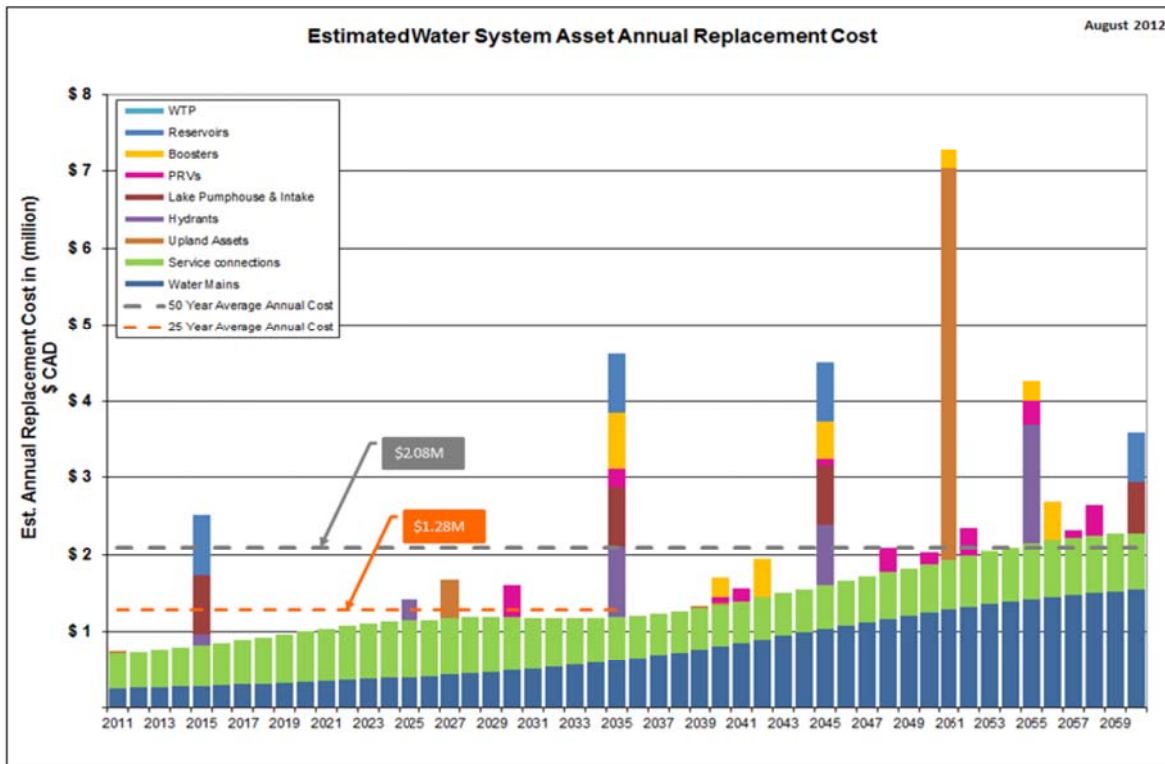


**PROJECT NO. R-1**

**Annual Renewal and Replacement Requirements - 25 Year Average**

Revision 1  
Date Revised 20-Aug-12

Priority/Timing: High



**Project Description**

The DWK owns and operates water system infrastructure with an estimated replacement cost of \$175M. This inventory requires maintenance, and in the future will require renewal or replacement due to deterioration. The estimated yearly renewal and replacement costs, averaged over the next 25 years are included in this upgrade project.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Yearly Renewal Requirements	1	LS	\$ 1,280,000	\$ 1,280,000
<b>Subtotal , Construction Cost Estimate</b>				<b>\$ 1,280,000</b>
Engineering	15%			\$ 192,000
Construction Contingency	25%			\$ 320,000
<b>TOTAL CAPITAL COST ESTIMATE (Estimated in 2012 \$)</b>				<b>\$ 1,800,000</b>

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## About AECOM

With nearly 100,000 employees — including architects, engineers, designers, planners, scientists and management and construction services professionals — serving clients in more than 150 countries around the world following the acquisition of URS, AECOM is a premier, fully integrated infrastructure and support services firm. AECOM is ranked as the #1 engineering design firm by revenue in Engineering News-Record magazine's annual industry rankings. The company is a leader in all of the key markets that it serves, including transportation, facilities, environmental, energy, oil and gas, water, high-rise buildings and government. AECOM provides a blend of global reach, local knowledge, innovation and technical excellence in delivering solutions that create, enhance and sustain the world's built, natural and social environments.

A Fortune 500 company, AECOM companies, including URS, had revenue of \$19.2 billion during the 12 months ended June 30, 2014.

More information on AECOM and its services can be found at [www.aecom.com](http://www.aecom.com).