DISTRICT OF SUMMERLAND


Thirsk Dam on Trout Creek - Upstream Face

2021 Water Master Plan

December, 2021

Agua Consulting Inc.
"Engineered Water Solutions"

ABBREVIATIONS

AES Atmospheric Environment Service
ADD Average Daily Demand
AF Acre-foot
ALC Agricultural Land Commission
AO Aesthetic Objective
ARDA Agriculture Rehab. & Development Act
AWWA American Waterworks Association
CCI Construction Cost Indices
Cl_2 Chlorine or sodium hypochlorite
CMHO Chief Medical Health Officer
CPI Consumer Price Index
CT concentration x time (disinfection measurement)
DAF Dissolved Air Flotation
DoS District of Summerland
DBP Disinfection By-product
DSM Demand Side Management
DWPA Drinking Water Protection Act
DWPR Drinking Water Protection Regulation
EIC Electrical, Instrumentation and Controls
FF Fire flow
FUS Fire Underwriters Survey
GCDWQ Guideline for Canadian Drinking Water Quality
GIS Geographical Information System
HGL Hydraulic Grade Line (slope of water in m/m)
Igpm Imperial Gallons per minute (flow rate)
IHA Interior Health Authority
kPa kilopascals (pressure)
L Litre
L/ca/d Litres per capita per day (usage rate)
L/s Litres per second
m^3/s cubic metre per second, (flow rate)
mg/L milligrams/litre (parts per million)
MAC Maximum Acceptable Concentration
MAR Mean Annual Runoff
MCC Motor Control Centre
MFU Multi-family unit
ML Mega-litre (one million litres = 1,000 m^3)
ML/ day Mega-litres per day
MDD Maximum daily demand
MHO Medical Health Officer
MIgpd Million Imperial gallons per day
MOE Ministry of Environment
MVID Meadow Valley Irrigation District
NTU Nephelometric Turbidity Unit
OBWB Okanagan Basin Water Board
OWSC Okanagan Water Stewardship Council
OCP Official Community Plan
O & M Operations and Maintenance
POD Point of Diversion (licensing)
PET Potential evapo-transpiration
PHD Peak hour demand
PIB Penticton Indian Band
PRV Pressure reducing valve
PS Pump Station
psi pounds per square inch (pressure)
PLC Programmable Logic Controller
PST Provincial Sales Tax
PZ Pressure Zone
RDOS Regional District of Okanagan Similkameen
RPBA Reduced Pressure Backflow Assembly
SCADA Supervisory Control and Data Acquisition
SFE Single Family Equivalent
SDWR Safe Drinking Water Regulation
SWTR Surface Water Treatment Rule
TCU True Color Units
TDH Total Dynamic Head
THM Trihalomethane
TOC Total Organic Carbon
TWL Top Water Level (metres)
UFW Unaccounted For Water
μg/L micrograms / litre (parts per billion)
uS /cm micro siemens
USgpm US gallons per minute(flow rate)
UV Ultra-violet
UVT Ultra-violet Transmissivity
VFD Variable Frequency Drive (motor speed control)
WSC Water Survey of Canada
WUP Water Use Plan

June 2, 2022

District of Summerland
PO Box 159
9215 Cedar Avenue
Summerland, BC
V0H 1Z0

Attention: Mr. Jeremy Storvold, P.Eng.
Director of Utilities

Dear Jeremy:

Re: 2021 Water Master Plan Update

We are pleased to present the 2021 Water Master Plan for the District of Summerland. The report provides a comprehensive review of water issues that the District is expected to face in the upcoming decade. Key components of the report include:

- A summary of existing water licenses and an assessment of source water capacity, including an inventory of potential future water reservoir storage sites in the Trout Creek watershed;
- A review of the existing water distribution system with respect to its ability to provide water to the existing users within the service area and for the future;
- A summary of historic water usage and a projection of future water use based on expected impacts from population growth and expanded agriculture;
- Appendix A, which provides a listing of 43 Capital Projects that are considered for implementation by the District. The first 28 projects are high and medium priority that should be completed as required. The low priority projects are included for future reference;
- A review of the financial position of the water utility is provided. An Economic model was developed to forecast revenues and expenditures, and the impact of capital projects into the future.

We thank you for the opportunity to be of service to the District. Please call us directly if you wish to meet and discuss any aspects of this report.

Yours truly:

Agua Consulting Inc.

R.J. Hrasko, P.Eng.
Principal

EXECUTIVE SUMMARY

INTRODUCTION

The 2021 Water Master Plan provides a comprehensive review of the Summerland water utility. The report covers the water system from source to tap, including financial position. The analysis used the data from the 2008 Water Master Plan as a benchmark to evaluate progress and performance over the past 13 years. Both local and regional data was used to identify possible issues that the District would be facing in the next decade. This plan is to be used by Summerland water utility staff as a guideline so that informed decisions can be made related to all aspects of the water supply system.

The report includes an overview of Summerland's sources, their water distributions system, water quality issues, future issues, probable projects and their costs, and the water utility's financial capacity and current trends. The report forecasts to a 20-year horizon and forecasts further into the future when assessing water source capacity and issues such as climate change and water availability.

In the development of this document, the historical evolution of the utility was reviewed and the information gathered from historical contributors was reviewed and provided to water utility staff.

Section 1 provides a listing of water supply objectives and the project work plan. Within this section are seven Guiding Principles for water supply. These principles provide a foundation from which good decisions can be made on water supply and management.

Over the past 13 years, Summerland was able to complete the majority of high priority works listed in the 2008 Water Master Plan. The highest priority was to bring the water utility into compliance with the regulator's requirements for drinking water quality. This involved completing the water treatment plant and then three phases of system separation so that raw water could bypass the WTP and be supplied directly to agricultural lands. The District, at both the staff and political level, was able to stay with the program until safe water was available to all of Summerland.

The developed concepts and recommendations provided in this report are based on the successful water initiatives carried out in the Okanagan Valley over the past 30 years. There are several large utilities in the Okanagan that have water supply challenges and are facing extremely high project costs. Summerland has been able to complete their most expensive works. The largest challenges are now to maintain and renew what they have.

CRITERIA

Criterion followed are consistent with the District of Summerland Subdivision Servicing Bylaw unless otherwise stated. Section 2 of this report sets out criteria for water system hydraulics, water quantity, water quality, growth rates and economic analyses parameters.

The criteria used by Summerland is stable and does not require many changes. One recommendation is to reduce the per capita water use criteria for water to new development from 2,400 L/ca/day down to 1,800 L/ca/day.

A critical concern with respect to water supply for the community is the annual depth of water that should be allocated to irrigation on arable (taxed) lands. New tools have been developed by the Province over the past 10 years to estimated water demand for agriculture. These tools are web-based and available for use by the public. The BC Agriculture Water Calculator is one such tool that can be used to estimate the water demand for any parcel of land in the province.

Link to BC Agricultural Water Calculator http://bcwatercalculator.ca/agriculture/welcome

Currently Summerland allocates an 800mm depth of water annually to the arable lands and has reliably provided this amount of water to those that required it. With the meters, pricing, more efficient water practices by the community, the average irrigation water demand has dropped significantly. The result is that there is less water being used, and also less arable land area utilizing water and being billed. The average depth of water used community-wide on the arable land, based on meter records, is 415 mm depth of water per year over the arable land area. This is just over half the 800mm allocation and is due to many owners not using their allocation. In review of the 800mm allotment depth, the 2021 metered records showed that for productive orchards, some growers had reached their 800mm base allocation and during the hotter years.

EXISTING WATER SUPPLY

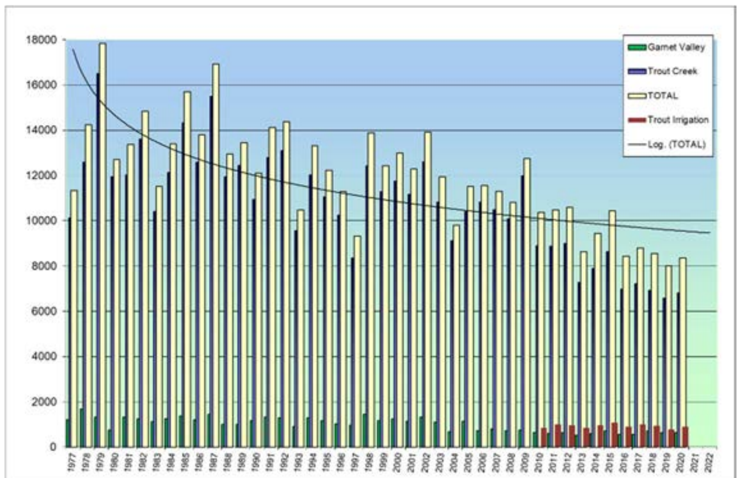
An eight-page history of the Summerland water supply system, dating back to events in the 1800s is included in Appendix D of this report. A chronological summary of water-related events that shaped the community is provided.

Sources The District has three available water sources; Trout Creek, Eneas Creek, and groundwater. There is a fourth potential source in Okanagan Lake, but the infrastructure is not in place yet. Groundwater is considered a supplemental source. Eneas Creek is used only for irrigation. Only Trout Creek is used to provide water to the Summerland water treatment plant.

Water Licences Water licenses are summarized in Section 3.3 of this report. Summerland holds sufficient water licensing on Trout Creek, Eneas Creek and Okanagan Lake for the foreseeable future. Minor licensing adjustments are required on Thirsk Reservoir and Headwaters Reservoirs to have the licenses match existing reservoir volumes. Domestic licenses need to be adjusted as the point of diversion (POD) for the domestic water is from Okanagan Lake and with the current domestic licenses at Trout Creek being insufficient to supply the domestic water demands.

Upper Watershed Reservoirs The water reservoir storage capacities and ability to fill (reliability) were reviewed for each of Summerland's twelve (12) reservoirs. The reservoirs were rated for ability to fill each year, based on the estimated runoff from the watershed above each dam. The reservoir reliability in order of most reliable are, Thirsk, Crescent, Isintok, Tsuh, Garnett, Headwaters, Whitehead and Eneas. Regarding reservoir expansion, the general consensus is that the Province and First Nations would prefer to see existing reservoir sites expanded rather than new sites being developed. The environmental impact is much lower if this approach is taken. For the existing dam sites, there should be good hydrology data available at the dam site, provided the utility is collecting the release flows from the outlet and spillway. In terms of which reservoir to expand, Thirsk Dam was recently reconstructed in 2007. Watershed reservoir operating procedures were confirmed and are included in this report.

Water Demand A historical trend of Summerland's total annual water use since 1977 is included. The graphed data shows a decrease in water use (adjacent figure). There are factors that have caused this decrease including more efficient irrigation practices and metering program, but the long-term trend is expected to now slowly increase as development continues and there is expected to be more pressure to develop agricultural land as is occurring in surrounding communities. Water use throughout the community was determined with daily, monthly and annual estimates made for the various user groups. Total annual average water demand is now 8,930 ML which is substantially less than the average use of 12,250 ML of 2008. Also of significance is that 1,550 ML of the annual water demand is supplied through the irrigation system to Garnett Valley and to Prairie Valley as a result of the recent system separation projects.



Annual Projects There are numerous projects identified and described in Appendix A of this report. Some of the works are on-going and some will require special funding. Water utility programs will continue for normal annual works including hydrant infilling, blow-off installations at dead end mains, SCADA system improvements, reservoir circulation, chlorine residual monitors, and PRV and pump station maintenance and the renewal of a section of water mains each year. The renewal works set aside are for $590,000 per year which includes water distribution system renewal and one PRV station per year. These improvements are to be carried out over time. Summerland also has renewal underway for meters, for services and other items as required through their normal system O & M.

Fire Protection Fire protection and reservoir storage to cover high demand fires in the downtown core of the District is considered to be adequate. With densification of the Old-Town and the Downtown areas, a maximum fire demand of 225 L/s for a duration of 2.875 hours is the maximum fire flow that can be provided. The duration at the high flow rate would require approximately half of the WTP clear well volume. Recommended works to upgrade the existing water distribution system are discussed in Section 3. The detailed project list and project sheets are listed in Appendix A. The listing assigns the project beneficiary as either existing users or new development. If there was substantial growth in Summerland the DCC revenue would be significant. Because of the limited growth rate, the majority of funding for projects will be from sources other than DCC revenue.

Water Quality Review

Raw Water Quality The raw water quality from Summerland's water sources has not significantly changed in the past 10 years. Monitoring of full water quality parameters at the raw water intakes is recommended in order to establish a baseline of water quality data. Summerland staff are in the watershed weekly to monitor activities by logging companies and other stakeholders. The two largest raw water impacts are logging and cattle-range activities. In particular, the community of Faulder is located above the Trout Creek intake and the community runoff goes into the local drainage system and into Trout Creek.

Multi-Barrier Approach The water quality and treatment issues for the District have been stable over the past 10 years. The Summerland Water Treatment Plant (WTP) provides high quality drinking water to the residents of Summerland. The WTP is an excellent barrier but it forms only a portion of the overall protection.

To provides the best available source water to the head of the WTP, a multi-barrier approach to drinking water has been practiced by District staff. By minimizing the amount of contamination in the water prior to treatment, the WTP is not significantly challenged resulting in good performance and reduced risk potential to the public.

WTP Capacity The Water Treatment Plant has a design capacity of 75 ML/day which is now sufficient to treat the current Maximum Day Demand (MDD) of 65 ML/day. With the most recently completed phase of system separation, splitting the Garnett Valley and Jones Flats systems, the plant is able to provide the MDD and the requirement for issuing Water Quality Advisories is now rarely required.

The plant is challenged due to the limited capacity in the clear well. With a maximum daily demand of 65 ML, and a 6.0 ML clear well, the amount of time the supply can be interrupted in mid summer is only in the range of 1.5 hours with fire storage being compromised during and after that time. Options include reducing demand on the WTP, constructing additional WTP balancing storage, or developing alternate emergency plans for extreme heat conditions such as in 2021. System separation is recommended to continue as funds become available which will help to resolve this issue. The peak demands are expected to increase in future years due to climate change, as experienced from the heat dome that formed in June of 2021.

Garnett Reservoir With the separation of the irrigation in Garnett Valley, the issues facing Garnett Reservoir are now, no longer related to water quality. The level of quality now has a less onerous standard to meet. The challenges facing Garnett Reservoir are the dam spillway and the capacity of the outlet channel between the dam and Okanagan Lake. The dam is currently being operated at lower water levels so as to not use the spillway or downstream channel.

FUTURE WATER SYSTEM

Climate Change The forecasting of future water availability is expected to be tied to climate change. In the past 10 years, the weather events have resulted in greater runoff resulting in flooding, followed by drought, and then late summer fires in the tinder-dry forests in the watersheds. The flooding in the spring of 2017 reached record levels and was followed by a record forest fire season for the province. The next year the runoff event in Trout Creek on May 9, 2018 (see photo) was estimated to be in the range of 75 m3/s at the Trout Creek intake.

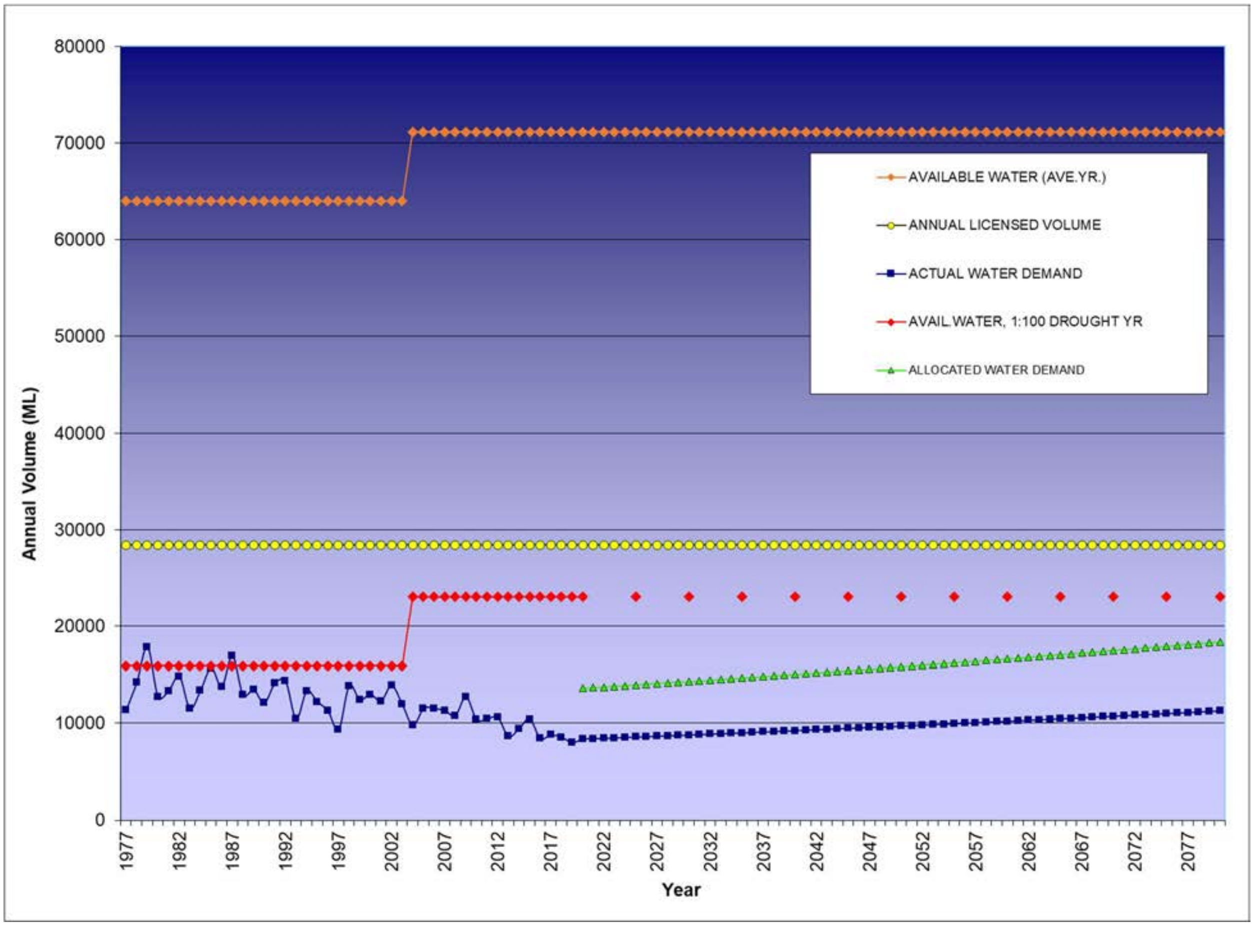
Understanding and accepting that these types of events are occurring more frequently is first step to being able to adapt to the changes needed to manage the water supply utility. The past 10 years of water data for the region have shown that we should expect more precipitation and runoff, although not in the form of snowfall. The impact of the weather is an external factor that cannot be controlled by Summerland. Summerland can only react to it.

The internal factors that Summerland can partially control include development, land use, water rates, available revenue and staff capability.

The concepts and objectives presented within the report should help to align Summerland with the basin-wide initiatives that are underway. Climate change and its impacts on water supply are presented in Section 6.4. Understanding the watershed and hydrological changes can only be done if sufficient data is collected and trended over time.

Water Availability Forecast Population growth estimates are predicted to remain constant at 2.00% annually. The growth in water demand is expected to be much lower though and was set within the hydrological model at 1.25%. In previous reports, the long-term forecast for water was that there would be a shortage of water in the Okanagan by the year 2050 and even less available water by the year 2080. With global warming, the air has a greater ability to hold more water in the vapour state. The rising of the air over the higher elevation plateaus has resulted in there being more precipitation on the higher elevation lands. Although it may be possible that there may be more water in the watershed in time, we have reviewed the trends for available water supply and they appear to be stable for the foreseeable future.

Forecasted Source Capacity & Annual Water Demand



A more detailed explanation of the above graph is provided in Section 6.7. The orange diamonds at the top show the source water available to Summerland in an average runoff year. The yellow circles are the total licensed volumes to Summerland for Waterworks Local Authority (domestic uses) and for irrigation. The red diamonds show the estimated water availability from all sources in an extreme 1:100-year return period drought. The green line shows the predicted water use for the foreseeable future. The details of this graph are presented in Section 6.7.

Penticton Indian Band Water

The water supply issues that may be of interest to the Penticton Indian Band are provided in Section 6.5. Opportunities exist for partnering on projects including the provision of water for Environmental flows needs to lower Trout Creek, the development and extension of water to the PIB lands for domestic or irrigation purposes, and the development of fish passage and upgraded fish screening at Summerland's Trout Creek water intake. It may be possible to leverage funding dollars for co-operative projects that meet the objectives of both the Penticton Indian Band and Summerland.

Project Priority List Table 1 provides a listing of the water system projects recommended for the District of Summerland. There are 28 projects considered to be viable at this time. These projects are prioritized as either medium priority or higher. An assessment of the project benefits to either new development or existing users is provided on the table.

- The first four (4) projects on the list are annual works that require investment each year.
- Projects number 5-15, are high priority projects that are necessary and should be done as soon as possible.
- Projects No. 16-28 are medium priority and should be done sooner only if funding becomes available, or the work is combined with other utility work.
- Project No. 29-45 are not included in Table 1 but are provided for future reference in Appendix A. These 18 projects are included for future reference.

Table 1 - Project Priority List and Costs

Priority	#	PROJECT NAME	Current Users	DCC Project	TOTAL
H	1	Water Main RENEWAL (ANNUAL COST)	$ 504,862	$ -	
H	2	METERING UPGRADES, (ANNUAL COST)	$ 200,000	$ -	$ -
H	3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ 200,000	$ -	$ -
H	4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ 90,000	$ -	$ -
H	5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 1,090,000	$ -	$ 1,090,000
H	6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 50,000	$ -	$ 50,000
H	7	CRESCENT DAM SPILLWAY - UPGRADE	$ 210,000	$ -	$ 210,000
H	8	TROUT CREEK FLUME - REPLACEMENT	$ 7,090,000	$ -	$ 7,090,000
H	9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 67,551	$ -	$ 67,551
H	10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,350,000	$ -	$ 1,350,000
H	11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 70,000	$ -	$ 70,000
H	12	DAM SAFETY REVIEWS	$ 345,000	$ -	$ 345,000
M	13	ENEAS DAM - DECOMMISSIONING	$ 110,000	$ -	$ 110,000
M	14	WTP - SLUDGE HANDLING - UPGRADES	$ 6,280,000	$ -	$ 6,280,000
M	15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ 6,410,000	$ 6,410,000
M	16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ 2,750,000	$ 2,750,000
M	17	SOURCE WATER ASSESSMENT PLAN	$ 80,000	$ -	$ 80,000
M	18	TSUH DAM - DECOMMISSIONING	$ 70,000	$ -	$ 70,000
M	19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,110,000	$ -	$ 1,110,000
M	20	JAMES LAKE PUMP STATION UPGRADE	$ 210,000	$ -	$ 210,000
M	21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 3,490,000	$ -	$ 3,490,000
M	22	WTP - FLOWMETER AND PROGRAMMING	$ 40,000	$ -	$ 40,000
M	23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ 520,000	$ 1,550,000	$ 2,070,000
M	24	AILEEN ROAD - WATER SYSTEM SEPARATION	$ 190,000	$ -	$ 190,000
M	25	SYSTEM SEPARATION - FRONT BENCH ROAD	$ 390,000	$ 1,160,000	$ 1,550,000
M	26	SYSTEM SEPARATION - HAPPY VALLEY	$ 480,000	$ 1,440,000	$ 1,920,000
		TOTAL (Projects 5-26)	$ 23,240,000	$13,310,000	$ 36,550,000

FINANCIAL PLAN

Existing Debt The Summerland water utility currently has two large projects that are being financed; the raising of Thirsk Dam, and the Water Treatment Plant. The debt for both will be retired in 2027 and the parcel tax will also end at that time. The debt servicing for the two projects forms approximately 25% of the total utility revenue. With financing rates being currently very low, borrowing funds to complete projects is one means of financing the recommended projects. The current parcel tax of $1,300,000, if extended at 2.00% interest over 20 years could fund $20,000,000 of projects.

Revenues and Expenditures Excluding the parcel tax, the annual revenue for the water utility is approximately $4,028,000. Excluding debt financing, the annual expenditures are $3,860,000. Of concern are that the expenditures have increased at a rate much higher than the revenues. In the past 12 years, the arable land acreage has decreased resulting in less revenue. A metering program was not yet implemented in 2008. The metering program required $380,000 in 2020 and $210,000 in 2019 to operate. The meters serve several purposes including monitoring of water use, a basis for billing, promoting equity and responsible use among customers, and in allowing Summerland to be eligible for grant funding from senior government.

Of the utility expenditures, 80% of the costs are fixed, meaning that they do not vary, regardless of water consumption. The variable costs such as electricity, water treatment plant chemicals and chlorine only account for 20% of the total expenditures. The addition of service connections and/or servicing additional arable land would increase utility revenues and the variable costs. On a connection or acreage basis, the revenue generated would be for 100% of the water bill, while the increase in costs would only be the 20% that is the variable cost. Any initiatives that result in reduce water connections or taxed acreage should be reconsidered as that would increase the unit cost for water supply.

Development Cost Charges Development Cost Charges should be updated. Project revenue in the range of $200,000 a year is lost due to insufficient funds being collected. The DCCs should cover the cost to replace capacity for various water system components. With the changes over the past decade, the capacity replacement cost for an average single family residential unit is now estimated to be:

▪ Watershed Reservoir Storage	$ 1,000
▪ WTP Capacity	$ 1,350
▪ Distribution Storage (concrete reservoir)	$ 1,200
▪ Conveyance	$ 450
TOTAL DCC per Single Family Equivalent Unit	**$ 4,000**

It is recommended that lands applying for agricultural water be permitted to connect if conveyance capacity is in place. An agricultural rate of $10,000/ha. ($4,046/acre) is presently in place for 2021.

Economic Model An Economic Spreadsheet model was developed to provide a forecasting tool of revenues, expenditures, debt servicing and project implementation. This tool has inputs for various economic factors such as interest rates, return-on-investment, financing rates, DCC rates, toll rate changes. These can be adjusted to test the financial health of the utility under many different scenarios. A detailed explanation of the model is included as Appendix B. Single Family equivalents (SFEs) were developed for Multi Family (MF), Industrial, Commercial and Institutional land uses. The SFE was used for projecting future revenues, expenditures and water rates.

The outcome of the Economic model is that the utility can manage for a period of time in its present form of operation, but the trend for revenues and expenditures must be stable. Borrowing and or grants will be necessary to carry out any of the larger projects that have been identified.

SUMMARY

There are key findings of the report are listed herein:

- **Licensing** Summerland holds 25 licenses for storage, waterworks local authority, and irrigation on Eneas Creek, Trout Creek, and Okanagan Lake. The licensed volumes should be sufficient for the foreseeable future; however, some reconciliation of storage volumes is required along with a revised Point of Withdrawal for the domestic licensing;
- **Thirsk Reservoir** The reliability to fill Thirsk dam is very high and provides Summerland with a large reservoir and large watershed above it, with substantial capacity for the foreseeable future;
- **Okanagan Lake Expansion** Expanding the water supply to be able to draw water from Okanagan Lake will provide some supply redundancy in the event of a forest fire in the Trout Creek watershed. Powell Beach is considered to be the most viable location for the new lake intake;
- **Water Quality** The WTP capacity is limited to 75 ML/day and with the recent separation projects in Prairie Valley, Garnett Valley and Jones Flats, the domestic water demands on the WTP have reduced to 65 ML/day. The Water Quality Advisories have almost been eliminated and the water quality supplied to Summerland consistently meets the regulators requirements;
- **Water Demands** Water demand have reduced in the past 12 years from an annual demand of 12,250 ML/yr. to 8,930 ML/year. This is due to less acreage being irrigated and more efficient water use practices. Unfortunately, the reduced acreage and the installation of meters has placed the utility is a trend of less connections, less water use and higher unit rates. Reversing this trend will be challenging but is possible;
- **Projects** A total of forty-five (45) projects are listed in Appendix A of this plan. Twenty-eight (28) of these projects are considered to be moderate or high priority. The low priority projects, numbered 29-45, are provided so that they can be reconsidered at some time in the future;
- **Recommended DCC Rate Increase** Summerland should consider updating the DCC bylaw for water. It is recommended that the bylaw be passed so that new development covers their share of costs to offset the erosion of water infrastructure capacity over time. There is in the range of $200,000 per year that can be gained for the water utility if a Water DCC bylaw was passed at the recommended rates.

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1. INTRODUCTION

1.1 GENERAL

The Summerland Water Master Plan is a guideline document for water supply for the community. It builds on the water planning work completed in the 2008 Water Master Plan. The 2008 document was developed right after Summerland completed a number of key water initiatives which included the raising of Thirsk Dam, the construction of the Summerland Water Treatment Plant, and the development of a Water Use Plan for Trout Creek.

Thirsk Dam Release – Single Gate

The 2008 Water Master Plan is a comprehensive assessment of the watershed, treatment and distribution system. It provides a number of recommendations and a listing of 36 projects in order of priority. Since 2008, the plan was closely followed with 11 of the first 13 projects being completed.

The 2019 Water Master Plan considers the changes in regulatory framework, environmental changes, climate change impacts, community and social issues including greater awareness and recognition of First Nations perspectives since 2008. The plan addresses the water supply issues, projects, financing requirements, toll rate adjustments, and review of Development Cost Charge rates.

The watershed and distribution system analysis works carried out is summarized within this plan. Probable projects that Summerland in the near future and beyond are included with project costs, and their impact on existing water rates and Development Cost Charge rates.

The District of Summerland is fortunate to have access to several sources of water including Okanagan Lake, Eneas Creek, and Trout Creek, which is the second largest watershed that feeds into Okanagan Lake.

1.2 WATER SUPPLY – GUIDING PRINCIPLES

The 2008 Summerland Water Master Plan identified 12 guiding principles with respect to water. The list is shortened to seven principles that are the most applicable to the Summerland water utility. When approaching difficult decisions where compromises must be made, deferring back to these key principles can assist in ensuring that a good foundation for wise decision-making is in place.

Principle 1: Recognize the Inherent Value of Water: Water is a precious and finite natural resource that has an inherent value. Clean water is necessary to support healthy ecosystem functions, the spiritual values of the First Nations people, and aesthetic values.

Principle 2: Control Pollution at its Source: Water, like air, has an enormous ability to transfer contamination from one source to a much larger area. Reducing or preventing contamination from entering surface or ground source water is an important and cost-effective way of maintaining cleaner water for all uses and values.

Principle 3: Protect and Enhance Ecological Stability: Natural processes in healthy watershed ecosystems are the most effective and cost-efficient means to maintain water quality and quantity. Water management committed to protecting and restoring ecosystems will ensure that local and cumulative impacts on sensitive habitats are considered in land and water management decisions.

Principle 4: Integrate Land Use Planning and Water Resource Management: Integrated water resource management means recognizing the interrelationship between land use and water quantity and quality. Good land-use decisions can minimize the impact of urbanization and reduce the human footprint on the environment, which will in-turn reduce impacts on water resources.

Principle 5: Promote a Basin-Wide Culture of Water Conservation and Efficiency: Reducing water wastage and promoting the efficient use of water is central to ensuring water supplies are adequate for now and in the future. Education, metering and adaptation are all key components to reduction of water wastage.

Principle 6: Ensure Water Supplies are Flexible and Resilient: Even with improved conservation and water use efficiencies, water storage capacity faces demands of population growth, climate change impacts, environmental flow needs, and those of agriculture. Improving the resiliency of supply lies with the ability of people to change their water use habits so as to not outstrip available water.

Principle 7: Encourage Active Community Engagement in Water Management Decisions: Transparent decision-making processes, opportunities for information sharing, and open communication are essential for sustaining public commitment to water stewardship. The public should be provided with meaningful opportunities to consult, advise, and participate directly in activities that support sustainable water management.

It is recommended that the District of Summerland consider these principles, adopt them, and refer to them as the foundation for making decisions related to their water supply. These principles are in-line with larger valley-wide principles and will assist the District in aligning their activities with those of the larger water basin.

1.3 WATER SUPPLY OBJECTIVES

The focus of this plan is to provide strategic direction for the Water Utility. The direction will involve all areas of the water supply from watershed management, to water treatment, treatment trends, distribution system separation and rate impacts to customers. The intent is to achieve the following water supply objectives:

- **Water Provider:** As a water supplier, the requirement under the water license is to obtain and provide water for beneficial use. Restricting water use, or pricing the water with punitive pricing results in the utility becoming a water restrictor rather than a water provider. This is a pitfall that occurs when there is an emphasis on pricing water volumetrically rather than as a community service;
- **Improved Adaptation:** The utility should work towards having the ability and means to deal with foreseeable issues that may arise. With climate change, in recent years we have experienced greater drought and more extreme flooding. The dates for when water utilities are starting to use their upper watershed storage appears to be earlier and earlier each year, however the data is not yet there to track this. To deal with the changing rules for water supply, adaptation is required. This may mean greater buffers and safeguards built into the supply, more water storage, greater setbacks and protection from natural streamflow channels, etc.;
- **Greater System Redundancy:** With the value of properties/structures in Summerland increasing, the water infrastructure will be expected to aid in the protection of those properties from drought and/or fire. There are several ways to provide and manage emergencies. Having the tools and resources to deal with extreme events, aging infrastructure, and the standards of reliability expected by customers is important in having a well-managed utility.
- **Water Quality Risks**: With our ability to analyze and monitor microscopic contamination to levels not possible 10 years ago, the risks and treatment requirements are ever increasing. Approaching treatment in a logical, functional and fiscally responsible way is important. Too many projects are brought forward that have low benefit and high cost;
- **Leveraging of Technology:** The use of appropriate and effective technology can provide continuous benefits to a water utility. Through the implementation of SCADA monitoring devices for monitoring flow quantity, quality and alarms, the ability to react earlier to emergencies improves. Having greater ability to foresee and react to problems is invaluable.

Focusing on these objectives over time will make the Summerland water supply system more robust. The Water Master Plan update is intended to be practical, but it is also to provide longer term direction as to where the water utility must evolve.

1.4 WATER MASTER PLAN OBJECTIVES

As a key resource document for the District of Summerland water utility, this plan must provide current water-related information and water projects that will direct the Summerland water utility staff and decisions made by the District related to water for the immediate future and in the longer term.

An excellent bench-mark indicator for any planning document is how often it is used. To keep the document current, we have incorporated a number of key water parameters for the District to track over time. The information is listed within tables of this report and will provide a baseline of data over time for good water management decisions. Some of the recommended tracked information includes:

1. Annual runoff flows sub-catchment areas in the watershed above each of the dams;
2. Dates for when Summerland starts to utilize water storage from reservoirs (not snowmelt);
3. Population and number of connections, areas of irrigable lands, etc.
4. Monthly community water demands;
5. Total Irrigation meter reads summarized monthly
6. Financial data for operational costs

This baseline information is critical for future planning and to understand when there are changes in water supply.

1.5 SPECIFIC WATER SUPPLY ISSUES

Based on our knowledge of the water system and discussions with the District staff during the past few years, we are aware of the following issues that may need to be addressed in the near future by Summerland. The intent is to set out a logical prioritized plan and list of projects for the development of the water system for the next 20 years.

List of Water System Issues

1. Watershed safety and upgrades as set out in the 2012 Watershed Master Plan. Identify and prioritize works in conjunction with the distribution system upgrades and WTP works;
2. Consistent and on-going data and flow collection so that the records and information is collected and tabulated in a consistent and trended format;
3. Flood protection for water infrastructure along Trout Creek;
4. Spillway width and rip rap lining for Garnett Dam to meet Dam Safety regulations;
5. Safe routing for greater water releases from Garnett Reservoir that do not negatively impact on the downstream urban area and stay within the existing drainage channels;
6. Flume restoration including fish screens and fish passage channel at the Trout Creek intake;
7. Summerland Reservoir dam status and evaluation and sizing of an emergency spillway including drawdown procedure for the reservoir to a safe release discharge location;
8. Improvement of sludge handing at the WTP. The method, while cost effective, has seasonal and operational challenges. The addition of mechanical dewatering is being considered;
9. Improved access to PRV 10 vault in order to remove the Confined Space designation from this critical piece of infrastructure;
10. Continued separation of the irrigation and the domestic water systems;
11. Timing and expansion for upper watershed storage must be identified;
12. Okanagan Pump Station and integration into the overall water distribution system;
13. Assess the agricultural irrigation impacts to be expected due to Climate Change;
14. Reconciliation of existing licensing so that the District is meeting the legal requirements of the domestic and irrigation licenses. This is to include an assessment of the land area that may need water for agriculture in the future;
15. Integration of Summerland drought plan into the approach taken valley-wide to match Provincial coordination objectives;
16. Thirsk Reservoir flow monitoring and upgraded remote release capability;
17. Conformance to Worksafe BC regulation for safe entry procedures to all buried water vaults;
18. Utility renewal plans that provide the estimated renewal costs in 10-year blocks of time;
19. James Lake Pump Station fire pump start up and shut down operational issues.

The preceding issues were reviewed with District staff. Additional items that were added to the list included:

- Annual budget for water main renewal works;
- Decommissioning or increase maintenance of Eneas Dam and Tsuh Dam, both located in Eneas Provincial Park;
- The issue of the “second-domestic-services” which are defined as those 0.5-to-2.0-acre parcels of land with irrigation, is to be resolved through metering or some alternative method;
- Upgraded standards for facility security.

On-going risks and/or challenges that continue to face the District include:

- ☐ Provision of sufficient water through the existing infrastructure so that the number of Water Quality Advisories or Boil Water Notices are minimized;
- ☐ Continuing to meet the 43210 IHA water treatment objective;
- ☐ Protection for the watersheds, including Okanagan Lake, management of cattle and agriculture, the duty of care required for leased lots on the Headwaters reservoir-lakes, and monitoring septic tank effluent impacts in the Faulder area;
- ☐ Drought management plans in the event of an extended duration, valley-wide drought;
- ☐ Contamination / vandalism of the source water and or facilities;
- ☐ Developing a truer sustainability model for water supply for increased agricultural production. For the first time in many years, the farming by larger agricultural businesses is seeing the growth of vineyards and cherries. For the first time in decades, water is being required for the irrigation of new lands. Farming is also increasing to higher elevations resulting in new water demands for agriculture;
- ☐ Setting aside sufficient monies for system renewal;
- ☐ Integration of water system improvements with the other municipal services provided by the District such as sewer upgrading, road repair and replacement works.

These challenges continue to face the District. Recognition of these issues and having plans in place for how to monitor and address them is addressed in this report.

1.6 ABBREVIATIONS / TERMINOLOGY / UNITS / CONVERSIONS

The abbreviations used in this report are listed on the inside of the front cover for easy reference. Terminology and spelling of facility names are consistent with Provincial designations.

Units used within this report are primarily metric.
Volumes provided are in megalitres (ML = 1000 m^3) which is consistent with provincial reporting.
Areas are in hectares (100 ha. = 1.0 km^2).
Flow rates are provided in ML/day or L/s.

A conversion table for metric to Imperial units is provided on the back inside cover of this report.

1.7 ACKNOWLEDGEMENTS

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Summerland Municipal Council

- Toni Boot (Mayor)
- Doug Holmes — Doug Patan
- Erin Trainer — Erin Carlson
- Richard Barkwill — Marty Van Alphen

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- Jeremy Storvold — Director of Utilities
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2. CRITERIA

2.1 INTRODUCTION

The administration and operations of a water utility must address requirements of various Provincial and Federal regulatory agencies. This section provides a brief summary of those agencies and the criteria to be met in setting out a plan for water supply.

Criteria used in this report includes:

- Water regulator requirements (Interior Health);
- Provincial Ministry requirements;
- Water demand criteria;
- Hydraulic Engineering criteria used in water distribution system design;
- Land use and population growth criteria; and
- Financial and cost estimating criteria.

2.2 WATER ACTS AND REGULATIONS

As a District municipality, Summerland generally follows three levels of regulation, Federal regulations which includes oversight by the Department of Fisheries and Navigable Waters, Provincial regulations including those controlling water, and those of the water regulator Interior Health, whose authority is delegated to them by the Province.

The Provincial and Federal Acts set out the overlying principles. The regulations are typically tied to the Acts and set out the functional details for implementation. The regulations that most affects water supply are the Provincial Drinking Water Act & Regulation and the Forest and Range Practices Act,

Table 2.1 - Water Acts and Regulations

Federal Acts & Regulations	Relevance to District of Summerland Water
Canadian Environmental Assessment Act	Last amended 2017-06-22. Similar to Provincial act, applies across the country, sets out responsibilities, authority, review panel, cost recovery for damages, injunctions and offenses;
Canadian Environmental Protection Act	Enacted March 31, 2000; sets out administration, public participation, codes of practice, pollution prevention, controlling toxic substances and pollution, enforcement and miscellaneous items;
Canada Water Act	Last amended April 1, 2014; Sets out provincial – federal arrangements for management of water resources including comprehensive water resource management plans. Includes pollution of waters, water quality management, inspectors, analysts, offenses and punishments.
Fisheries Act	Last amended 2016-04-05, An act respecting fisheries, addressing fish, fish habitat and practise and intentions of what is not permitted along and within wetlands, lakes, streams and rivers. Summerland is impacted along all wetlands streams and lakes where there may be fish present.
Navigation Protection Act	Last amended on 2017-06-22. An act respecting the protection of navigable waters. Influence of this act may impact on lake intakes, WWTP outfalls, boat launches, etc.

Provincial Acts & Regs.	
Dam Safety Regulation	Last amended Feb 29, 2016; Provides dam rating criteria and classification, requirements for Operation, Maintenance and Surveillance, Dam Emergency plans, reporting and record keeping, and the assessment of hazardous activities at a Dam;
Dike Maintenance Act	Current to Sept 4, 2019; Act that sets out the authority and powers for the inspector of dikes for maintenance, monitoring and repairs as required
Drinking Water Protection Act.	Assented to April 11, 2001; Sets out the requirements for the protection of drinking water with the assignment of Drinking Water Officers, Operating permits, qualitied system operators, emergency response and contingency plans, water quality monitoring reqt's, protection of systems, etc.
Drinking Water Protection Regulation	Last amended Nov. 15, 2018; Sets out standards for Potable water, treatment, construction permits, operating fees, temporary facilities, public reporting, Emergency response and contingency plans, well floodproofing, etc.
Environmental Management Act	Assented to Oct 23, 2003; Sets out prohibitions and authorizations related to the public, municipal waste management, contaminated sites, water management facilities pollution prevention and Conservation Officer service and enforcement tools;
Forest and Range Practices Act.	Assented to Nov 21, 2002; is currently in the process of being upgraded. This act sets out Forest Stewardship plans, plans for range and forestry in the watershed including requirements for the protection of the environment and protection of resources;
Groundwater Protection Regulation	Last amended June 10, 2016; Sets out the requirement for registration of wells and drillers, defining wells for water supply, permanent dewatering or site recharge wells, including details on liners, surface seals, well yield testing, well caps and identification
Mines Act	Current to Sept 4, 2019; Act that sets out authority, powers to inspectors, permitting, engineering reporting, manager appointment, supervision and mining plans, and reporting;
Parks Act	Current to Sept 4, 2019; Act that sets out classifications of parks, sets powers over Crown Lands, sets out requirements and allowances for various activities on park land, permitting, fees, and natural resource tenures.
Riparian Areas Regulation	Last amendments to Feb 29, 2016; Provides framework for the protection of riparian areas, stream banks, lakeshore and sets out the requirements for assessment reports prior to development, including development of strategies for monitoring, enforcement and education;
Water Sustainability Act	Replaced the Water Act, Enacted Feb 29, 2016.
Water Sustainability Regulation	Last amended March 6, 2019. Sets out rules and requirements for water licensing, applications for drilling, amendments to water licenses, transfers of appurtenances, and licensing application procedures;
Water Utility Act	Current to Sept 4, 2019 Act that does not apply to a municipality but does apply to private suppliers that provide water and receive compensation;

2.3 WATER QUALITY CRITERIA

The critical act and regulations for the District of Summerland Water Utility to be concerned with are the Water Sustainability Act, the Drinking Water Protection Act and regulation and the Forest Range and Practices Act. These regulations are all tied to water quality.

Regarding Drinking Water, the District of Summerland is obligated to meet the Drinking Water Act and Regulation that sets out the standards for water supply for public and private utilities. The regulation is outcome based and does not set out stringent requirements for individual water quality parameters such as turbidity, colour, etc., but leaves this to the discretion of the Drinking Water Officer. The powers of the Drinking Water Officer are delegated by the Province to the local Health Authorities throughout the Province. For the District of Summerland, that authority lies with the Medical Health Officer at Interior Health who is currently Dr. Silvina Mema.

Regarding water quality parameters, Interior Health has improved their policies in the past 10 years and is in conformance with the larger industry criteria for drinking water following the Guidelines for Canadian Drinking Water Quality for specific physical parameters of water such as color, turbidity, disinfection of protozoa and monitoring and reduction of THMs.

For the design of new water systems and the supply of drinking water the IHA engineering group, who review all plans and specifications require that water meet the 4, 3, 2, 1, 0 protocol.

The Summerland Water Treatment Plant provides treatment through chemical addition through an ActiFlow process using ballasted floc, followed by filtration to produce a high-quality treated water. The plant is able to treat flows up to 75 ML/day.

Interior Health Authority Requirements

The Interior Health Authority has stated that they expect that the following water quality 4,3,2,1,0 protocol be achieved by all larger water utilities in the Southern Interior: Filtration is expected of all utilities by 2025. The treatment protocol consists of the following criteria:

- 4 log (99.99%) removal and/or inactivation of Viruses;
- 3 log (99.9%) removal and/or inactivation of *Giardia Lamblia and Cryptosporidium;*
- 2 types of treatment processes including at least one form of disinfection;
- Less than 1.0 NTU Turbidity units year-round;
- Zero *Fecal Coliforms* in the distribution system.

Since the 2008 Water Master Plan, the Garnett Reservoir source was dedicated to be used only for irrigation. The Garnett Valley water system separation project in 2017 included the installation of 5.3 km of new watermain of various sizes. The irrigation water is still disinfected to maintain control of biofilm within the transmission main pipe walls, but the irrigation water is not considered to be potable.

For the development of additional water supply from Okanagan Lake, the Public Health Engineer have suggested that the water must be filtered. This requirement is good practise, however the costs to accomplish it are financially onerous. The same desired safe health outcomes can be achieved through enhanced disinfection processes. The approach for accessing raw water from Okanagan Lake is discussed further in Section 4 of this report.

2.4 Water Demand Criteria

Domestic Water Use Criteria

Water demand criteria utilized for the engineering analysis included the actual water demand as determined by existing meter readings, data developed in the assembly of the computer model, and design criteria as set out in the Subdivision Bylaw. To assess the existing water system conditions and performance, the best estimate of actual water demands was used. These criteria are summarized in Table 2.2. For the analysis of future development areas, the recommended revised bylaw criteria set out below was utilized.

Condition	Bylaw	Recommended Bylaw	Long Term
Average Day Demand (ADD)	1,000 L/ca/day	900 L/ca/day	500 L/ca/day
Maximum Day Demand (MDD)	3,000 L/ca/day	1,800 L/ca/day	1,500 L/ca/day
Peak Hour Demand (PHD)	5,000 L/ca/day	1.5 x MDD flow rate	1.5 x MDD

In the past 15 years, the per capita (per person) water demand number throughout the Okanagan has continued to be reduced. There are several reasons including the increased cost for water, reduced availability, less water application to land, metering, public awareness and inclining block pricing of municipal water. Water distribution system existing design parameters and proposed revisions are presented in Table 2.2.

Recommendation:
For upcoming bylaw update, that Summerland consider reducing the design maximum daily water demand (MDD) criteria to 1,800 L/ca/day.

Irrigation Water Use Criteria

A review of water use on agricultural parcels was estimated based on the arable lands tax roll, volume of water utilized and parcel size. There are issues with respect to the accuracy of the assessment as there are many parcels that are in full production and many that do not require intensive irrigation.

The District taxes a total of 1,417 ha. of arable lands of which 1,292 ha. are considered to be in agricultural production. The Ministry of Agriculture and Lands (MoAL) was contacted to obtain information from their *Agricultural Water Demand Model* which contains a GIS crop inventory. Their numbers, which are preliminary, have 1,204 hectares of land in production at the current time with another 62 ha. of miscellaneous land use. The MoAL numbers agree reasonably well with the District's arable lands assessment of 1,292 ha. of lands greater than 0.20 ha. in size. The MoAL database has another 1,531 ha. of lands within the District that are not in production.

The original 1973 ARDA assessment report stated that the total design water supply service area for Summerland was 1,476 ha. The water utilities in the Central Okanagan have used an allocation of 685mm of annual water depth (27 inches) per area for several years with good success. Summerland is slightly drier than the Central Okanagan and with an estimated normalized water demand of 8,927 ML for all uses. An allocated annual depth of 800 mm should be considered sufficient for the service area.

Fire Protection Criteria

Agua Consulting Inc. assists Summerland in carrying out development reviews for the District engineering department. With many new developments, there is a fire supply requirement. There are two instances to consider:

1. For subdivisions, Summerland follows the Fire Underwriters Survey guidelines for the development of their community water system. The application of the FUS guidelines is appropriate and should continue as it has provided the development community with a consistent and legally defendable standard to follow;
2. For building development, FUS calculations are currently accepted. For buildings, the BC Fire Code governs new building development. As the Provincial Fire Code references National Fire Protection Association (NFPA) standards, it may be more appropriate and defendable for Summerland to require fire flow calculation estimates for new buildings that are consistent with the estimates within the NFPA.

Recommendation:
<u>For new building development only</u>, the Summerland building department and water system staff require fire flow calculations for building fire protection that are in conformance with NFPA standards, in particular NFPA 13, Automatic Sprinkler Systems Handbook;

Table 2.2 Water System Design Parameters

	Criteria	Existing Condition (analysis of ex. areas)	Current Summerland Bylaw Criteria	Utilized Criteria (analysis of new areas)
1.	**Population (persons/connection)** Single family unit Multi-family unit	 2.50 1.67	 3.0 2.0	 3.0 2.0
2.	**Base (Indoor) Demand (L/ca/day)** Single family unit Multi-family unit Leakage	 155 155 23.11 L/s	 n/a n/a	 400 (for indoor & MF) 400 (for indoor & MF)
3.	**Average Daily Demand (L/conn/day)** Single family unit Multi-family unit	 1,725 1,152	 3,000 2,000	 1,808 1,205
4.	**Max Day Water Demand (L/conn/day)** Single family units Multi-family units		 9,000 6,000	 7,200 4,800
5.	**Pk Hr Water Demand (L/conn/day)** Single family units Multi-family units	1.5 x MDD	1.667 x MDD	1.5 x MDD
6.	**Fire Demand (minimum required)** Single family units Multi-family units Commercial – Shopping Centres Institutional Industrial - Downtown	L/s 60 L/s for 2.0 hrs 90 L/s for 2.0 hrs 150 L/s for 2.5 hrs 150 L/s for 3.0 hrs 225 L/s for 3.0 hrs	L/s 60 L/s for 2.0 hrs 90 L/s for 2.0 hrs 150 L/s for 2.5 hrs 150 L/s for 3.0 hrs 225 L/s for 3.0 hrs	Must meet District Subdivision Bylaw minimum or greater if required in accordance with FUS
7.	**Water Quality (GCDWQ)** Colour , Turbidity, THMs Coliforms, Chlorine Residual Levels	Set with WTP project works	Same as WTP project criteria	Criteria is set by the Interior Health Authority (IHA)
8.	**Disinfection**			To meet IHA requirements
9.	**Pressures** Static (maximum) Dynamic at ADD (minimum) Dynamic at PHD (minimum) Residual during MDD + FF (minimum)	 150 psi 40 psi 36 psi 20 psi	 150 psi 40 psi 36 psi 20 psi	 150 psi 40 psi 36 psi 20 psi
10.	**Reservoir Storage** A + B + C criteria	A = Balancing storage of 25% of MDD B = Fire (as per FUS) C = Emergency storage 25% of A + B	as per Subdivision Bylaw	A = Balancing storage of 25% of MDD B = Fire (as per FUS) C = Emergency storage 25% of A + B
11.	**Pump Station Criteria** with balancing storage on-line	Pump MDD with largest pump out of service in the station Pump PHD and/or MDD + FF with stand-by power provided.	Pump MDD with largest pump out of service in the station Pump PHD and/or MDD + FF with stand-by power provided.	Pump MDD with largest pump out of service in the station Pump PHD and/or MDD + FF with stand-by power provided.

2.5 PROJECTED GROWTH

The District of Summerland Official Community Plan is the document adopted by Council for identifying future land use and development. Water supply planning is intended to match that document. From 1921 to the present, the growth rate in Summerland has averaged 1.87% per year, with recent years being lower than 1.00%. The 2015 OCP forecasts a growth rate for Summerland of 0.75%. That document also defines an Urban Development boundary of where densification is planned for the downtown core.

Population data is summarized in this section to Census data shows that from 1921 to 2021, the population of Summerland grew from 1,892 persons to 12,042. The growth was relatively steady. The data is tabulated on Table 2.3 and illustrated on Figure 2.1.

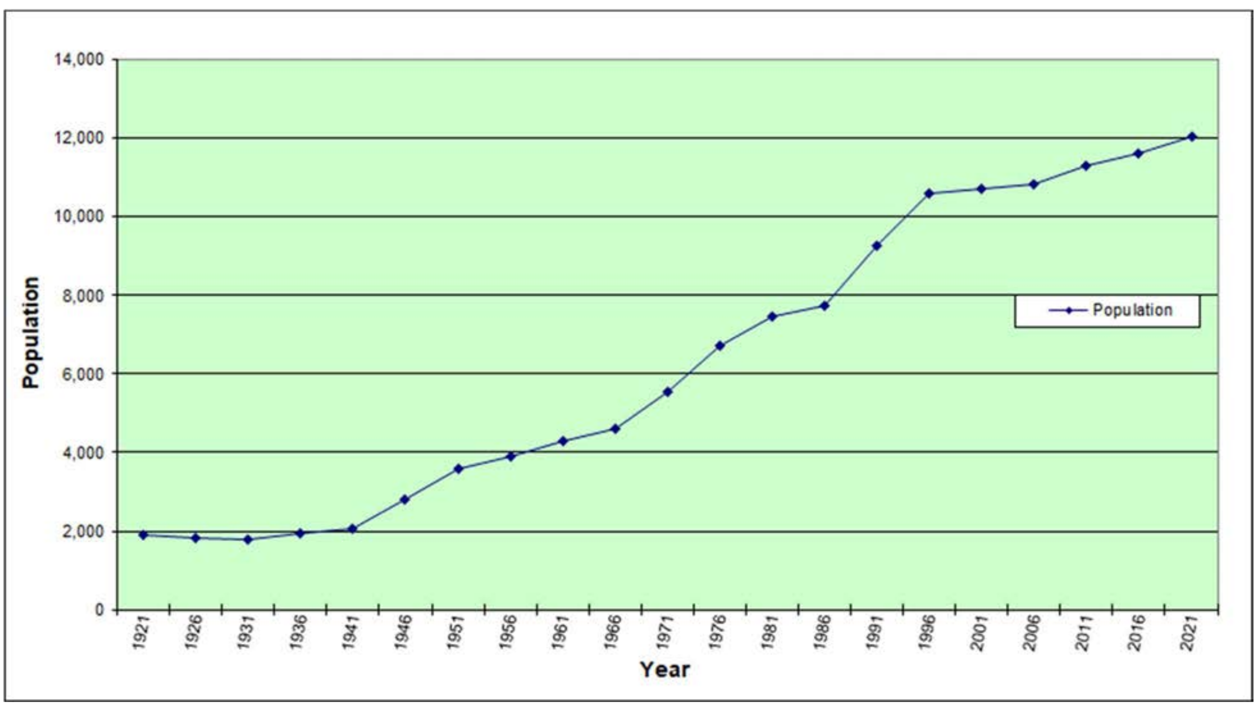
The agricultural base was the core industry for the community. The growth rates in the District were highest between 1941-51, 1966-76, and from 1986-96.

The historic rates presented here will be considered when projecting forwards with population growth and forecasting future water demands. The 2021 Census data has just been released at the time of final release of this report.

Table 2.1 - Summerland Population Growth

Year	Summerland Population	Growth Rate over Current 5 Year Period	Aggregate Growth Rate Total Since 1921
1921	1,892		
1926	1,842	-0.529%	-0.534%
1931	1,791	-0.554%	-0.547%
1936	1,923	1.474%	0.108%
1941	2,054	1.362%	0.412%
1946	2,811	7.371%	1.596%
1951	3,567	5.379%	2.136%
1956	3,893	1.828%	2.083%
1961	4,307	2.127%	2.078%
1966	4,585	1.291%	1.986%
1971	5,551	4.214%	2.176%
1976	6,724	4.226%	2.332%
1981	7,473	2.228%	2.316%
1986	7,755	0.755%	2.194%
1991	9,253	3.863%	2.293%
1996	10,584	2.877%	2.322%
2001	10,713	0.244%	2.191%
2006	10,828	0.215%	2.074%
2011	11,280	0.835%	2.004%
2016	11,615	0.594%	1.929%
2021	12,042	0.735%	1.868%

Figure 2.1 District of Summerland – Population Growth (1921 – 2021)



2.6 FINANCIAL CRITERIA

Cost estimates are prepared in year 2019 dollars. The cost estimates include an engineering allowance of 10% on the estimated capital cost, and a contingency allowance of 20% on the capital and engineering costs unless otherwise noted. Goods and Services Tax is not included in the cost estimates as all municipalities in BC recover this charge from the Federal Government. For the cost estimates, unless noted as provided by a third party, the following formula was used.

TOTAL COST = (Estimated Capital Construction Cost + 10% engineering allowance) + 20% contingency allowance.

It is noted that construction costs have continued to escalate in the Okanagan Valley. Most of the cost estimates are developed based on unit prices. They reflect our best estimates of the escalated costs.

Although interest rates recently reached a 50-year low, we believe that the numbers used within the analysis should reflect slightly higher values for forecasting for the next 10 years. Criteria for financial analyses is as follows:

- Long term Analysis period 25 years
- Amortization rate 2.50 %
- Return of Investment 1.50 %
- Inflation rate (CPI) 2.00 %
- Construction cost inflation rate (CCI) 2.50 %

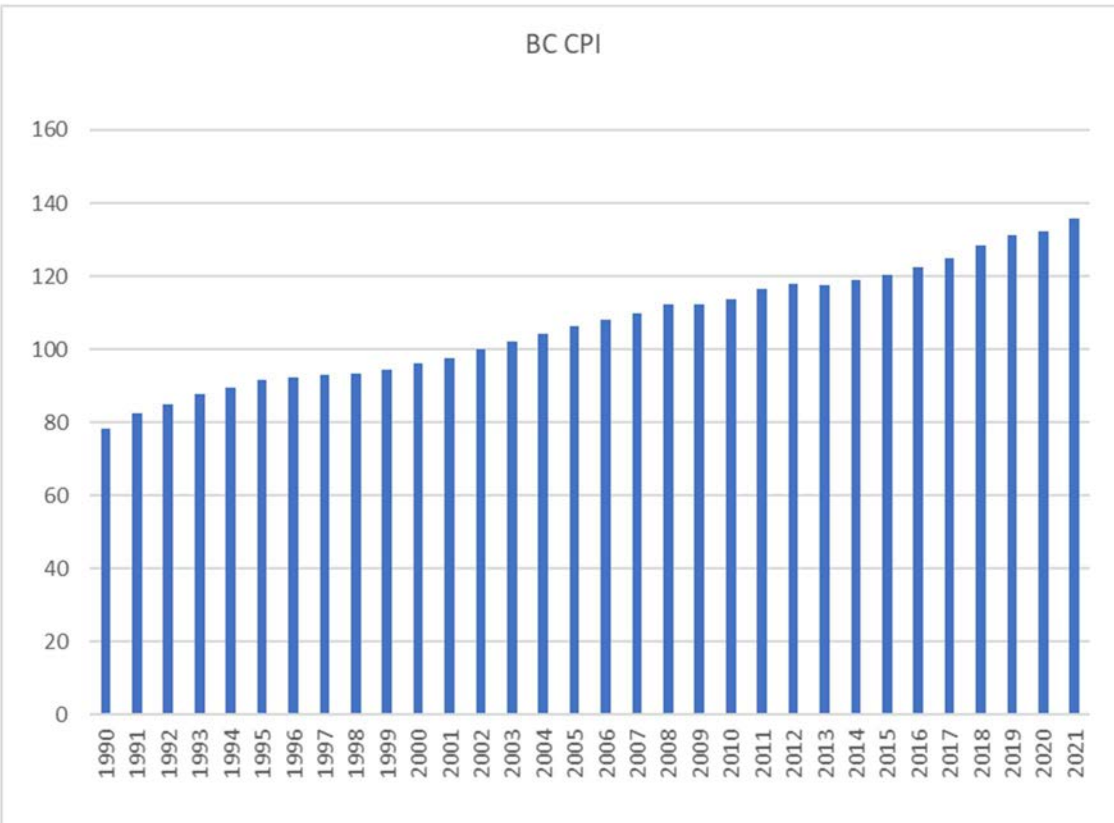
While a longer analysis period was built into the spreadsheets, the focus of the exercise was to develop an economic tool that would provide reasonable results for the first 10 years and guidance on issues to expect within a 25-year horizon.

Table 2.4 Estimated Construction Inflation (Construction Cost Indices)

Year	BC CPI	Calc. %	Canada CPI	CCI Est. %	CCI	RSMeans	RSMeans	RSMeans
1990	78.4		78.4		**1.000**		94.3	1.000
1991	82.6	5.08%	82.8	2.50%	**1.025**	2.65%	96.8	102.65%
1992	84.8	2.59%	84.0	2.50%	**1.051**	2.69%	99.4	105.41%
1993	87.8	3.42%	85.6	2.50%	**1.077**	2.31%	101.7	107.85%
1994	89.5	1.90%	85.7	2.50%	**1.104**	2.65%	104.4	110.71%
1995	91.6	2.29%	87.6	2.50%	**1.131**	3.07%	107.6	114.10%
1996	92.4	0.87%	88.9	2.50%	**1.160**	2.42%	110.2	116.86%
1997	93.1	0.75%	90.4	2.50%	**1.189**	2.36%	112.8	119.62%
1998	93.4	0.32%	91.3	2.50%	**1.218**	2.04%	115.1	122.06%
1999	94.4	1.06%	92.9	2.50%	**1.249**	2.17%	117.6	124.71%
2000	96.1	1.77%	95.4	2.50%	**1.280**	2.81%	120.9	128.21%
2001	97.7	1.64%	97.8	2.50%	**1.312**	3.47%	125.1	132.66%
2002	100.0	2.30%	100.0	3.00%	**1.351**	2.88%	128.7	136.48%
2003	102.2	2.15%	102.8	5.00%	**1.419**	2.56%	132	139.98%
2004	104.2	1.92%	104.7	12.00%	**1.589**	8.86%	143.7	152.39%
2005	106.3	1.98%	107.0	12.00%	**1.780**	5.50%	151.6	160.76%
2006	108.1	1.67%	109.1	8.00%	**1.922**	6.86%	162	171.79%
2007	110.0	1.73%	111.5	3.00%	**1.980**	4.57%	169.4	179.64%
2008	112.3	2.05%	114.1	2.50%	**2.030**	6.49%	180.4	191.30%
2009	112.3	0.00%	114.4	2.50%	**2.080**	-0.17%	180.1	190.99%
2010	113.8	1.32%	116.5	2.50%	**2.132**	1.89%	183.5	194.59%
2011	116.5	2.32%	119.9	2.50%	**2.186**	4.20%	191.2	202.76%
2012	117.8	1.10%	121.7	1.48%	**2.218**	1.78%	194.6	206.36%
2013	117.7	-0.08%	122.8	0.90%	**2.238**	3.39%	201.2	213.36%
2014	118.9	1.01%	125.2	1.92%	**2.281**	1.84%	204.9	217.29%
2015	120.2	1.08%	126.6	1.11%	**2.306**	0.63%	206.2	218.66%
2016	122.4	1.80%	128.4	1.40%	**2.338**	0.53%	207.3	219.83%
2017	125.0	2.08%	130.4	1.53%	**2.374**	3.04%	213.6	226.51%
2018	128.4	2.65%	133.4	2.25%	**2.428**	4.35%	222.9	236.37%
2019	131.4	2.28%	136.0	1.91%	**2.474**	1.97%	227.3	241.04%
2020	132.4	0.76%	137.0	0.73%	**2.492**	3.40%	235.03	249.24%
2021	135.9	2.58%	141.4	3.11%	**2.570**	*2.97%*	*242*	*256.63%*
AVE. ANNUAL 2011-21		**1.76%**		**1.95%**		**3.49%**		

Table 2.4 summarizes the best available data that we have for construction prices in the Okanagan. The consumer price index for BC and for Canada, and the estimated construction cost indices (CCI) for the Okanagan are listed in the table. The BC Consumer Price Index is illustrated in Figure 2.2. Notable increases were experienced in 2021 due to the COVID pandemic and then the hydrological flooding events of December 2021 that affected supply chains and the transport of products.

Figure 2.2 BC Consumer Price Index



Note that the CPI was available to November 2021 and an estimate of 0.3 basis points was added to estimate year end 2021.

3. WATER SOURCE ASSESSMENT

3.1 INTRODUCTION

This section provides a review of Summerland's existing water sources and supply reliability. Included is an update to water licensing, water source capacity, and factors affecting the source water capacity and quality. A summary of existing problem areas and remedial works is presented in this section.

3.2 EXISTING WATER SUPPLY

The District serves a population of 12,042 persons (2021 census) and provides irrigation water for 1,292 ha. of agriculture. The water system is a combined domestic and irrigation system that is supplied water from two watersheds, Trout Creek and Eneas Creek.

District of Summerland – Aerial View from SE

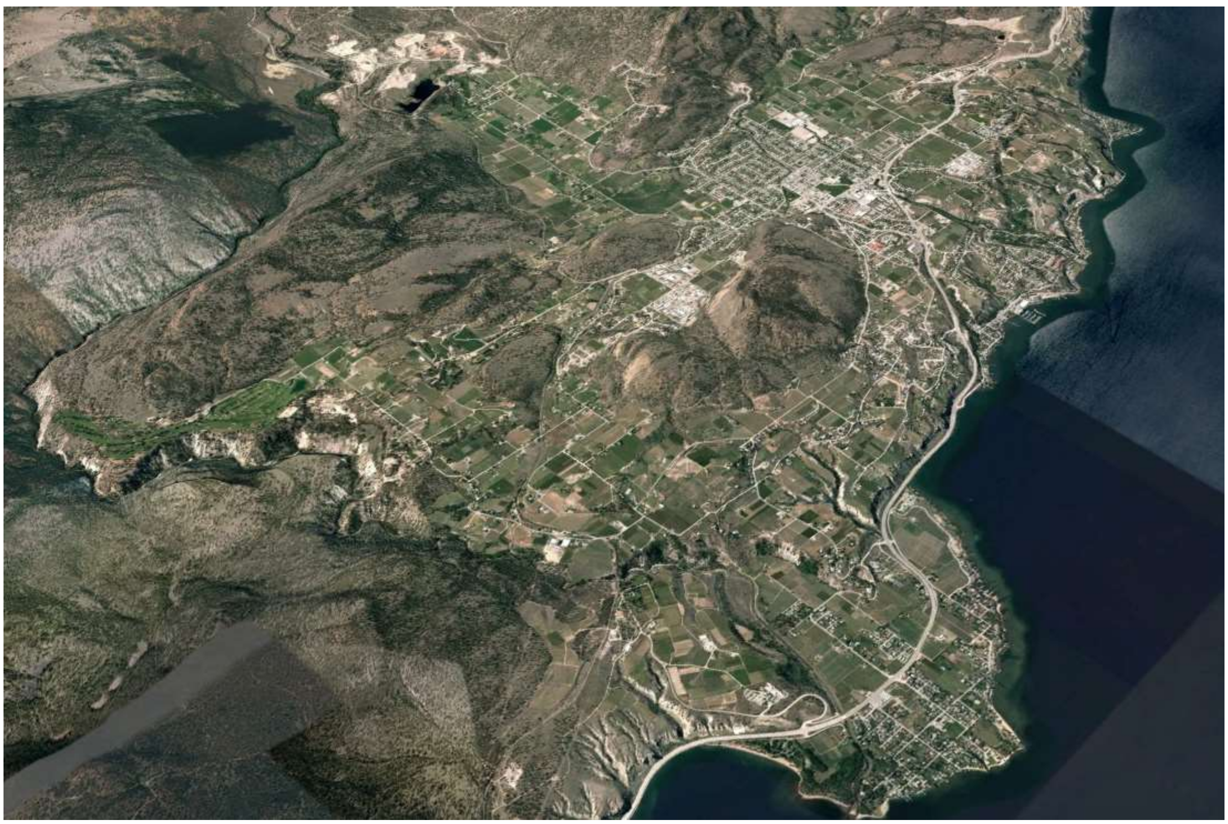


Image source: Google Earth

The source supply from the two watersheds has adequately served the service area for over 100 years, however recently with the multiple commitments for instream flow needs and shared resources, there has been greater pressure to meet all demands.

Currently the District does not utilize water from Lake Okanagan but has licensing to do so. The development of Okanagan Lake has been delayed due to funding issues, however is still in the works and re-application for licensing is required.

There are two groundwater wells that were developed in 2003-2004 located on the Summerland Rodeo Grounds in proximity to the Trout Creek supply flume. The wells have limited capacity and are currently not-in-use due to high levels of radioactive substances.

This assignment is focused on the District water utility. The specific study area encompasses all lands within the existing District of Summerland municipal limits serviced by the District Water Utility. The study area includes the Trout Creek and Eneas Creek community watersheds, the local aquifers, the water distribution system service area and lands surrounding the District that may be viable as future development areas.

3.3 WATER LICENSING

The water for Summerland is available from four water sources; Trout Creek, Eneas Creek, Okanagan Lake, and groundwater. The primary source of water is Trout Creek, from which 85% of the water is obtained annually. Water is licensed by the Province of BC to the end user, usually in the form of a "Conditional License". Links to critical licensing web pages are provided as follow:

Provincial Water License Query webpage is: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input

Provincial Scanned Water License Directory is: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/

The licenses are issued by the Province to Summerland in one of three forms:

- **Storage: (STO)** This type of license allows the water supplier to hold excess runoff water from a stream in a storage reservoir and then release it during lower flow times of the year in a manner that will not have a negative impact on lower downstream flow requirements in the creek (such as water for conservation or fisheries). This type of license is reported in the form of cubic metres per year (MY). Storage licensing is tied to either WWLA licensing or IRR licensing;
- **Waterworks Local Authority (WWLA):** WWLA licensing is a usage license. It is the normal license issued for typical domestic water uses by a community. It can be used any time during the year for the purposes of domestic, industrial, lawn and home irrigation, commercial uses and any other typical uses within a community. This type of license is reported by the Province in the form of cubic metres per year (MY);
- **Irrigation (IRR):** Irrigation licensing is also a usage license. It is the normal license issued for irrigation activities to support agriculture. These licenses have time frames of when the water can be used, typically from April 1 to September 30 annually. They are typically issued in conjunction with storage licenses. These licenses are issued in the form of cubic metres per year (MY) per year. The irrigation license is typically assigned to a water supplier with a defined service area. The depth of irrigation is assigned to a specific land area with a set depth of water allowed over the Irrigated or "Graded" lands. In the case of Summerland, the arable land that pays tax receives this water.

Table 3.1 provides a summary of all water licenses currently held by the District of Summerland. The licenses are converted to megaliters per year (ML/yr.) which is equivalent to 1,000 m3/year. Please note that although there are 40 lines of licensing, there are only 25 licenses. Several licenses have multiple points of diversion (PD) from which water can be withdrawn on a reservoir or stream course.

Table 3.1 District of Summerland – Existing Water Licences Summary *(Current as of Dec, 2021)*

Lic. No	Stream Name	Purpose	Quantity	Units	Storage	WWLA	Irrig.	Status	Priority	Point of Diversion
C014568	Trout Creek (Thirsk)	Stream Storage Non-Power	3244052	MY	3244			Current	19400626	PD54524
C014569	Trout Creek	Waterworks Local Provide	414830.7	MY		415		Current	19400626	PD54712
C016412	Trout Creek	Irrigation Local Provide	3910132	MY			3910	Current	18881218	PD54712
C016413	Trout Creek	Irrigation Local Provide	7400880	MY			7401	Current	19030711	PD54712
C016414	Isintok Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54500
"	Tsuh Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54503
"	Crescent Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54802
"	Crescent Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54800
"	Headwater 3 Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54820
"	Trout Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54818
"	Headwater 4 Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD54821
"	Trout Creek	Stream Storage Non-Power	6784140	MY	6784			Current	19260326	PD54816
"	Whitehead Creek	Stream Storage Non-Power	6784140	MY				Current	19260326	PD56951
C016415	Eneas Creek	Irrigation Local Provide	3700440	MY				Current	18890801	PD54598
"	Eneas Creek	Irrigation Local Provide	3700440	MY				Current	18890801	PD54597
"	Latimer Creek	Irrigation Local Provide	3700440	MY				Current	18890801	PD54629
"	Eneas Creek	Irrigation Local Provide	3700440	MY				Current	18890801	PD54628
"	Eneas Creek	Irrigation Local Provide	3700440	MY			3700	Current	18890801	PD54627
C016416	Eneas Creek (Garnet)	Stream Storage Non-Power	2466960	MY	2467			Current	19130429	PD54596
"	Finlay Creek (Garnet)	Stream Storage Non-Power	2466960	MY				Current	19130429	PD54585
C029847	Trout Creek (Headwaters 1)	Stream Storage Non-Power	925110	MY	925			Current	19610518	PD54818
C030786	Whitehead Creek	Stream Storage Non-Power	273832.6	MY	274			Current	19650628	PD56951
C030787	Headwater 3 Creek	Stream Storage Non-Power	308370	MY	308			Current	19650628	PD54820
"	Headwater 4 Creek	Stream Storage Non-Power	308370	MY				Current	19650628	PD54821
"	Trout Creek	Stream Storage Non-Power	308370	MY				Current	19650628	PD54816
C032615	Okanagan Lake	Waterworks Local Provide	2654917	MY		2655		Current	19670606	PD54692
C034398	Crescent Creek	Stream Storage Non-Power	314537.4	MY	315			Current	19670606	PD54800
C034399	Crescent Creek	Stream Storage Non-Power	1233480	MY	1233			Current	19670606	PD54801
C034400	Whitehead Creek	Stream Storage Non-Power	429251	MY	429			Current	19670717	PD56951
C056161	Eneas Creek	Irrigation Local Provide	30837	MY			31	Current	19480318	PD54597
C056869	Eneas Creek	Stream Storage Non-Power	444052.8	MY	444			Current	19800624	PD54596
C060898	Trout Creek	Irrigation Local Provide	1850220	MY			1850	Current	19730803	PD54712
"	Trout Creek	Waterworks Local Provide	968317.8	MY		968		Current	19730803	PD54712
C066455	Trout Creek	Irrigation Local Provide	3083700	MY			3084	Current	19880602	PD54712
C066491	Trout Creek	Irrigation Local Provide	92511	MY			93	Current	19410526	PD54712
C106027	Thirsk Lake	Storage	2466960	MY	2467			Current	19930122	PD67252
C106243	Prairie Creek	Land Improve: General	0	TF				Current	19930217	PD67436
C106464	Eneas Creek	Land Improve: General	0	TF				Current	19940421	PD70241
C126858	Okanagan Lake	Waterworks Local Provide	3455028	MY		3455		Current	20031022	PD78202
F066492	Trout Creek	Irrigation Local Provide	859735.6	MY			860	Current	18881218	PD54712
"	Trout Creek	Waterworks Local Provide	8296.614	MY		8		Current	18881218	PD54712
F066493	Trout Creek	Irrigation Local Provide	6167.4	MY			6	Current	18901220	PD54712
Okanagan Lake Licenses						**6,110**				
Trout Creek Licenses					**15,980**	**1,391**	**17,203**			
Garnet Valley Licenses					**2,911**	**0**	**3,731**			
TOTAL WATER LICENSING IN ML / YEAR					**18,891**	**7,501**	**20,935**			
Total number of Licences and/or Applications found is **25**									Current as of July 4, 2019	

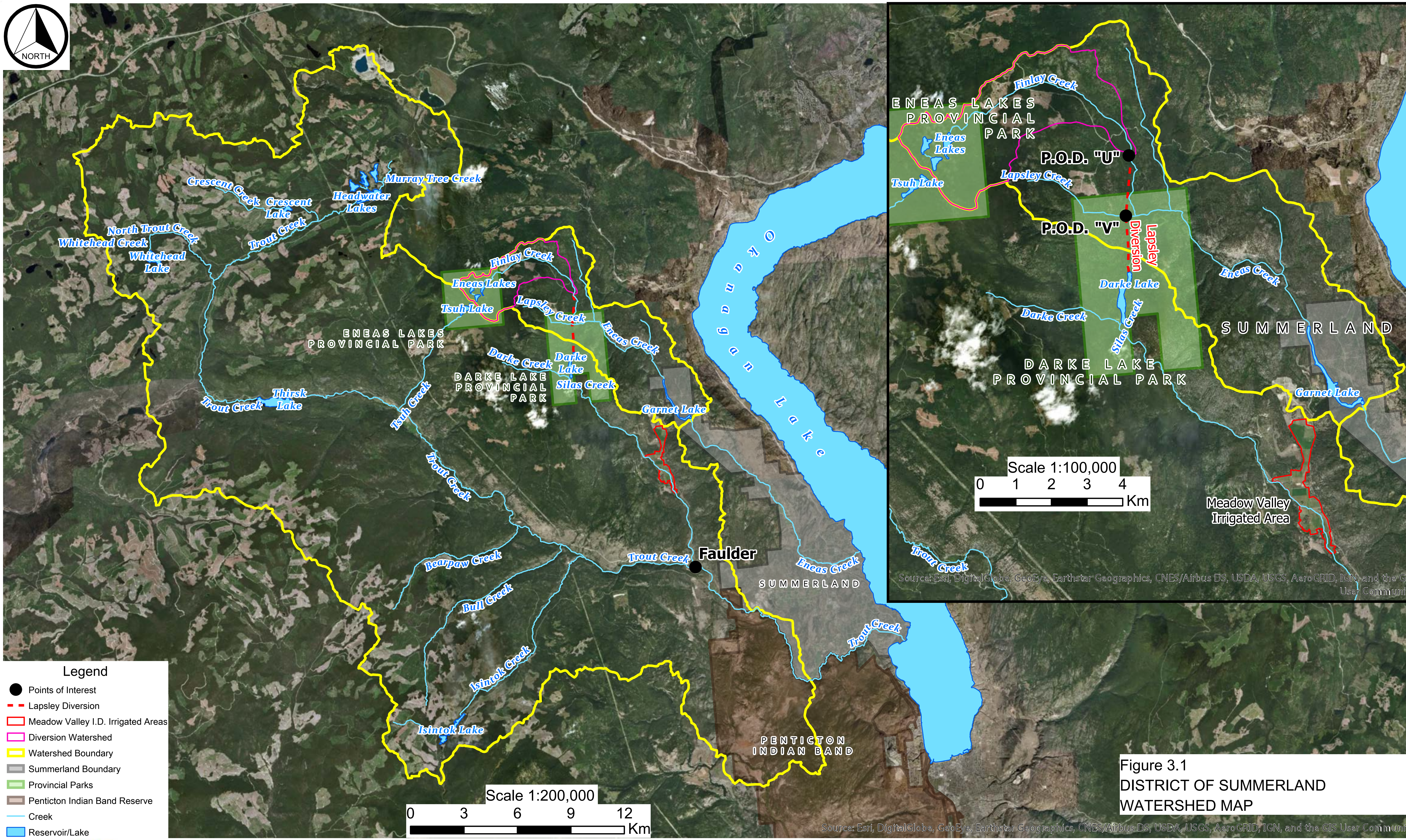


Figure 3.1
DISTRICT OF SUMMERLAND
WATERSHED MAP

DISTRICT OF SUMMERLAND

CTQ

Agua Consulting Inc.
"Engineered Water Solutions"

RESIDUAL WATERSHED LICENSES

A license database search was conducted to determine the volume of water licensed in the watersheds that are not controlled by Summerland. The licenses and their volumes are listed below.

- **Trout Creek Mainstem Watershed:**

18	Domestic Licenses	2.273 m3/day	14.93 ML/yr.
4	Domestic Licenses	1.137 m3/day	1.66 ML/yr.
11	Irrigation Licenses		284.03 ML/yr.
1	Power License (non-consumptive)	2.40 m3/second	75,555 ML/yr.

- **Darke Creek Watershed:**

4	Irrigation Licenses	1,107.9 ML/yr.
1	Diversion License Lapsley/Finlay Ck to Darke Lake (C029859)	615.6 ML/yr.
1	Storage License (Darke Lake)	795.6 ML/yr.

- **Eneas Creek Watershed:**

1	Conservation License (Fish & Wildlife Conserv.) 0.085 m3/s	2,680.0 ML/yr.
1	Conservation-Storage (Garnett Valley Ranch)	5.1 ML/yr.
1	Land Improvement Licenses	1.2 ML/yr.

LICENSING ADJUSTMENTS

As per earlier reports including the 2014 Water Allocation Report, adjustments in the licensing for Summerland should be considered for the following areas:

- **Okanagan Lake:** Two WWLA licenses are held on OK Lake, one at existing Lower Town site, and a second issued in 2011 that is located in Trout Creek on Wharf Street. Summerland's current plan is for a lake intake at Powell Beach Park. The existing licenses will require that their Point of Diversion (POD) be relocated to the new intake site. The allotment of these license is sufficient to meet the 20 ML/day capacity planned for the Okanagan Lake pump station.
- **Additional Capacity:** No additional license capacity is required by the District of Summerland for the foreseeable future; however, adjustments to existing licenses should be done so that licensed storage matches existing storage. The forecasts for future water demand are presented in Section 5 of this report.

Recommendation:
Trout Creek Watershed:
There is 6,490 ML of existing storage at Thirsk Reservoir. The amount licensed is only 5,709 ML. There is a shortfall in storage licensing of approximately 781 ML. The Headwaters Reservoirs holds 4,640 ML of storage while there is 5,857 ML of licensed storage at these four reservoirs. Reconciliation/adjustment of these licensed volumes is recommended;

Recommendation:
Shortfall in Domestic Licensing:
Summerland holds only 1,391 ML/Yr of domestic water licensing on Trout Creek. This is insufficient to supply the needs of the District as the system is currently operated. Summerland should apply for 4,000 ML of domestic licensing on Trout Creek. If unsuccessful, the District should work to transfer irrigation licensing to domestic to ensure they are legally licensed under the provincial rules.

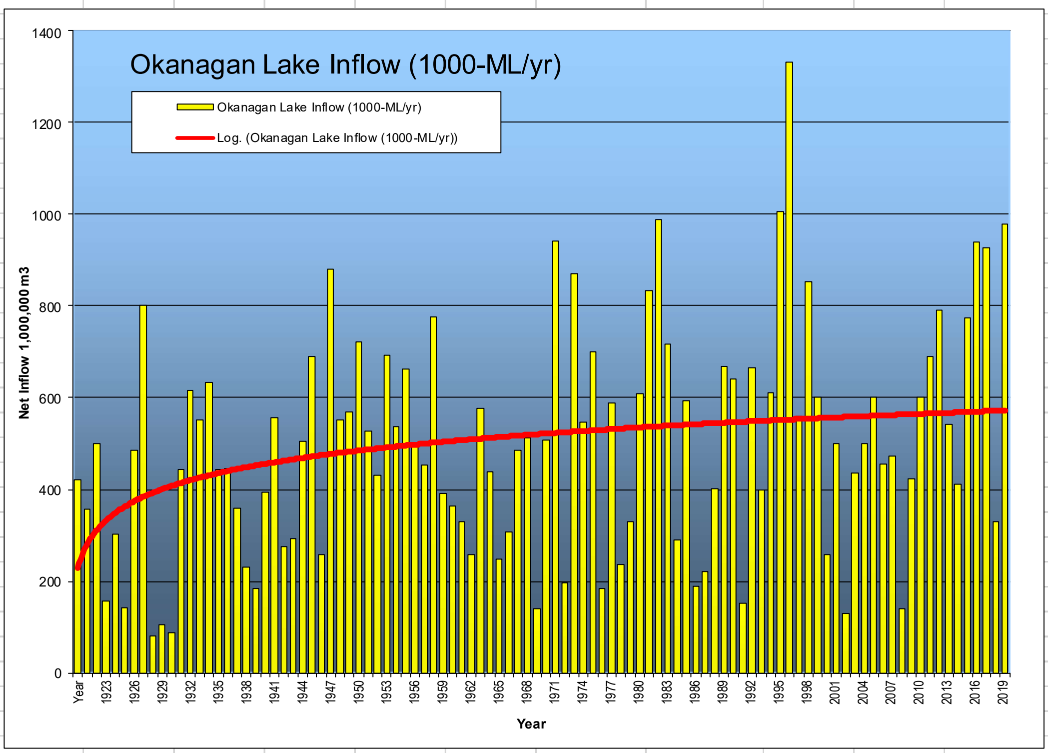
3.4 Water Sources

Summerland currently relies on the two watersheds, Trout Creek and Eneas Creek for its water supply. There is some small supplemental flow available from groundwater but this could provide only very limited capacity. This section provides an update of the watershed characteristics for Trout Creek and Eneas Creek, including the storage reservoirs, dams, catchment areas, capacity and reliability. Figure 3.1 provides an illustration of the existing Trout Creek and Eneas Creek watersheds and storage reservoir lakes.

Of note is the change in watershed production in recent years. The cycles of drought to wet years appears to be magnified with greater peak flows and more intense dry periods. To provide some perspective to the regional climate changes and the impacts on the watersheds, the trended outflow from the Okanagan Basin from 1921 to present day is provided. The last 20 years from 1999 to 2018 is compared to the long-term history of some 97 years. The last 20 years have shown 8.5% higher runoff volume than the 100-year average. The long-term trended average is presented as Figure 3.2

Figure 3.2 - Okanagan Lake Inflow - Long Term Trend (in 1000-ML)

1992	153
1993	666
1994	400
1995	610
1996	1007
1997	1331
1998	560
1999	852
2000	600
2001	257
2002	501
2003	130
2004	435
2005	501
2006	602
2007	455
2008	472
2009	140
2010	423
2011	602
2012	690
2013	790
2014	542
2015	410
2016	775
2017	940
2018	928
2019	330
2020	980



500,020	**AVERAGE INFLOW (1921 - 2020)**			
545,150	**20-Yr Average 2001-2020**	65,499	acre-feet	Trout Creek Production
9.03%	Percentage of last 20 yrs above 100 yr average	80,760	Mega-Litres	Trout Creek Production
514,077	D.B. Letvak Provincial estimate (1970-1982)	85,642	Letvak Rpt	Factored up to recent 20 year average

The historical hydrology reports on the basins including Reksten (1973), Weiss (1981), D.B. Letvak which was an update of the first two (1989), Northwest Hydraulics (2001), and Water Management Consultants (2004). Subsequently in 2009, the Okanagan Basin Water Board undertook a basin-wide hydrology study that included Trout & Eneas Creek watersheds. That report reviewed an eleven-year period from 1996 to 2006 which included two extreme runoff years in 1996 and 1997. The study summarized the best estimate of the unregulated natural flow condition for each of the watersheds. The report provided excellent runoff-elevation curves for regions throughout the basin that were used to estimate the runoff from the higher elevation sub catchment areas above Summerland's dams. The capacity of the Trout Creek basin is estimated to be an average of 83,800 ML of runoff per year (approx. 68,000 acre-feet). Eneas Creek is estimated at 2,840 ML/year which excludes the diversion flow to Darke Lake Reservoir that is licensed to the Meadow Valley Irrigation District.

Snow Pack Indicators

In addition to the current and historic hydrometric data that is available, Summerland relies on their snowpack measurements taken each winter and the historic snowpack information available from the Province. This data is graphed and presented in Figures 3.3 below for the Summerland Reservoir and Isintok Creek snow survey stations. The trended data shows that the peak snowpack for each year has been relatively consistent.

Figure 3.3 - Snow Pack – Summerland Reservoir Site – 1935 to Present

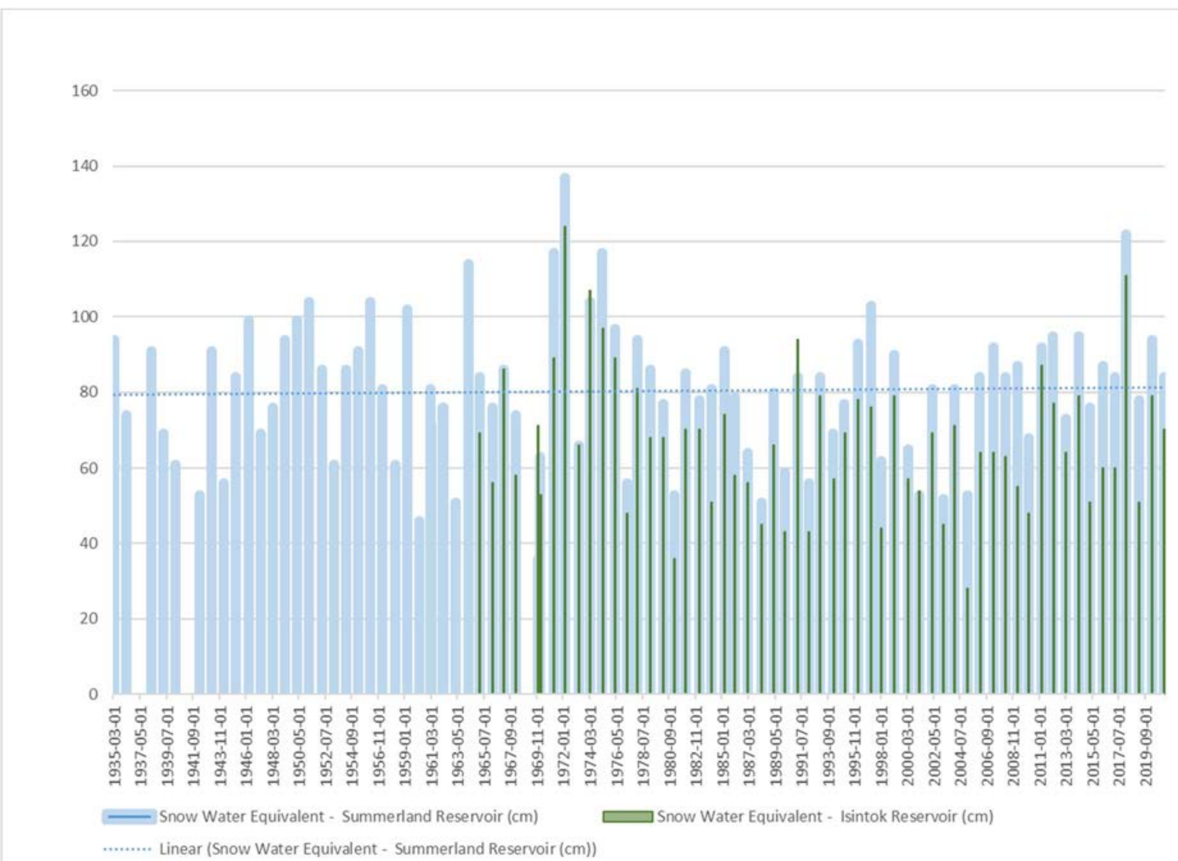


Table 3.2 - Summary of Annual Average Runoff

SUB-BASINS	AREAS FOR SHOWN ELEVATION RANGE (km^2)						Local Area (km2)	Total Upstrm Area (km2)	Annual Ave. Runoff (ML)
	Below 600	600 900	900 1200	1200 1500	1500 1800	Above 1800			
Headwaters Reservoirs	0	0	0	14.23	1.15	3.8	19.18	19.18	2,604
Crescent Reservoir	0	0	0	4.14	9.05	2.20	15.39	15.39	2,666
Whitehead Reservoir	0	0	0	6.71	0	0	6.71	6.71	639
Thirsk Reservoir *	0	0	15.36	99.66	74.52	5.90	195.44	236.72	25,623
Tsuh Reservoir	0	0	0	0	2.22	0	2.22	2.22	410
Isintok Reservoir	0	0	0	0	10.42	5.89	16.31	16.31	3,530
Darke Creek Watershed	0	20.83	26.65	18.26	10.94	0	76.68	76.68	5,542
Trout Creek @ Intake **	0	33.7	92.81	131.30	114.52	9.7	*382.03*	*713.96*	82,629
Trout Creek @ Mouth	12.59	24.24	8.46	0.24	0	0	*45.53*	***759.49***	1,183
Runoff depths per elev.	*0.015*	*0.023*	*0.049*	*0.095*	*0.185*	*0.272*			
Average Runoff (ML/yr/km^2)	**12.59**	**78.77**	**143.28**	**274.54**	**222.82**	**27.49**			
Runoff per Elevation Band	**184**	**1,835**	**6,963**	**26,164**	**41,177**	**7,488**			**83,812**
Subtract licensed diversions (800 ML) and WUP commitments (20,695 ML) from flow at Intake									-21,495
TROUT CREEK - AVERAGE RUNOFF AVAILABLE TO SUMMERLAND (ML)									**61,134**
**** Thirsk Reservoir does not include local areas of dams upstream as that water is caught by those dams***									
***** Trout Creek at Intake includes unregulated runoff flow from all lands above (excluding diversions)***									
Eneas Reservoirs	0	0	0	0	3.11	0	3.11	3.11	575
Garnett Reservoir	0	24.7	18	6.5	4.39	0	53.59	56.7	2,881
Runoff depths per elev.	*0.015*	*0.023*	*0.049*	*0.095*	*0.185*	*0.272*			
Ave.Runoff (ML/ yr/ km^2)	**0**	**24.7**	**18**	**6.5**	**7.5**	**0**		**56.7**	
Runoff per Elevation Band	**-**	**576**	**875**	**619**	**1,386**	**-**			**3,456**
Subtract Lapsley Diversion to Meadow Valley I.D.									-616
ENEAS CREEK - AVERAGE RUNOFF AVAILABLE TO SUMMERLAND (ML)									**2,840**

Runoff Table adapted from Water Management Consultants WUP Technical Brief on Basin Hydrology

Table 3.2 provides annual average runoff estimates for the sub-basins within the Trout & Eneas Creek watersheds in ML/year (1,000 m^3/year). The higher the watershed elevation, the higher the annual precipitation and resulting runoff volumes.

The data was compared to the longer history of runoff into Okanagan Lake and also data received from Summerland related to the inflow to Garnett Reservoir. This information supersedes the data presented in earlier hydrology reports to Summerland.

Trout Creek Watershed

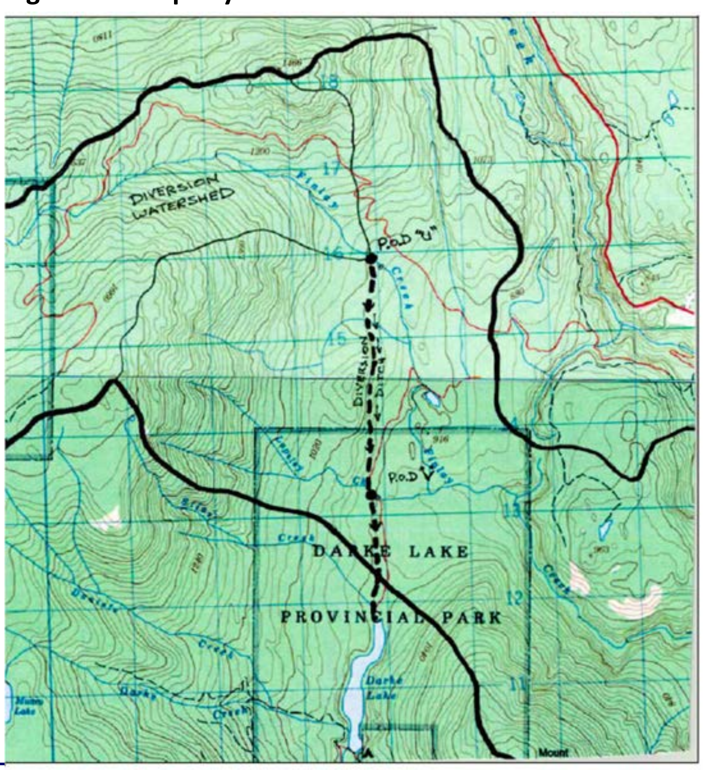
With a catchment area of 759 km^2 at the mouth, Trout Creek is the second largest watershed of the Okanagan Lake basin. The area of watershed accessible to Summerland above its intake is 714 km^2. Summerland operates 9 storage reservoirs within the watershed. These include Headwaters (4 reservoirs), Crescent, Whitehead, Tsuh, Thirsk and Isintok. Although designated as a "*Community Watershed*" by the Province, the watershed is unprotected and subject to numerous activities. Community watershed designation by the Province recognizes that the watershed is the source for drinking water to the domestic water licensees.

The only protected watersheds in the province are the Greater Vancouver Water District watersheds north of Vancouver and the Capital Regional District watersheds for Victoria. Both are owned by the local agencies and have no public access. Activities within the Summerland watersheds include agriculture in Meadow Valley, the community of 215 persons in Faulder, forestry, recreation, parks, and cattle grazing/range. The total average annual volume of water estimated to flow immediately above the intake each year is 83,812 ML. Subtracting diversions, the area below the Summerland intake on Trout Creek, and Water Use Plan commitments, the average annual available raw water supply is estimated at 61,134 ML/year.

Eneas Creek Watershed

Eneas Creek, with a catchment area at the mouth of approximately 91 km^2, is the second surface water source for the District of Summerland. At Garnett Dam, which is the point of withdrawal, the watershed catchment area is 56.7 km^2. The Eneas Creek watershed extends northwards up Lapsley Creek. The reservoir is influenced by groundwater that originates from the west in the Darke Creek watershed.

Figure 3.4 Lapsley Creek Diversion



The water quality from the Eneas Creek watershed is considered good for most of the year. The water is now used exclusively for irrigation of Garnett Valley and for parts of Jones Flats. Garnett Reservoir is not fully utilized and is kept at lower water levels to reduce the potential for flooding through Summerland during the spring freshet.

The Meadow Valley Irrigation District diverts a significant volume of water from Eneas Creek watershed to Darke Lake Reservoir. Their licensing permits 616 ML/year of water to be diverted via a 4.2 km ditch from Finlay Creek to Darke Lake Reservoir. The diversion of water is permitted under license No. C029859.

The watershed is unprotected and is considerably smaller than the Trout Creek tributary area. There are a number of activities within the watershed including forestry, agriculture, and recreation.

A summary of characteristics for each of Summerland's reservoirs have been updated with the best available information.

THIRSK RESERVOIR

Thirsk Reservoir is the primary control reservoir for flow to lower Trout Creek. The reservoir is located 34 km upstream of the existing District of Summerland intake. Travel time for releases from this reservoir to reach the district intake is 18 hours during low summer flows. The average stream velocity is 1.9 km/hr or 0.50 m/s. There is a control gate at the reservoir that was to be controlled through the Summerland SCADA system, however reliable communications have been an issue.

Thirsk dam provides in-stream storage on Trout Creek mainstem, effectively collecting and storing all upstream water in the watershed. The reservoir concrete dam was upgraded with the structure being raised by 4.6 metres in 2007. Thirsk Reservoir is the largest and most critical reservoir owned and operated by the District. Remote monitoring and controls for the reservoir is recommended to collect more reliable data and use the resource as effectively as possible.

Thirsk Reservoir		
Subcatchment area *	19544.3	ha.
Reservoir Surface Area	57.8	ha.
Reservoir Elevation	1026	m
Mean Subcatchment Elevation*	1335	m
Live Storage	6490	ML
Ave. Reservoir Depth	11.228	m
Average Annual Runoff	25623	ML
Average Annual Runoff Depth	0.131	m
Average Year Ability to Fill	**395%**	
Evaporation Losses	**588**	**mm**
	340	**ML**
1:100 year Drought Runoff	6662	ML
1:100 year Drought Runoff Depth	0.034	m
1:100 year Ability to Fill	**103%**	
* *Includes only unregulated areas*		

The reservoir has a 237 km^2 total catchment area with an unregulated area below the upper watershed dams of 195 km^2. The old height of dam was 1025.4 m. The raised elevation is 1030.0 m. The height of the concrete arch dam is now 25.8 m.

Google Earth Image: Thirsk Reservoir in foreground, prior to 2006 Raising, looking westwards up Trout Creek

Headwaters Reservoirs No. 1, 2, 3 & 4

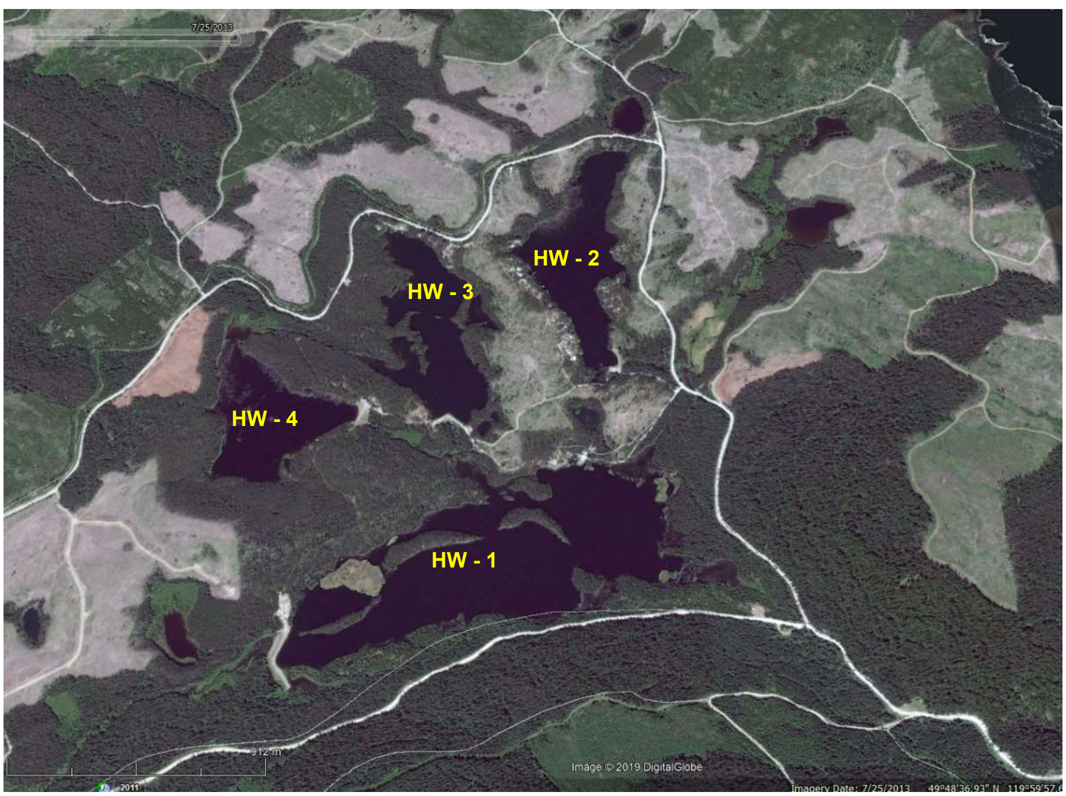
Headwaters Reservoirs are located at the top of Trout Creek watershed approximately 55 km from the District intake. Access to the reservoir lakes is through Peachland. The lakes are located 11 kms up the Brenda Mines Road and then another 14 km on Headwaters Road to the lake sites. The lake storage data is listed below:

Reservoir	Storage (ML)	Area (ha.)	Ave.Depth (m)
Headwaters 1	2613	69.7	3.75
Headwaters 2	738	21.0	3.51
Headwaters 3	617	21.0	2.93
Headwaters 4	504	15.9	3.17

There are multiple land-uses around the lakes. Of concern is the issue of excessive recreational activities that occur on the long weekends in the summer.

Headwaters Reservoirs		
Subcatchment area	1917.7	ha.
Reservoir Surface Area total	127.6	ha.
Reservoir Elevation	1289	m
Mean Subcatchment Elevation	1335	m
Live Storage	4472	ML
Ave. Reservoir Depth	3.504	m
Average Annual Runoff	2604	ML
Average Annual Runoff Depth	0.136	m
Average Year Ability to Fill	**58%**	
Evaporation Losses	**527**	**mm**
	673	**ML**
1:100 year Drought Runoff	677	ML
1:100 year Drought Runoff Depth	0.035	m
1:100 year Ability to Fill	**15%**	

In addition, there are presently 10 recreational homes and 14 campsites situated around Headwaters 1. Headwaters 2 has 33 houses within 7 lots. There are another 7 recreational homes on 3 lots along Headwaters 3. No cabins exist on Headwaters 4.



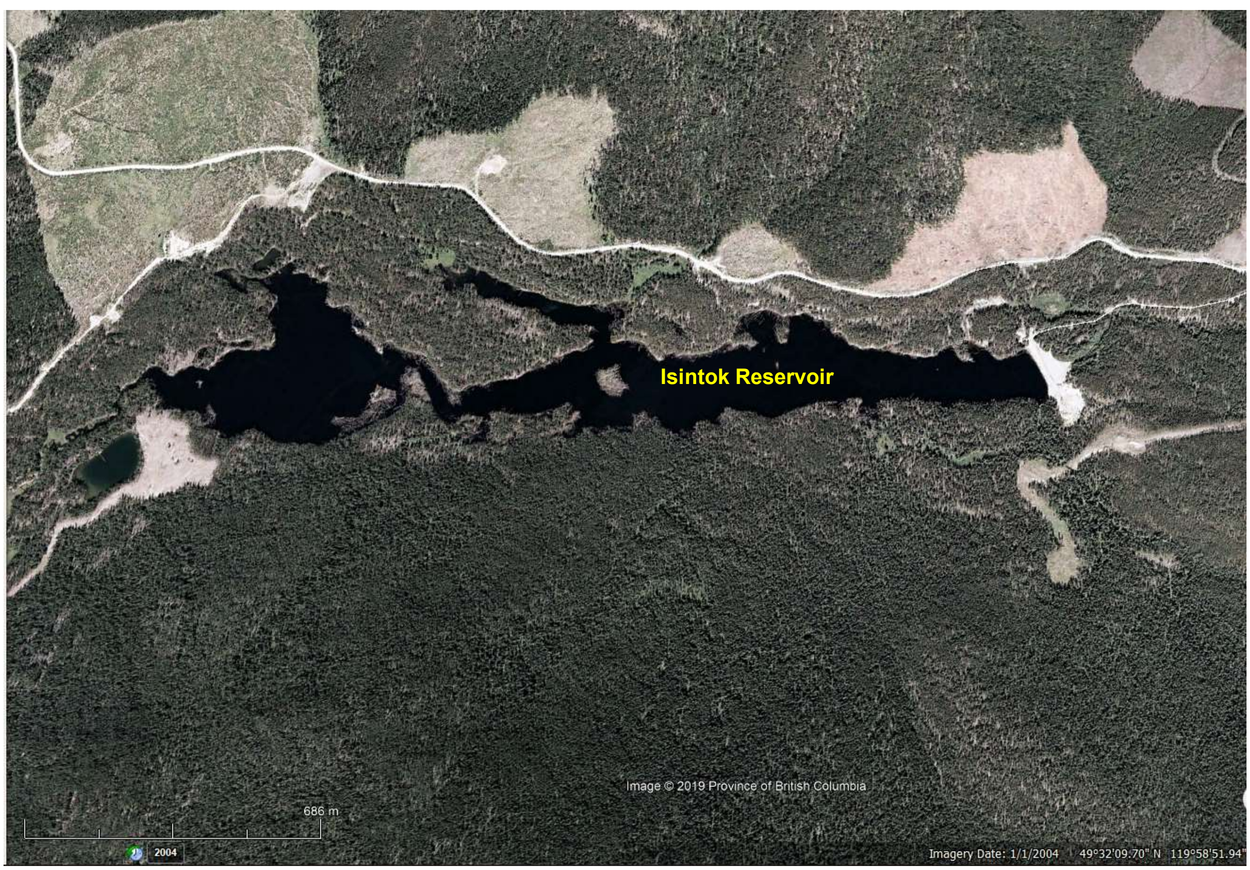
Google Earth Image: Headwaters Reservoirs, Peachland lake to the North and beyond

ISINTOK RESERVOIR

Isintok Reservoir is a moderately sized reservoir located 12 km south and upstream from the mainstem of Trout Creek. The reservoir is 24 km from the intake making Isintok the closest upper watershed reservoir to the District. This reservoir is used when more urgent adjustments are to be made in creek flow. It has reasonable access with the dam is located at the north end of the lake.

The dam outlet pipe is currently being replaced and an upgrade to the spillway is planned for 2023. The lake reliably fills from snowmelt each year. As shown by the annual runoff table, with an estimated annual runoff of 3,530 ML, this reservoir is a viable site for expansion.

Isintok Reservoir		
Subcatchment area	1630.5	ha.
Reservoir Surface Area	38.7	ha.
Reservoir Elevation	1649	m
Mean Subcatchment Elevation	1780	m
Live Storage	1384	ML
Ave. Reservoir Depth	3.573	m
Average Annual Runoff	3530	ML
Average Annual Runoff Depth	0.217	m
Average Year Ability to Fill	**255%**	
Evaporation Losses	**511**	**mm**
	198	**ML**
1:100 year Drought Runoff	918	ML
1:100 year Drought Runoff Depth	0.056	m
1:100 year Ability to Fill	**66%**	



Google Earth Image: Isintok Reservoir, looking northwards towards Trout Creek valley in the background

WHITEHEAD RESERVOIR

Whitehead Reservoir is the most remote of the Summerland storage facilities. It is located another 11 km west of Crescent Reservoir on a plateau above and west of North Trout Creek. The reservoir has a relatively small catchment area and is not able to fill itself reliably in an average year. The travel distance to the Summerland intake is approximately 50 km. Renewal and widening of the dam spillway is required.

The dam is located on the north side of the lake approximately 5 km northwest of the mainstem of Trout Creek. The summary table to the right lists the parameters of the reservoir and sub-catchment area. The ability to fill the lake on an annual basis is low at only 53%. Management of water sources is designed to allow use of this water in the latter years of a multi-year drought cycle. Expansion of reservoir storage at this site is not a viable option due to lack of watershed capacity.

Whitehead Reservoir		
Subcatchment area	671.0	ha.
Reservoir Surface Area	48.6	ha.
Reservoir Elevation	1447	m
Mean Subcatchment Elevation	1472	m
Live Storage	1216	ML
Ave. Reservoir Depth	2.503	m
Average Annual Runoff	639	ML
Average Annual Runoff Depth	0.095	m
Average Year Ability to Fill	**53%**	
Evaporation Losses	**508**	**mm**
	247	**ML**
1:100 year Drought Runoff	166	ML
1:100 year Drought Runoff Depth	0.025	m
1:100 year Ability to Fill	**14%**	

Google Earth Image: Looking northwards to Whitehead Reservoir (yellow boundary) mainstem of Trout creek in foreground

CRESCENT RESERVOIR

Crescent Reservoir is located above and approximately 5 km west of Headwaters Reservoirs at the top of Crescent Creek. The distance from the lake to the District intake is estimated to be 54 km. Access is by means of the road north of the Headwaters Reservoirs. A dam and release structure are located in the northeast end of the lake. Water is normally diverted via a diversion channel back to Headwaters Reservoir No. 4. The diversion is generally set up in the spring season to divert maximum freshet flow to Headwaters after Crescent Reservoir fills. If the diversion is shut off, the natural drainage is south 2.5 km to the Trout Creek mainstem.

The lake has a relatively small storage capacity but a large inflow making it one of the most reliable that is available to the District during drought cycles. Expansion of this site is viable because of sufficient watershed capacity.

Crescent Reservoir		
Subcatchment area	1539.1	ha.
Reservoir Surface Area	29.6	ha.
Reservoir Elevation	1363	m
Mean Subcatchment Elevation	1661	m
Live Storage	765	ML
Ave. Reservoir Depth	2.584	m
Average Annual Runoff	2666	ML
Average Annual Runoff Depth	0.173	m
Average Year Ability to Fill	**349%**	
Evaporation Losses	**547**	**mm**
	162	**ML**
1:100 year Drought Runoff	693	ML
1:100 year Drought Runoff Depth	0.045	m
1:100 year Ability to Fill	**91%**	

Google Earth Image: Crescent Reservoir on left (west) with diversion ditch to Headwaters Reservoirs south of road

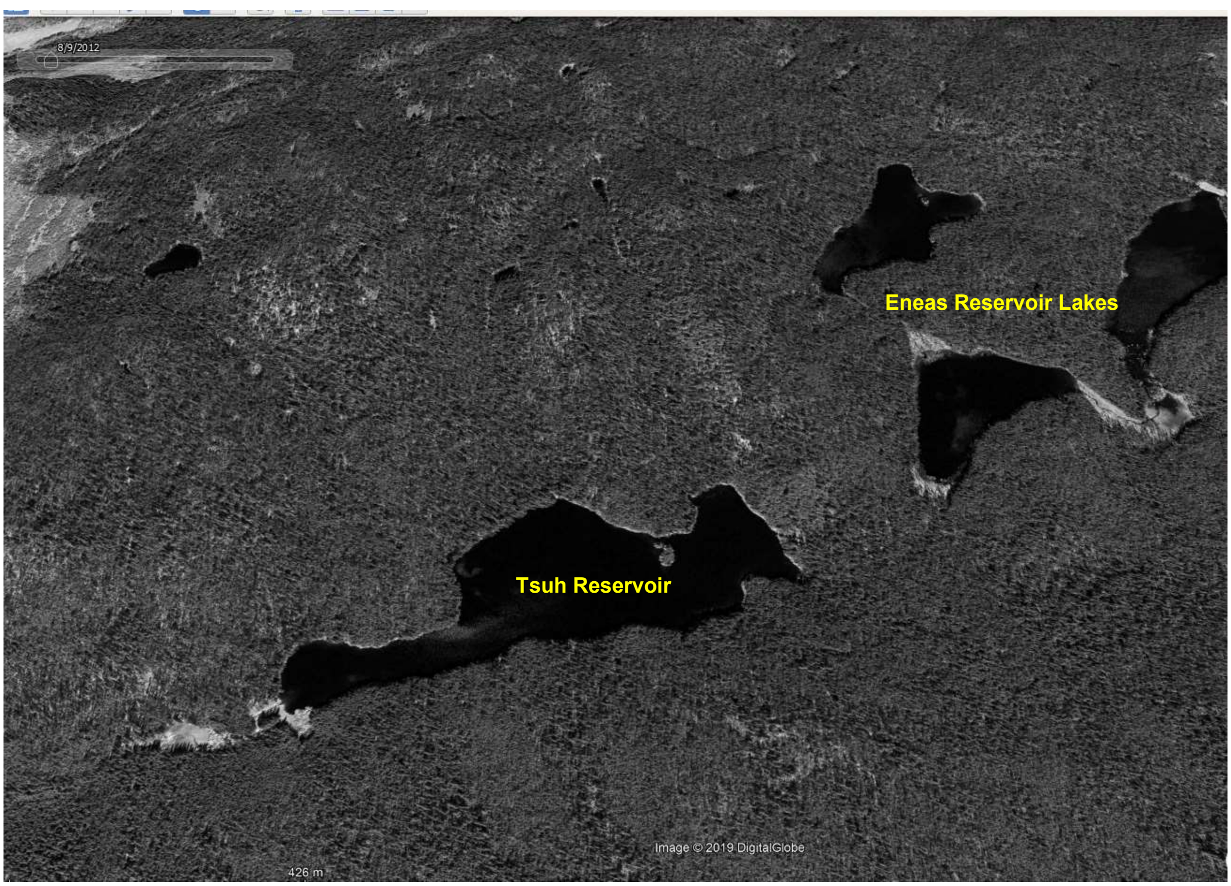
Tsuh (Deer) Reservoir

Tsuh Reservoir is a very small reservoir located at the divide between the Eneas and Trout Creek watersheds. The reservoir is 7 km north of Trout Creek mainstem approximately 26 km upstream of the District intake. Tsuh Reservoir and creek is located below Thirsk Reservoir. The reservoir is very small and is accessible through Eneas Provincial Park. It is a remote site and difficult to access.

The lake should reliably fill each year however, the site is remote and storage volumes small so the reservoir has not been used for several years. Decommissioning of the dam or reassignment of this storage volume to a third-party agency such as fisheries could be considered.

The dam and storage are maintained for the purposes of emergency supply. As noted in the photo below, there is a very narrow trail from the southeast ridge and access should be improved.

Tsuh Reservoir		
Subcatchment area	222.0	ha.
Reservoir Surface Area	15.8	ha.
Reservoir Elevation	1555	m
Mean Subcatchment Elevation	1624	m
Live Storage	308	ML
Average Reservoir Depth	1.949	m
Average Annual Runoff	410	ML
Average Annual Runoff Depth	0.185	m
Average Year Ability to Fill	**133%**	
Evaporation Losses	**373**	**mm**
	59	**ML**
1:100 year Drought Runoff	107	ML
1:100 year Drought Runoff Depth	0.048	m
1:100 year Ability to Fill	**35%**	



Google Earth Image: Tsuh Reservoir on the left. Eneas Reservoirs located to NE (right)

SUMMERLAND RESERVOIR

Summerland Reservoir is located off-line from Trout Creek and is considered balancing storage rather than watershed storage. This reservoir allows balancing of daily water demands so that Summerland releases from Thirsk Dam can be reduced to the average daily flow rather than the peak hour demand.

The area of Trout Creek upstream of the intake is approximately 714 km^2. The intake reservoir has been an area of concern due to the nature of its construction, the potential contamination from leachate from the landfill, leakage from the reservoir, and the critical nature of the facility being the primary source of water for the community. Leachate risk is discussed in Section 3.10 of this report.

Options and risks related to this reservoir are summarized elsewhere in this plan. The measured groundwater losses for the reservoir are between 3.6 and 4.5 ML/day as measured by Summerland staff. This water flows to Prairie Valley Creek

Summerland Reservoir		
Subcatchment area *	71396.0	ha.
Reservoir Surface Area	6.9	ha.
Reservoir Elevation	623	m
Mean Subcatchment Elevation*	714	m
Live Storage	69	ML
Usable Reservoir Depth	0.999	m
Average Annual Runoff	61134	ML
Average Annual Runoff Depth	0.086	m
Average Year Ability to Fill		
Evaporation Losses	**593**	**mm**
	41	**ML**
1:100 year Drought Runoff	15895	ML
1:100 year Drought Runoff Depth	0.022	m
1:100 year Ability to Fill		
* Includes all upstream areas		

Google Earth Image: Trout Creek Reservoir looking northwest towards Prairie Valley

ENEAS RESERVOIR-LAKES

Eneas Reservoir-Lake is in a remote location at the headwaters for Eneas Creek. The reservoir is located within Eneas Provincial Park 14 km upstream of Garnett Reservoir. The original dam was constructed prior to 1941 and the reservoir dam was reconstructed in 1975. The high-water level is 1561 m. The reservoir is not actively used for storage as all flow over the spillway is collected downstream by Garnett Reservoir. The reservoir is left full for the recreational purposes of angling and non-gasoline powered watercraft. There are three lakes shown in the aerial photograph; Island Lake, Little Eneas Lake, and Eneas Reservoir-Lake. Road access should be improved.

Reservoir	Live Storage (ML)	Dead Storage (ML)	Area (ha.)	Ave.Depth (m)
Island	0	271	7.25	3.73
Little Eneas	0	617	6.14	5.61
Eneas	148	142	9.00	3.22
TOTAL	148	1,030	22.39	4.05

Eneas Reservoir		
Subcatchment area	311.0	ha.
Reservoir Surface Area (all)	22.4	ha.
Reservoir Elevation	1559	m
Mean Subcatchment Elevation	1615	m
Live Storage	148	ML
Dead Storage	758	ML
Ave. Reservoir Depth	4.0	m
Average Annual Runoff	575	ML
Average Annual Runoff Depth	0.185	m
Average Year Ability to Fill	**388%**	
Evaporation Losses	**373**	**mm**
	214	**ML**
1:100 year Drought Runoff	149	ML
1:100 year Drought Runoff Depth	0.048	m
1:100 year Ability to Fill	**101%**	

* Dead storage is noted here as it forms a significant portion of the total reservoir-lake volume

Google Earth Image: Eneas Reservoir-Lakes. Flow direction is north to Eneas Creek.

GARNETT RESERVOIR

Garnett Reservoir is the terminal location for water from Eneas Creek. The headwaters are located at Eneas Provincial Park 14 km upstream of the dam. There are significant factors that influence the flows into Garnett Reservoir. This includes a diversion from Lapsley Creek & Findlay Creek to Darke Lake. There is also a return of groundwater to Garnett Reservoir from the Darke Creek valley.

The original dam was constructed in 1940 and was reconstructed in 1976-77. The high-water level is 627 m and the valley is approximately 100m lower than Meadow Valley (Darke Creek valley) immediately to the west.

The water quality data indicates that there is a substantial percentage of groundwater-influenced flow into the reservoir, likely from the west. The reservoir is operated at a level lower than full pool so as to reduce the risk of flows over the spillway as the downstream channel conveyance capacity is very limited.

Garnett Reservoir		
Subcatchment area	56.7	ha.
Reservoir Surface Area	38.3	ha.
Reservoir Elevation	629	m
Mean Subcatchment Elevation	1200	m
Live Storage	2360	ML
Ave. Reservoir Depth	6.162	m
Average Annual Runoff	2840	ML
Average Annual Runoff Depth	5.008	m
Average Year Ability to Fill	**120%**	
Evaporation Losses	**559**	**mm**
	214	**ML**
1:100 year Drought Runoff	738	ML
1:100 year Drought Runoff Depth	1.302	m
1:100 year Ability to Fill	**31%**	

Google Earth Image: Garnett Reservoir looking northwest.

3.5 WATERSHED RELIABILITY ANALYSIS

The hydrologic analysis carried out by Water Management Consultants was reviewed and using the updated information, the frequency runoff flow estimates were summarized. Average annual flows and drought flow estimates for a 1:10-year, 1:50-year and 1:100-year return period drought is provided.

The runoff conditions represent the upstream runoff less any amount required to fill upstream reservoirs. If the estimated upstream runoff is greater than the reservoir live storage, then the reservoir will fill for that runoff condition even starting empty. Table 3.3 provides a summary of the reservoir characteristics with parameters such as the upstream catchment area, average annual runoff, licensed storage and actual storage volumes.

Table 3.3 - Summerland Reservoir Characteristics

Reservoirs	Unregulated Catchment Area (km^2)	Ave. Runoff (ML)	Licensed Storage (ML)	Ex. Actual Storage (ML)	Ability to Fill (Ave.Yr)
Thirsk Reservoir	195.44	25,623	5,709	6,490	**395%**
Headwaters Reservoirs	19.18	2,604	5,857	4,472	**58%**
Isintok Reservoir	16.31	3,530	1,665	1,384	**255%**
Whitehead Reservoir	6.71	639	1,442	1,216	**53%**
Crescent Reservoir	15.39	2,666	931	765	**349%**
Tsuh Reservoir	2.22	410	370	308	**133%**
Summerland Res. (Trout Ck Intake)	713.96	82,629		260	**n/a**
Garnett & Eneas Reservoir	56.70	2,840	2,910	2,360	**120%**
TOTALS			18,884	17,255	

Table 3.4 provides the summary update of the frequency analysis for the Summerland reservoirs. The flows estimated for the Trout Creek intake do not include the live storage in upstream reservoirs. Table 3.4 shows that Garnett Reservoir would be expected to fill in all years, even starting empty, except for the 100-year drought event. The Headwaters Reservoirs will fill in an average year but in less than average years, filling is not guaranteed if the lakes are empty prior to the freshet. Whitehead Reservoir will not fill in an average year and the current reservoir operation strategy is to leave storage in these lakes because of the uncertainty of refilling. Thirsk Reservoir fills in all simulated conditions, even with the expanded storage and the requirement for filling upstream reservoirs. Isintok Reservoir fills in an average year but refilling is uncertain in extreme drought years.

Table 3.4 - Summerland Reservoir Inflows

Reservoirs	Licensed Storage (ML)	Ex. Actual Storage (ML)	Ave. Runoff (ML)	1:10 Drought Runoff (ML)	1:50 Drought Runoff (ML)	1:100 Drought Runoff (ML)	1:100 Yr. Ability to Fill
Thirsk Reservoir	5709	6490	25623	13324	8712	**6662**	**103%**
Crescent Reservoir	931	765	2666	1386	907	**693**	**91%**
Isintok Reservoir	1665	1384	3530	1836	1200	**918**	**66%**
Tsuh Reservoir	370	308	410	213	139	**107**	**35%**
Headwaters Reservoirs	5857	4472	2604	1354	885	**677**	**15%**
Whitehead Reservoir	1442	1216	639	333	217	**166**	**14%**
Summerland Reservoir (Intake)		260	82629	42967	28094	**21484**	
Environmental Flow Needs as per WUP			20695	12449	9485	**5381**	
Trout Creek Totals		14895				**16103**	**108.1%**
Garnett & Eneas Reservoir	2910	2360	2840	1477	966	**738**	**31%**
TOTALS	**18884**	**17255**				**9961**	

Table 3.5 - Summerland Drought Year Storage

Reservoirs	Licensed Storage (ML)	Ex. Actual Storage (ML)	Ability to Fill (1:100 Drought)	1:100 Yr Gross Storage (ML)	Annual Evaporation Losses (ML)	1:100 Yr Net Storage (ML)
Thirsk Reservoir	5709	6490	103%	7002	340	**6662**
Headwaters Reservoirs	5857	4472	15%	1350	673	**677**
Isintok Reservoir	1665	1384	66%	1116	198	**918**
Crescent Reservoir	931	765	91%	855	162	**693**
Whitehead Reservoir	1442	1216	14%	413	247	**166**
Tsuh Reservoir	370	308	35%	166	59	**107**
Summerland Reservoir (intake)		260	n/a	n/a	41	**9223**
Garnet & Eneas Reservoirs	2910	2360	31%	1166	428	**738**
TOTALS	**18884**	**17255**		**12068**	**2148**	**9961**

Table 3.5 provides the drought year reservoir storage that would be available from each of the reservoirs. For a 1:100-year drought event, 9,961 ML of effective reservoir storage is estimated to be available within the watersheds.

Table 3.6 - Trout Creek Available Water per Month – Average and Drought Year

Month	Ave. Runoff (ML)	EFN as % of Runoff	Normalized Demand	Ave. Yr Fish Flow	Ave. Year Req'd Storage Volume	1:100 Drought Runoff (ML)	Dry Year Demand	1:100 Yr Fish Flow	1:100 Yr Req'd Storage Volume
Jan	995	0	135			259	149		
Feb	1315	0	125			342	137		
Mar	3591	0	137			934	151		
Apr	12094	0	298			3144	328		
May	26523	0	1014			6896	1115		
Jun	27969	57.2	1397	11838		7272	1537	4929	
Jul	3325	18.8	2177	3891	2743	864	2395	1620	3151
Aug	1553	9.6	2161	1987	2595	404	2377	827	2801
Sep	1174	7.5	1133	1552	1511	305	1247	646	1588
Oct	2038	6.9	456	1428		530	501	595	566
Nov	1057	0	133			275	146		
Dec	995	0	132			259	146		
TOTAL	**82629**	**100.0**	**9299**	**20695**	**6849**	**21484**	**10228**	**8618**	**8105**
		20695		20695				8618	

Table 3.6 provides a numerical summary of the estimated monthly volumes of water that:

1. Blue Column - Average naturally runoff for all Trout Creek as per hydrology estimates;
2. Green Column - Fish Flow – For average climate year;
3. Light Brown Column - Normalized water demand plus 4% buffer for hot weather;
4. Green Column - Fish flow in average climate year
5. Light Blue Column - Available runoff in a 1:100-year drought
6. Tan coloured column - Runoff available to Summerland for a 1:100-year drought.
7. Reduced fish flows (Light green column) for 1:100-year drought
8. Storage required to supply water under average conditions (mid white column) and under 1:100 year drought conditions (right-white column)
   Req'd Storage = Dry year demand + 1:100 Yr Fish Flow – 1:100 Drought Runoff.

The table shows that the July fish flow allowance utilized in the Water Use Plan may be high as it currently exceeds the expected average July flow in Trout Creek. This would have to be reviewed in future updates of the WUP.

RESERVOIR DRAWDOWN OPERATING RULES

Based on the adjusted hydrology, the operating guidelines for releases from Summerland's Trout Creek watershed reservoirs is provided. The principles for operating are generally as follows:

- Make-up water from the reservoirs is generally released to meet water supply demand, route losses, and fisheries requirements in accordance with the Water Use Plan; and
- Demands are adjusted considering the time of year and volume of water remaining in storage.

The primary objective in setting the reservoir drawdown procedure is utilize water from the most reliable reservoirs. The reservoirs with the highest probability of filling each year are the ones to be used first. In conjunction with the releases from those reservoirs, releases for a portion of the water in the less reliable reservoirs is then recommended. Adjustments can be made considering storage remaining, reservoir turn-over, water demands, time of year and drought stage condition. Recommended Operating Guidelines are listed in Table 3.7.

Table 3.7 - Trout Creek Watershed Reservoirs - Recommended Operating Guidelines

No.	Release Instructions	Release Volume (ML)	Total Storage (ML)	Remaining Storage (ML)	Cumulative Release (ML)
1	Thirsk Reservoir Release to 80% remaining	1,298	6,490	5,192	1,298
2	Crescent Reservoir Release to 50% remaining	383	765	382	1,681
3	Isintok Reservoir Release to 50% remaining	692	1,384	692	2,373
4	Headwaters Reservoirs Release to 48% remaining (90% of annual inflow)	2,339	4,472	2,133	4,712
5	Tsuh Reservoir Release 1:100 year runoff from watershed	107	308	201	4,819
6	Whitehead Reservoir Release approx. 2/3 of annual inflow volume	432	1,216	1,050	5,251
7	Isintok Reservoir Release for flow adjustments**	226	1,384	466	5,477
8	Crescent Reservoir release to 20% remaining	230	765	153	5,707
9	Thirsk Reservoir Release to 30% to end of irrigation season	3,245	6,490	1,947	8,952

It is noted that in the WUP, all reservoirs are allowed to be drawn down to a minimum level of 1.8m above the bottom outlet pipe of the reservoir. The reservoirs are not drawn down further so as not to draw off sediments from the bottom of the reservoir.

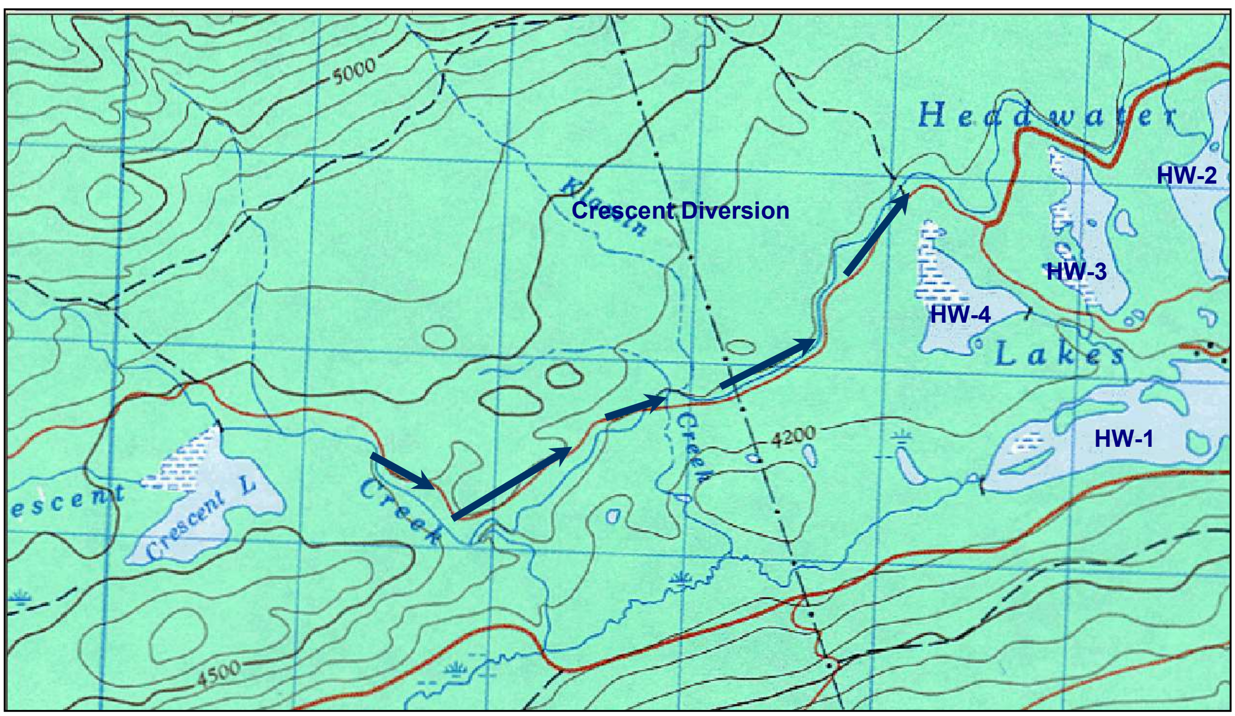
HEADWATERS RESERVOIR-LAKES OPERATIONS

Operations of the Headwaters Reservoir-Lakes is provided on this page. Headwaters Reservoirs do not have sufficient watershed area to fill all four reservoirs each year on a reliable basis. The reservoirs are filled from the natural watershed above and from a diversion of water from Crescent Reservoir to the west.

As illustrated in Figure 3.5, water fills Crescent Reservoir is then diverted to the Crescent Diversion ditch (blue arrows) that runs along the access road (red line) to the Headwaters Reservoirs. This diversion ditch also collects runoff from the lands immediately upstream of the road. Water from the diversion ditch flows into either Headwaters Reservoirs No. 2 or No. 4. Both reservoirs have gates at the inlet to allow water into the reservoir.

Headwaters Reservoirs 2, 3 & 4 all have outlet gates that release to Headwaters 1. The release from Headwaters 1 is directly into Trout Creek.

Figure 3.5 - Headwaters Reservoir-Lakes Operations



Crescent Lake is one of the most reliable water reservoirs for the District. Releases from Crescent Reservoir can go directly to Trout Creek and on to Thirsk, or can be diverted to Headwaters. The excess flow from Crescent Reservoir watershed is used to assist in filling Headwaters Reservoirs. Headwaters No. 4 fills and then overflows into Headwaters No. 1 which then subsequently fills.

UNAVAILABLE WATER

From the Trout Creek and Eneas Creek watersheds, there is portion of the natural runoff water that may not be available to the District. These annual volumes of water include:

- Darke Creek and Darke Reservoir-Lake water is licensed to the Meadow Valley Irrigation District (MVID). For planning purposes, it is conservatively assumed that MVID licensed water will be fully diverted and utilized. They have a total annual licensing for 1,108 ML of irrigation water. Part of that supply is tied to the diversion of 616 ML of water from Eneas Creek to Darke Reservoir in the Trout Creek watershed;
- There are evaporative losses from all of the reservoir surface waters. An estimate of the average annual evaporative losses from the surface of the reservoirs is estimated to be 2,148 ML/year. This is summarized in Table 3.6 for each reservoir. During a hotter climate year, the amount could be expected to increase between 10 % (2,360 ML) and 20% (2,580 ML);
- There is naturalized base flow in the creek that is to be allowed to pass to support the Environmental Flow Needs (EFNs) downstream of the Trout Creek intake. An average of the total annual volume for EFNs in accordance with the Water Use Plan is summarized in Table 3.6. This amount varies, based on water availability for each year;
- There are groundwater losses to the alluvial fan when Trout Creek leaves the Trout Creek valley immediately above Summerland. An estimate for these losses was developed for the Water-Use-Plan to be 4.0 ML/day or 1,460 ML/year. During long hot dry periods, it is believed that this daily amount may increase to daily levels in the range of 10 ML/day but exact measurements have not been determined by the District or the Province;
- There are seepage losses out of the Trout Creek Balancing Reservoir estimated to be 4.0 ML/day. This volume works out to a loss of 122 ML/month or 1,460 ML/year;
- As per Summerland water license No. C16414, an allotment of this license in the amount of 66.3 ML annually is to be released from Thirsk Dam which may include the dams above Thirsk to supply water for the instream flows for the community of Faulder. There are approximately 80 lots in the Faulder area that rely on a shallow groundwater well for their source water. This release was required to assure the Province that there is adequate water in the shallow aquifer along Trout Creek and so that Faulder does not have a negative impact on the in-stream flow needs in lower Trout Creek. A nominal contribution to watershed dam maintenance and eventual renewal would be built into the agreement.
- Eneas Creek Water for Fish Hatchery: As part of Water License No. C066281, there is an authorization of the conservation use of water for the Trout Hatchery, located on Lakeshore Drive in Summerland, they are to receive a constant flow of 0.085 m3/s. This amounts to an annual volume of up to 2,680 ML.

Recommendation:
Raw Water Supply for Faulder:
Summerland should contact the RDOS who operate the Faulder water system. The releases from Thirsk Reservoir to supply Faulder requires a bulk water supply agreement to legalize the releases and purpose. The Province should support this or they could revise Summerland water license C16414 to exclude the release requirement. The annual revenue would be small, in the range of $3,000.

3.6 Summerland Dam Status

The District of Summerland operates 14 dams in the Trout Creek and Eneas Creek watersheds. Only two dams, Garnett Dam and the Eneas Reservoir Dam, are in the Eneas Creek watershed.

The dams are operated and monitored in conformance with the BC Dam Safety Regulation. The level of monitoring is dependent on the consequence classification of the dam which is determined by the height and storage volume of the dam, and the level of damage that could occur downstream in the event of a dam breach or failure.

There were recent changes in the consequence classification for the Summerland Dams. These are listed on Table 3.8.

Table 3.8 - Summerland Dams – Consequence Classification

Dam	Former CC	New CC	Change	Minimum Activity Frequency
Headwaters 1	Very High	Very High	same	no change
Headwaters 2	Significant	Significant	same	no change
Headwaters 3	Significant	Low	decrease	minimal change, weekly to quarterly visits, OMS & DEP updates not required
Headwaters 4	Significant	Low	decrease	minimal change, weekly to quarterly visits, OMS & DEP updates not required
Crescent	Significant	High	increase	monthly to weekly visits, DSR required
Whitehead	Significant	High	increase	monthly to weekly visits, DSR required
Thirsk Arch Dam	Very High	Very High	same	no change
Thirsk Spillway	High	Very High	increase	minimal change, more frequent OMS/DEP
Thirsk Saddle Dam	High			CC suggested that it does not currently impound water as the maximum reservoir water level is below the elevation of natural ground at the downstream toe of the embankment. As such, failure of this embankment is improbable and was excluded from this assessment.
Tsuh	Significant	High	increase	monthly to weekly visits, more frequent DSR
Isintok	High	Very High	increase	minimal change, more frequent OMS/DEP
Summerland	High	Very High	increase	minimal change, more frequent OMS/DEP
Eneas	Significant	High	increase	monthly to weekly visits
Garnett	Extreme	Very High	decrease	minimal change, less frequent DSR

Also provided in Table 3.8 is the minimum monitoring activity at the dam sites.

3.7 TROUT CREEK WATER USE PLAN

The Trout Creek Water Use Plan, created in 2004, relied on the watershed model developed by Water Management Consultants. The plan is the agreed upon approach for allocation of water in Trout Creek, agreed upon by Provincial Fisheries and Summerland. From the plan, the reservoir model and trigger graphs for Summerland were updated in 2008 which was immediately after Thirsk Reservoir was constructed and incorporated into the operating model. The reliability of water supply for Summerland improved significantly with the expansion of Thirsk Reservoir. There has been 17 years of operations under the Water Use Plan protocol with stability and trust built between the Province and Summerland.

Figure 3.6 - Trigger Graph - Water Usage Reductions

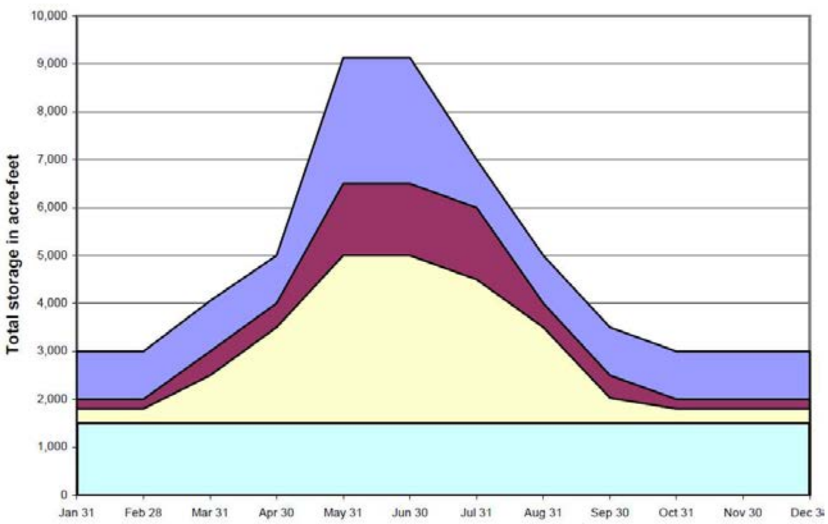


Figure 3.6 illustrates the drought stage trigger levels currently in-place. The levels are based on time-of-year and the total volume of storage remaining within the Trout Creek watershed. The Water Use Plan does not apply to the Eneas Creek watershed which includes Garnett Reservoir.

Details of the WUP are included in the Appendices of the 2008 Water Master Plan.

Table 3.9 - Reduction Stage Percentage based on Natural Flow in Camp Creek

	Reduction Stage					
	1	2	3	4	5	
June	10	8	6	4	0	Fish flow x Camp
	90	85	80	70	0	Community target factor %
July	10	10	9	4	0	Fish flow x Camp
	90	85	80	70	0	Community target factor %
Aug	10	10	10	4	0	Fish flow x Camp
	90	85	80	70	0	Community target factor %
Sept	10	10	10	4	0	Fish flow x Camp
	90	85	80	70	0	Community target factor %
Oct	10	10	10	4	0	Fish flow x Camp
	50	50	50	50	0	Community target factor %

Operating Agreement – B of the Trout Creek WUP was implemented after the raising of Thirsk Dam. Table 3.9 provides the reduction stage percentages for the community reduction from normal use, and for the fish flow release reduction. All flow to fish is based on the flow in Camp Creek x the multiplier number shown per stage.

3.8 Okanagan Lake Source

This section presents information on the supply of water from Okanagan Lake. Should water supplied by either Trout Creek or Eneas Creek become compromised due to landslide, pestilence or forest fire, having a significant water supply capacity from the other creek or from Okanagan Lake would be very beneficial.

The District of Summerland holds licenses at two locations on Okanagan Lake. The oldest license for domestic water was issued in 1967 for the Lower Town Pump Station at the Marina. This license permitted 2,655 ML of water for domestic purposes. A second license was issued in 2004 for 3,455 ML of water to be drawn out in Lower Trout Creek.

In addition to the existing District of Summerland point of diversion from Okanagan Lake, there also exists connection to the Summerland Research Station where a tie-in point exists, but additional pumping would be required to provide water from this location into the District's water distribution system. The two water supply options available to Summerland from Okanagan Lake are listed in Table 3.10.

Table 3.10 - Okanagan Alternate Supply Capacity

Option	Capacity	Lift	Limitation
Summerland Research Station Pump Station	96 L/s @ 180m TDH	522m HGL	Line size across trestle is limiting. Water is committed to Research station. An alternative agreement for supply could be arranged
Trout Creek at Powell Beach Park (Proposed)	232 L/s @ 159m TDH	502m HGL	Two stages of pumping, water treatment is required

Details for the lower Town Pump station, which is now decommissioned, and the potential emergency supply from the Summerland Research Station are presented in the Summerland 2008 Water Master Plan. The Old Town Station pump capacity was small at 25.2 L/s (400 USgpm) which is only 265 ML over a 4-month period. The decommissioned station only had capacity for supplying only approximately 10% of the annual licensed volume.

The objective for a new pump station at Okanagan Lake is to: provide sufficient water to reduce water treatment plant costs; to reduce the reliance on one source of domestic water; and to provide a significant secondary water supply to town in the event of a supply issue from Trout Creek.

Recommendation:
Okanagan Lake Water Supply
That Summerland continue to progress in financially manageable stages to obtaining a consistent and reliable water supply from Okanagan Lake

3.9 GROUNDWATER SOURCES

The groundwater sources in Summerland are relatively small in comparison with the available surface water. For this reason, over the last 100 years, the community has relied on the surface water from Trout and Eneas Creek for their supply with very minimal activity in the development of groundwater wells. This section summarizes:

- Links and Reports: Providing web locations for where the most relevant groundwater reference reports are available;
- Hydrogeology: A description of the hydro-geology with the limitations in groundwater supply based on natural conditions. An aquifer Location map is provided as are the characteristics of the aquifers;
- Summerland Groundwater wells; The location and limitations of the existing wells is provided;
- Special Groundwater conditions; Describe two groundwater sensitive locations within the District including the Summerland Trout Hatchery and groundwater intrusion potential from the Summerland Landfill.

In the last 15 years, there has been extensive work completed in the assessment of groundwater availability in the Okanagan Basin with groundwater wells being drilled in Summerland in 2003 and 2004.

GROUNDWATER REPORTS AND LINKS

The key web links for reviewing the condition of groundwater in the Summerland area are listed below. The links provide the aquifer mapping, the aquifer summary reports, and the well location database

1. Provincial Aquifer Mapping Site:
   https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d
2. Provincial Well Location Mapping Site:
   https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d
3. Provincial Observation Wells
   https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d&find=OBS%20WELL%20154

- Report "*Groundwater and Hydrogeological Conditions in the Okanagan Basin, BC, A State-of-the-Basin Report*", prepared for the Okanagan Basin Water Board.
  The report, prepared by L. Neilsen-Welch and D. Allen, provides a compilation of hydrogeological information for the Okanagan Basin to document the then (2007) current state of knowledge of groundwater in the Okanagan Basin. The report identifies groundwater information sources (previously completed and currently underway) and develops a synthesis of available information regarding hydrogeology in the Okanagan Basin.

  Report https://www.obwb.ca/fileadmin/docs/water_supply_demand/water_supply_demand_final_report.pdf
  App 1 & 2 Maps/ Aquifer Info Tables http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=16990

4. Report "*Phase 2, Okanagan Water Supply and Demand Project: Groundwater Obj. 2 & 3 Basin Study*" : This regional groundwater study outlines a conceptual model of groundwater movement in the Okanagan Basin. Groundwater is modelled as a topographically-driven system whereby upland areas tend to recharge valley-bottom aquifers. A number of assumptions were made to determine the approximate water balance for individual aquifers in the Basin.
   https://www.obwb.ca/obwrid/detail.php?doc=330

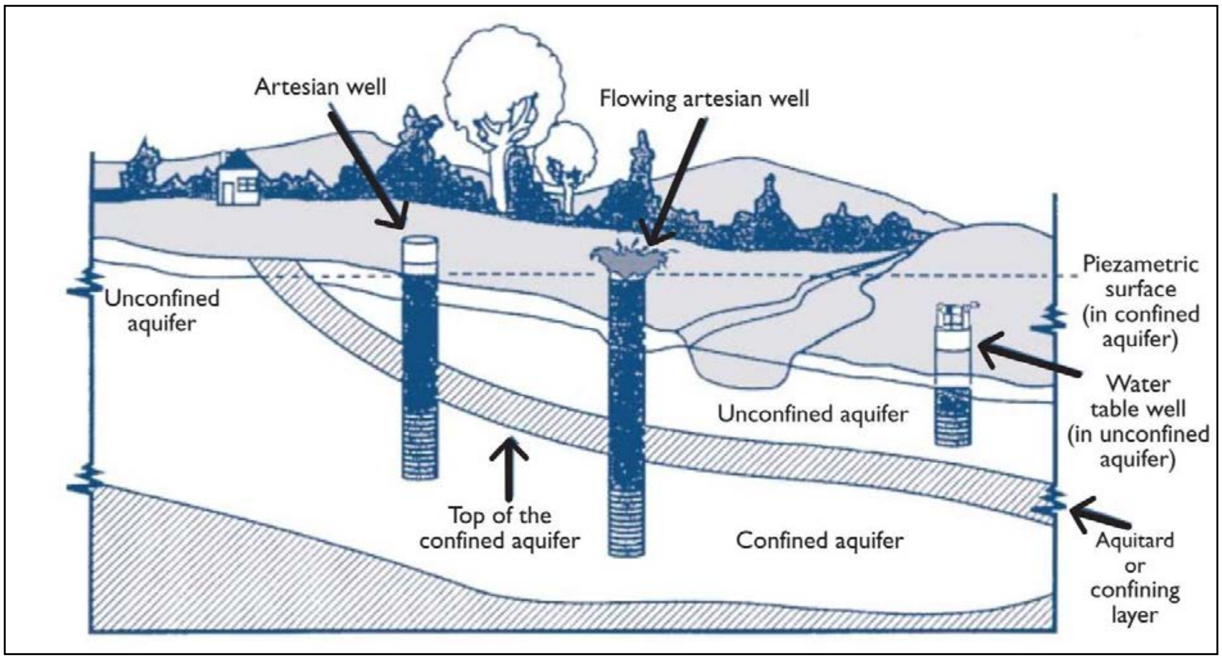
5. Trout Creek Aquifer – Aquifer No. 297 listing of detailed information on that aquifer https://apps.nrs.gov.bc.ca/gwells/aquifers/297

6. Faulder Aquifer – Aquifer No. 299 covering Meadow Valley down along Trout Creek https://apps.nrs.gov.bc.ca/gwells/aquifers/299

7. Summerland Aquifer – Aquifer No. 300 for the area west of Garnett Valley listing of detailed information on that aquifer https://apps.nrs.gov.bc.ca/gwells/aquifers/300

An explanatory diagram for the groundwater terminology is provided in Figure 3.7.

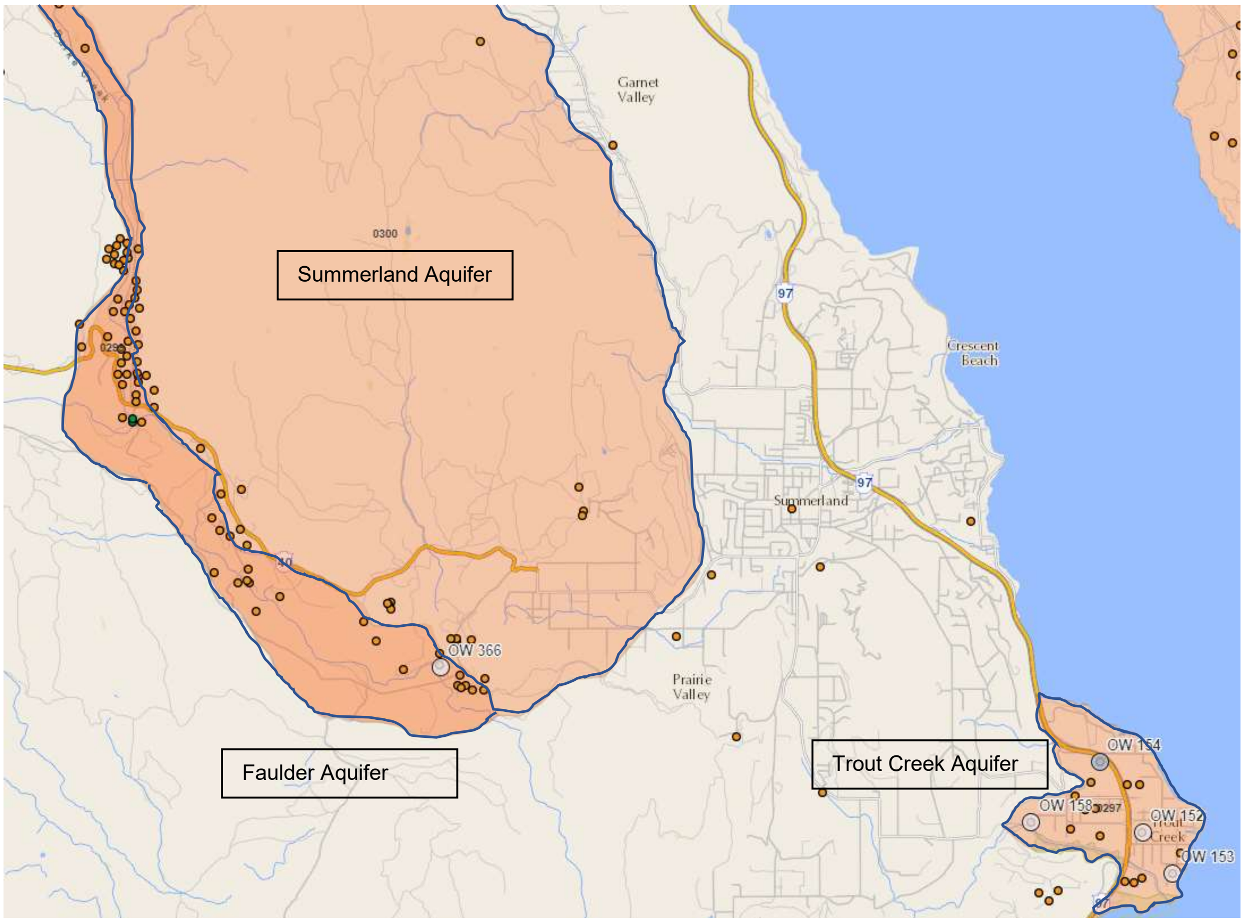
Figure 3.7 - Groundwater Explanatory Diagram



HYDROGEOLOGY

Figure 3.8 illustrates the three existing defined aquifers in the Summerland area of service. The mapping provides a general basis of the data that the Ministry has for Summerland. Each known aquifer is categorized based on the aquifer yield (productivity), vulnerability, and concerns related to the sustainability of the resource (sensitivity). There is a rating system in place by the Provincial government for aquifers throughout much of the Province.

Figure 3.8 - Summerland Groundwater Aquifers



The productivity number designates the development condition of the aquifer:

- I Heavy aquifer development
- II Moderate aquifer development
- III Light aquifer development

The vulnerability rating provides an assessment of the aquifer to contamination or other problems:

- A High vulnerability
- B Moderate vulnerability
- C Low vulnerability

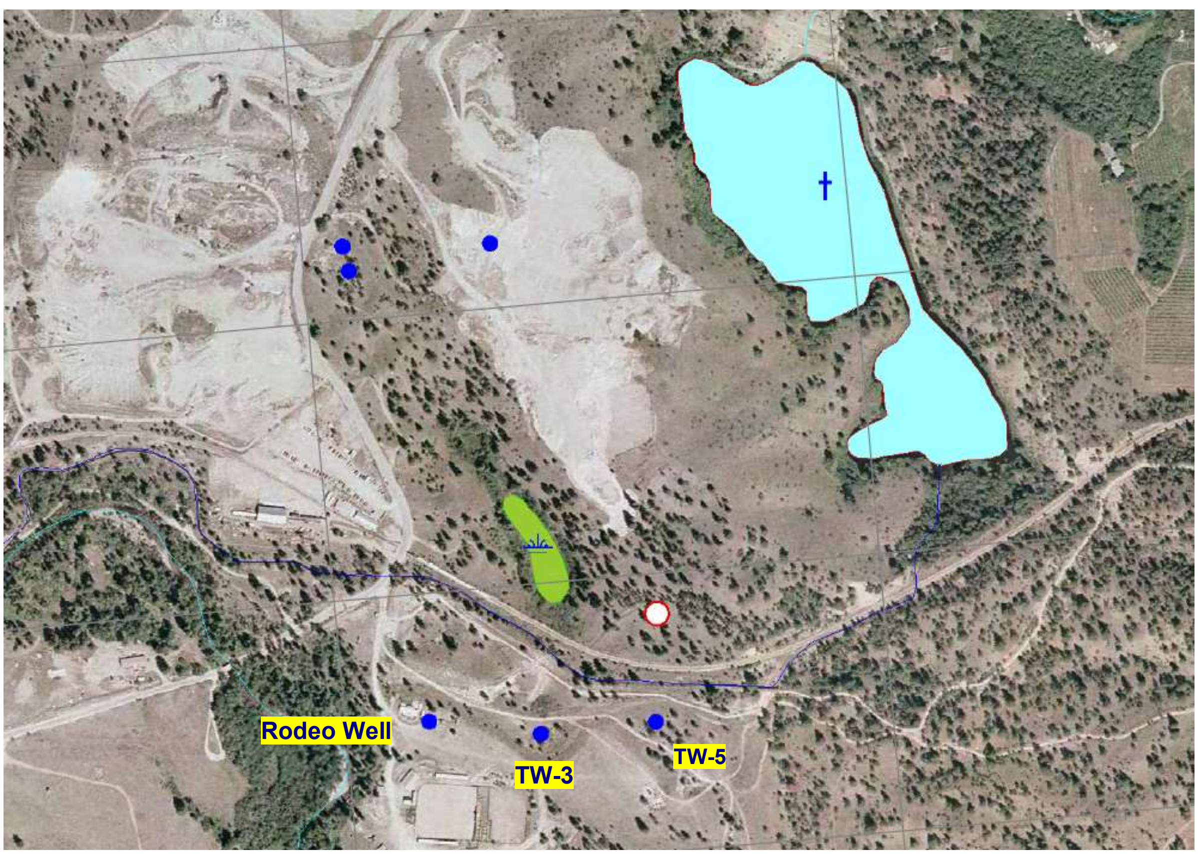
DISTRICT OF SUMMERLAND GROUNDWATER WELLS

The District of Summerland owns and operates three groundwater wells, all located above the Trout Creek intake reservoir as shown on Figure 3.9.

Rodeo Ground Well (MOE Well Tag No. 82373) The smallest well provides water year-round directly to the Rodeo Grounds buildings, the caretaker's residence at the Rodeo Grounds and to the Kettle Valley Railway commercial operation. The well capacity is in the range of 4.3 L/s. The well is not chlorinated but is tested regularly by the District of Summerland for bacteriological parameters and for other drinking water parameters.

Emergency Wells - TW-3 & TW-5 In late 2003, two wells were installed to supplement the District water supply capacity. Both are located above the existing Trout Creek Reservoir and both pump water directly into the flume which flows into Trout Creek. TW 3 has a capacity rated to be 41.58 L/s (3.53 ML/day) and TW 5 has a capacity of 26.46 L/s (2.29 ML/day). The wells were used only during times of drought. They are regularly maintained but used infrequently. They have background levels of radioactivity that are below the Guidelines for Canadian Drinking Water Quality, so as a precautionary measure, a 4:1 dilution with Trout Creek water is required by IHA so that that the levels are well below the acceptable limits. As directed by the IHA, the wells must be flushed for a period of time before they are used, and can only be utilized for a limited amount of time.

Figure 3.9 - Existing Groundwater Well Locations



3.10 SUMMERLAND TROUT HATCHERY

The Summerland Trout Hatchery, at 13405 Lakeshore Drive South, is one of five hatcheries operated by the Freshwater Fisheries Society of BC (FFSBC). With more than 90 years of operation, it is the oldest fish hatchery in the Province, having been in continuous operation since 1928. The hatchery was in operation at times prior to that with water licensing dating back to 1902. It holds two water licenses on Shaughnessy Brook which is in the draw between Prairie Valley Creek and Eneas Creek. The licensing release for conservation flows from Eneas were adjusted in 1987 to match the licensed withdrawals from the Trout Hatchery. The stable water supply is the primary reason the Summerland Trout Hatchery was constructed in its current location on Lakeshore Drive. Without the reliable water supply, the hatchery could not safely operate at this location. The Summerland Hatchery stocks 275 lakes in the southern interior of BC and is of significant provincial importance. The hatchery also offers public tours and receives 10,000 visitors annually.

The Summerland Trout Hatchery is the single largest groundwater user in the District and that the hatchery is extremely vulnerable to activities in the watershed upslope of the hatchery and including activities in both Prairie Valley Creek and Eneas Creek.

Figure 3.10 - Shaughnessy Brook

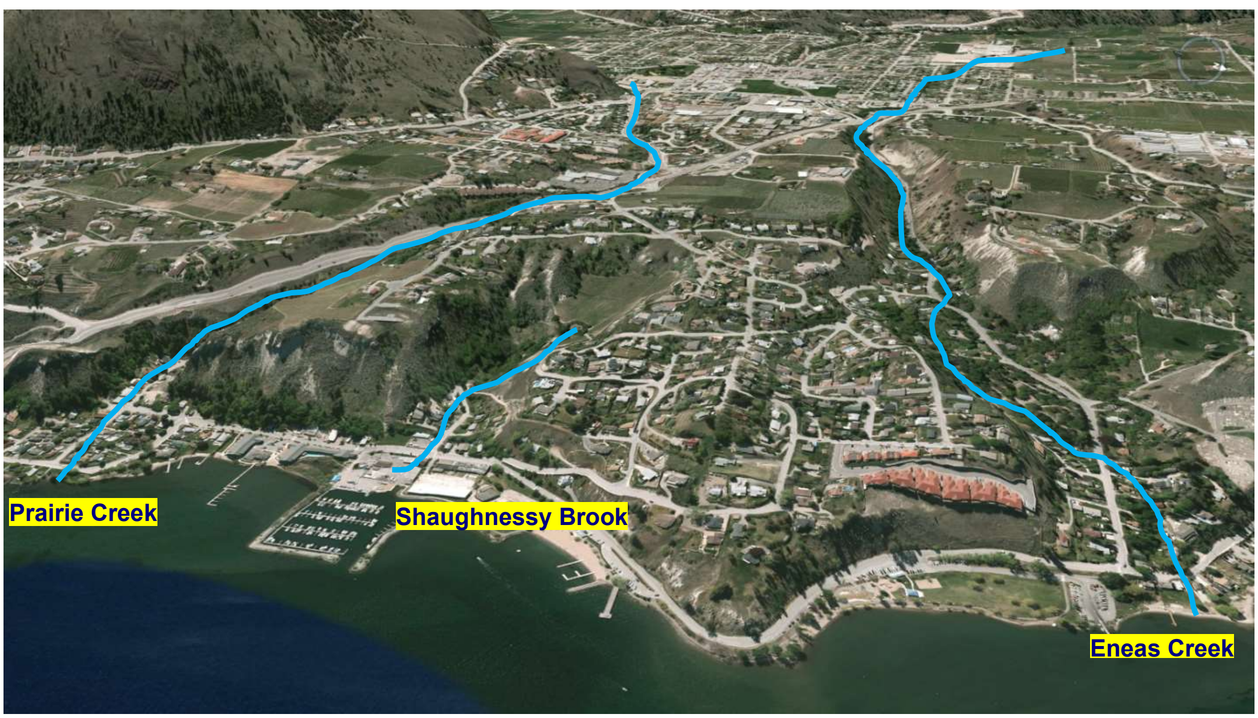
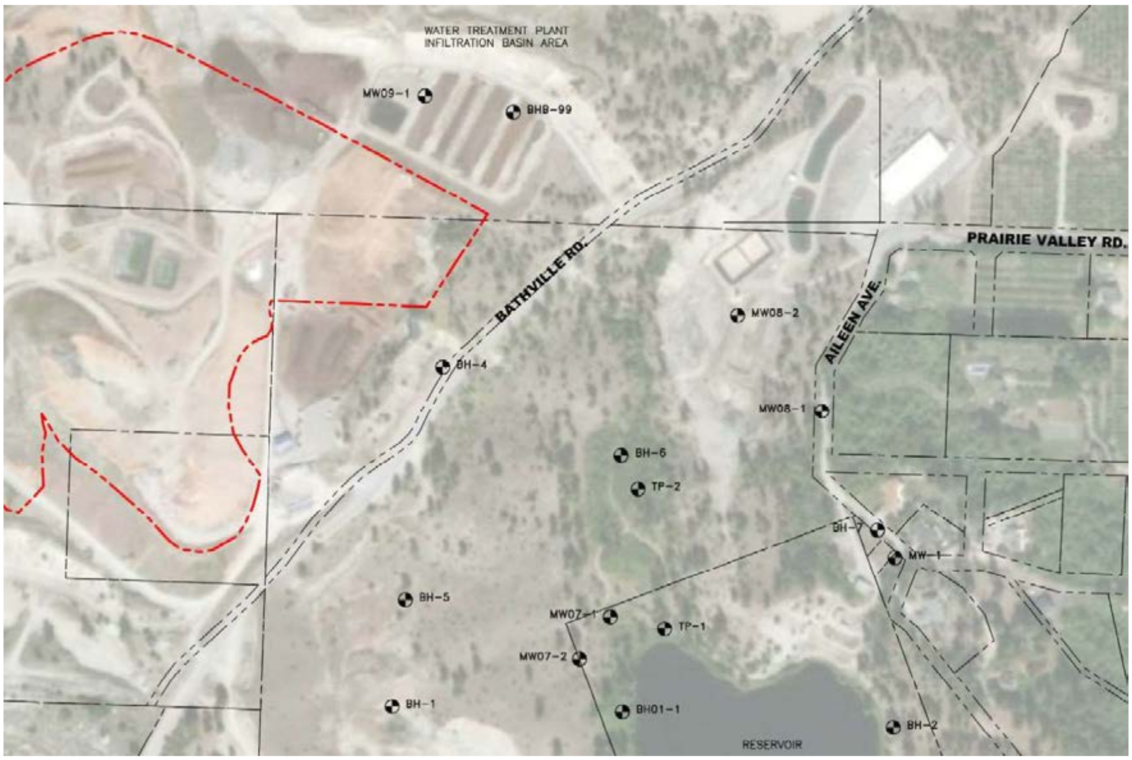


Figure 3.10 shows Prairie Creek along Highway 97 on the left, Eneas Creek on the right along Peach Orchard Drive. Shaughnessy Brook is the draw between the two larger creeks with its outlet at the location of the Trout Hatchery.

3.11 SUMMERLAND LANDFILL MONITORING

There have been concerns within the community that the safety of Summerland's drinking water is at risk of leachate from the Summerland Landfill at 17202 Bathville Road. The landfill covers a significant area of 16 hectares, and is located 300 metres west and upgradient of Summerland Reservoir. Summerland operates the landfill in conformance with Operating Certificate No. 15275. The province has mandated that the groundwater from the landfill be monitored including reporting annually on the groundwater levels around the reservoir. There are 18 active monitoring wells in the vicinity of the Landfill and the Reservoir as illustrated in Figure 3.11.

Figure 3.11 – Site Plan - SNC Lavalin - 2019 Landfill Monitoring Report



In 2020 SNC Lavalin reported on groundwater levels and water quality through chemical analysis of samples from the wells and from the reservoir. The groundwater monitored must meet the criteria within the BC Guidelines for Drinking Water Quality as the downstream stakeholder are the residents of Summerland.

SNC Lavalin also concluded that "*Groundwater and Reservoir water levels in 2019 were generally consistent with historical water levels. General groundwater flow direction was to the east, with localized mounding in the vicinity of the Reservoir*". They also concluded "*Groundwater at TP-1 and BH01-1 and surface water concentrations in the Reservoir area were significantly lower than at monitoring wells located immediately downgradient of the Landfill (BH-4 and BH-6), and therefore, the Landfill is not causing an adverse effect on the water quality of the Reservoir"*.

The installation of an impervious liner for Summerland Reservoir may negatively impact flow regimes and raw water quality within Shaughnessy Brook which is the water source for the Summerland Trout Hatchery. Therefore, future changes to the reservoir should consider the potential impact to downstream flow into Prairie Valley Creek and to other groundwater users downgradient in the District.

3.12 WATER SOURCE SUMMARY

The following points summarize our assessment of water sources for the District of Summerland:

- Summerland has two large reliable developed water sources, Trout Creek for domestic and irrigation supply, and Eneas Creek (Garnett) that is used solely to supply irrigation water;
- Summerland owns three small groundwater wells located at the Rodeo Grounds. These wells have quality issues and are used in the event of an emergency or in times of very low available water supply;
- The development of a water supply from Okanagan Lake is considered to be an important and valuable project for Summerland. The supply from Okanagan Lake would offer two benefits: an emergency supply for domestic water; and reduced operating costs for water supplied to the Trout Creek area would not have to be treated from the Water Treatment Plant;
- There is sufficient water licensing in place for storage and irrigation purposes. There is insufficient domestic licensing in place for Summerland. To adjust licensing to be representative of Summerland's domestic use, Summerland should first apply for additional domestic water licensing on Trout Creek. Should that not be successful, Summerland should apply for an alternate point-of-diversion (POD) of the Okanagan Lake domestic license, and if not successful, Summerland would be forced to reallocate existing irrigation license on Trout Creek;
- Water storage licenses should be reconciled so that licensed volumes at the various sites matches the actual storage volume constructed;
- Recent Okanagan-basin-wide data suggests that the overall runoff in the basin has increased by 8-10% in the past 11 years in comparison with the 100 years of runoff data in place. The warmer and wetter weather may be due to climate change. The recent runoff impacts have been more intense storm events such as the event on May 2018, lesser snowpack at medium elevations 800m to 1400m elevation, and the extreme heat experienced in June of 2021;
- The Water Use Plan (WUP) was last reviewed in 2008. It appears to be functioning well. With a new Water Survey of Canada flow monitoring station in lower Trout Creek, Summerland will have additional data to consider in their hydrometric monitoring. Cooperation and data sharing with Okanagan Nation Alliance and the Ministry of Environment Fisheries staff is recommended;
- For the watershed, the most reliable reservoirs to fill in order are Thirsk, Eneas, Crescent, Isintok, Garnett, Headwaters and then Whitehead.
- The next reservoir site recommended for expansion is Isintok Reservoir. Thirsk Reservoir was recently raised, Eneas is remote and too small, and excess water from Crescent Reservoir watershed is diverted to fill Headwaters Reservoirs;
- Spillway monitoring is recommended at all dam sites so that the water producing capacity of the sub-catchment area above each dam is known. This data is critical to confirm the reliability of the sub catchments to annually fill each reservoir;
- For best management practices for reservoir operations, it is recommended that Summerland staff continue to operate the reservoirs as per Table 3.7. This maximizes the ability of the watershed sub-basins to fill all of the reservoirs annually.

4. WATER DISTRIBUTION SYSTEM

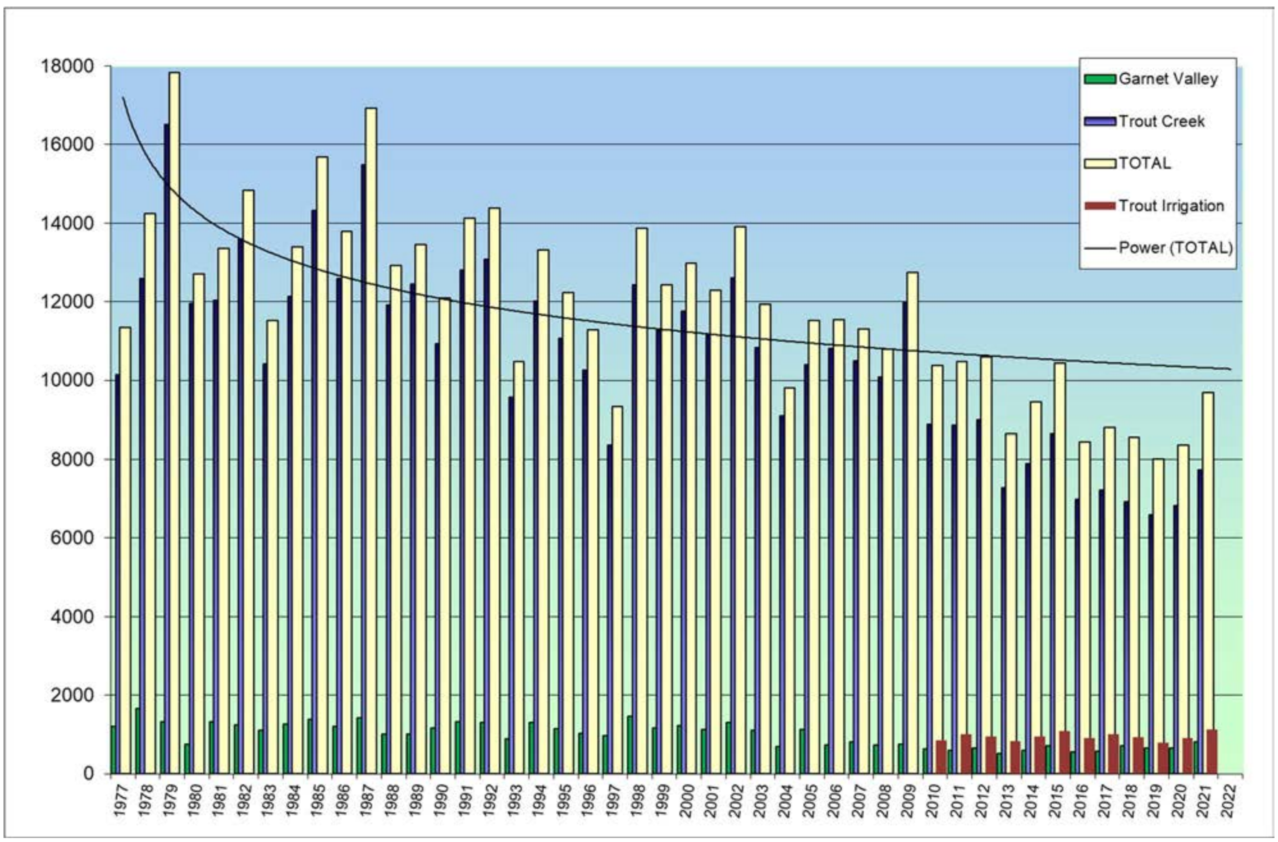
4.1 INTRODUCTION

This section provides a review of the existing Summerland water supply system. Included is an update to water licensing, water source capacity, existing usage, an assessment of the present water distribution system and the recommended direction for water supply capacity improvements. A summary of existing problem areas and remedial works is presented in this section.

4.2 WATER DEMAND SUMMARY

Summerland has a substantial record of District water-use dating back to 1977. For future projections and planning, this report relies heavily on the last 11 years of use. More accurate monitoring, improved technology, more efficient irrigation, reduced crop water demands, densification of the population, increased public awareness and appropriate water pricing have all contributed to reduced overall water demands for the District.

Figure 4.1 - Historic Water Consumption Summary (1977 – 2021)



The data presented in this section is useful to understand the evolution of water consumption within the district. In the past 40 years, the year of highest recorded water use was 1979 when 17,900 ML of water was used. Very dry years were also experienced in 1985, 1987, 1998, 2003 and 2009. Figure 4.1 illustrates the variation in annual water consumption by Summerland for both the Trout Creek and Garnett Valley water sources. Since the separation project of Prairie Valley in 2010, the dedicated irrigation supply is provided and is shown in the red bars in Figure 4.1. Since 2017, the Garnett Valley water supply is used solely for irrigation and fire protection.

Although the long-term 40-year average total water demand is 11,916 ML/year, the recent 9-year average demand from 2013-2021 is only 8,931 ML/year. The probable reasons include the changing of crop types to those requiring lower annual water use (vineyards), a strong effort placed towards water scheduling, education, metering and metered price for water, and increased irrigation efficiencies. Although the trend line for the water demand is declining, the water demand will inevitably start to climb with the expansion of agriculture into new areas begins and densification of the population continues.

Table 4.1 on the following page provides the detailed numbers for the monthly water demand for the entire Summerland water system.

Table 4.2 provides a summary of the demand information for the Garnett Reservoir supplied water system.

Table 4.1 Summerland - Monthly Water Demand History (ML / month)

Year	Jan.	Feb.	Mar.	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TROUT	TROUT IRRIG.	GARNETT	TOTAL
1977	143	120	135	160	188	1868	2278	2148	2599	234	131	132	10137		1205	11342
1978	125	110	123	154	1670	3058	3500	2374	469	513	346	141	12581		1664	14245
1979	211	234	176	429	2509	3159	3533	3110	2407	456	162	127	16513		1314	17827
1980	130	143	148	411	1207	2164	3111	2751	1232	395	133	130	11956		750	12706
1981	128	125	153	527	1501	1592	2610	3382	1537	225	132	124	12038		1327	13366
1982	134	126	135	2815	2132	3071	1151	2270	1146	350	134	133	13598		1241	14840
1983	135	124	145	235	1661	2162	1857	2977	430	403	139	145	10410		1114	11524
1984	141	132	141	179	1257	2063	3585	2173	1528	546	166	214	12125		1268	13394
1985	161	151	170	456	1990	2866	4304	2832	777	221	184	203	14316		1373	15689
1986	160	148	165	215	1592	2805	2092	3642	1182	259	159	170	12589		1205	13794
1987	165	148	181	991	2010	2862	3196	2891	2253	427	187	180	15493		1427	16920
1988	195	176	185	274	1346	1939	2706	2518	1718	496	191	179	11923		1005	12927
1989	176	181	210	419	1641	2560	2594	2097	1366	843	185	180	12452		1005	13456
1990	182	169	205	548	939	880	2699	2786	1524	657	172	179	10939		1164	12103
1991	184	165	182	460	1192	2005	2845	2354	1974	1038	200	201	12800		1318	14118
1992	189	172	250	584	2350	2407	1653	2720	1694	651	211	205	13086		1296	14382
1993	212	210	215	262	1561	1381	890	2042	1550	849	191	210	9573		896	10468
1994	212	194	245	594	1439	1910	2904	2291	1198	633	209	191	12021		1296	13317
1995	201	175	206	361	1774	1520	2390	1732	1873	441	198	198	11068		1155	12223
1996	199	199	190	306	521	1715	2841	2571	780	535	200	202	10258		1023	11281
1997	217	195	214	300	1209	971	1829	2048	704	280	201	198	8367		964	9331
1998	170	164	197	399	1481	1409	2806	3075	1853	481	191	195	12421		1455	13876
1999	198	179	212	507	1054	1793	2369	2364	1430	788	193	186	11273		1159	12433
2000	198	186	205	611	1272	1826	2444	2716	1111	743	254	191	11758		1232	12990
2001	197	183	215	473	1587	1398	2198	2224	1720	611	180	168	11156		1132	12288
2002	166	152	185	500	1241	2148	2919	2583	1655	701	176	178	12602		1309	13911
2003	174	160	177	313	1194	2015	3022	1804	1302	356	158	159	10832		1105	11937
2004	172	155	201	515	1204	1383	2247	1699	592	625	159	153	9104		696	9800
2005	156	151	169	495	1302	947	2239	2647	1362	527	215	182	10393		1132	11525
2006	195	186	191	268	1113	1369	2574	2476	1394	680	190	184	10820		727	11547
2007	174	157	206	486	1509	1630	2110	2176	1303	391	176	178	10496		809	11305
2008	184	143	181	391	1100	1332	2585	1737	1467	649	150	156	10075		724	10799
2009	151	141	152	350	1739	2149	3094	2093	1268	558	149	149	11993		756	12749
2010	152	140	169	342	672	1049	2325	2279	930	524	161	144	8888	844	638	10370
2011	144	126	141	217	579	1386	1709	2349	1635	314	139	126	8864	1006	598	10469
2012	122	117	130	190	1003	955	1697	2299	1554	657	130	140	8994	955	645	10594
2013	133	125	129	243	911	916	1894	1708	622	327	135	137	7280	839	520	8639
2014	135	126	143	221	836	1185	1929	1716	926	399	141	138	7895	956	596	9447
2015	140	125	148	412	1082	1541	1845	1632	943	504	137	128	8637	1086	715	10438
2016	149	134	133	547	1069	1120	1159	1469	628	338	114	121	6981	900	557	8438
2017	88	82	84	120	379	1117	1967	1720	1056	419	87	103	7222	1000	570	8791
2018	138	122	135	196	916	1124	1586	1538	692	203	134	138	6922	938	703	8563
2019	141	130	145	233	979	1325	1201	1480	480	212	130	127	6583	781	648	8011
2020	119	108	130	355	736	662	1472	1592	1064	315	130	139	6820	907	647	8374
2021	138	118	138	404	1191	1424	1845	1205	739	*250*	*135*	*140*	7727	1135	818	9680
2022																
2023																
Average	163	151	171	433	1285	1737	2351	2273	1282	489	169	162	10666	945	998	11916
Extr.Low	88	82	84	120	188	662	890	1205	430	203	87	103	6583	781	520	8011
Extr.High	217	234	250	2815	2509	3159	4304	3642	2599	1038	346	214	16513	1135	1664	17827
9 Yr Ave.	**131**	**119**	**132**	**303**	**900**	**1157**	**1655**	**1562**	**794**	**330**	**127**	**130**	**7341**	**949**	**642**	**8931**
% of annual	1.47	1.33	1.47	3.40	10.08	12.96	18.53	17.49	8.89	3.69	1.42	1.46	82.2%	10.6%	7.2%	100.0%

The data in Table 4.1 is very useful in showing the long-term trends in water usage. Key indicator years in the history of the Summerland water system include:

- Exceptional Arid Years 1979, 1985, 1987, 1992, 1994, 1998, 2003, 2009, 2021;
- Wet , Cooler Years 1977, 1983, 1990, 1997, 2004, 2019;
- 2007 WTP on-line and operating
- 2009 Separation of Prairie Valley
- 2010 Implementation of Metering of Larger Irrigated Parcels;
- 2017 Separation of Garnett Valley

Garnett water supply, being a smaller service area, does not show the peak water usage to the same extent as the larger system. The stability in usage over the past 10 years is primarily due to tighter controls on the usage through the water metering program.

Table 4.2 Garnett Reservoir - Total Monthly Water Demand (ML/month)

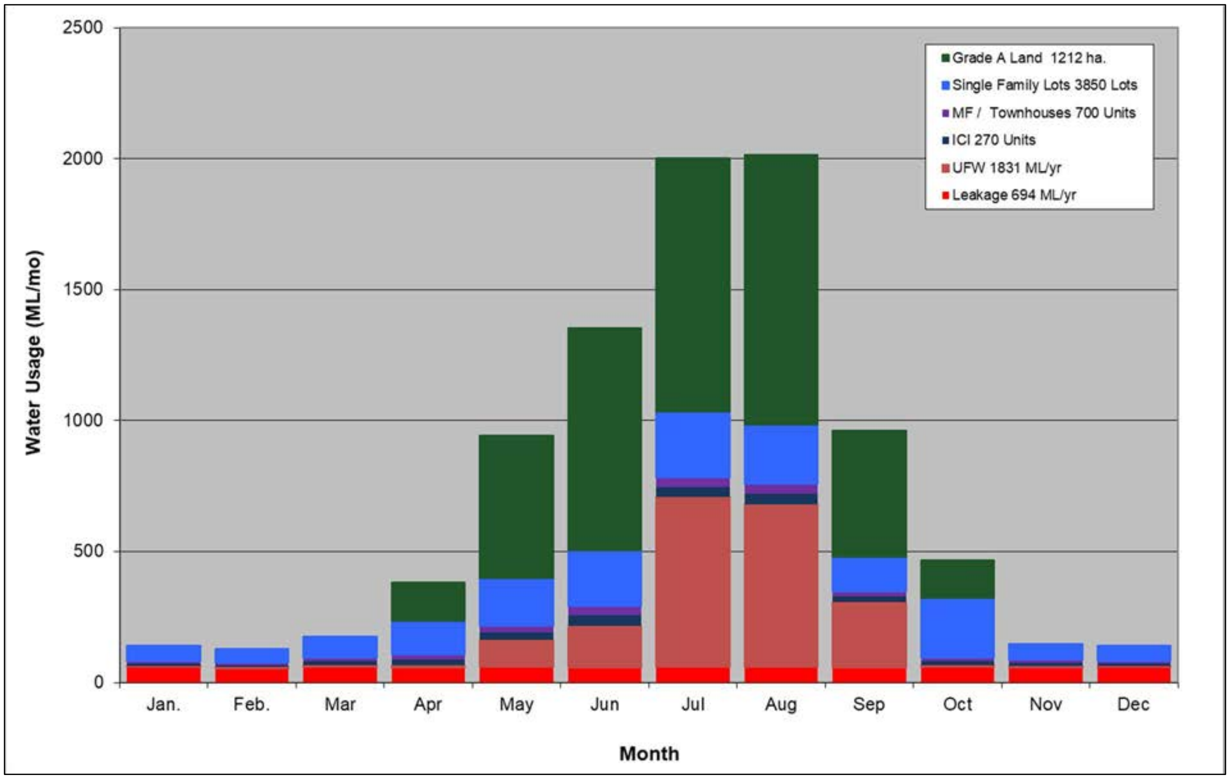
Year	Jan.	Feb.	Mar.	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2008	7.85	7.48	8.41	26.37	100.64	88.19	192.80	119.96	113.82	39.70	9.04	9.89	724.2
2009	10.17	9.20	10.64	35.91	43.60	155.87	200.93	156.38	85.01	26.82	9.50	11.87	755.9
2010	12.98	14.32	17.91	29.40	71.24	60.18	189.57	160.60	40.78	24.61	7.88	8.74	638.2
2011	7.37	7.31	8.91	21.15	55.55	64.91	114.20	179.46	110.28	17.30	5.90	6.04	598.4
2012	6.24	6.05	7.15	15.54	90.91	38.86	112.14	191.04	121.94	42.45	5.93	6.56	644.8
2013	6.80	6.52	7.55	23.85	85.81	62.44	150.89	105.73	42.00	12.70	7.86	8.11	520.3
2014	9.25	9.37	7.73	19.65	81.88	78.30	153.60	132.86	70.59	18.27	7.10	7.52	596.1
2015	7.9	7.8	9.5	48.4	107.9	122.6	164.9	130.5	75.0	23.8	8.2	9	715.3
2016	8.91	8.39	9.85	48.52	86.67	79.90	89.40	120.37	51.11	24.95	15.48	13.68	557.2
2017	10.98	10.09	13.47	8.21	19.02	87.04	173.01	147.53	72.19	16.30	6.08	5.61	569.5
2018	6.07	5.42	6.18	10.74	97.33	109.99	204.60	178.78	62.93	7.70	6.24	6.71	702.7
2019	6.2	6.0	6.6	19.7	113.9	147.5	122.4	162.4	36.7	9.9	9.2	8	648.0
2020	7.8	7.3	8.0	23.3	74.5	55.2	148.9	173.7	107.4	21.5	9.2	10.1	646.7
2021	8.90	4.50	3.90	42.40	135.70	165.20	222.20	121.40	75.60	*20.0*	*9.0*	*9.0*	817.8
2022													0.0
2023													
Average	8.39	7.84	8.99	26.65	83.19	94.02	159.96	148.62	76.1	21.9	8.3	8.6	653
Extreme Low	6.07	4.50	3.90	8.21	19.02	38.86	89.40	105.73	36.68	7.70	5.90	5.61	520
Extreme High	13.0	14.3	17.9	48.5	135.7	165.2	222.2	191.0	121.9	42.5	15.5	13.7	818

The

WATER DEMAND CHARACTERIZATION

Figure 4.2 illustrates the monthly water use data that is summarized in Table 4.3. Table 4.3 provides our best estimate of the average monthly water demand per user group for Summerland.

Figure 4.2 - Average Monthly Water Demand per User Group (all sources)



UFW – Unaccounted For Water
ICI – Institutional, Commercial, Industrial

Table 4.3 Monthly Usage per User Group

WATER USAGE PER MONTH (ML)																
LAND USE			**Jan.**	**Feb.**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**	**%**
Arable Land	1204	ha.	0	0	0	120	558	1023	1204	963	530	173	0	0	4572	51.2%
Single Family Lots	3850	Lots	59	54	80	129	180	211	250	227	129	227	59	59	1663	18.6%
MF / Townhouses	700	Units	8	7	13	19	25	35	38	36	20	13	13	8	234	2.6%
ICI	270	Units	9	8	16	22	29	41	51	53	23	16	15	9	291	3.3%
Leakage	694	ML/yr	59	53	59	57	59	57	59	59	57	59	57	59	694	7.8%
UFW	1425	ML/yr	5	5	8	10	105	226	500	470	125	8	5	5	1472	16.5%
TOTAL DEMAND PER MONTH			**140**	**128**	**176**	**357**	**956**	**1593**	**2101**	**1808**	**883**	**496**	**149**	**140**	**8927**	**100%**

Summerland has a universal water metering program and most of the properties metered. There is constant work and effort to keep all meters functioning properly and a full accounting of all water used in the water system.

4.3 WATER DISTRIBUTION SYSTEM

The District of Summerland currently operates three separate water distribution systems. These include:

1. Summerland (Trout Creek) domestic via WTP;
2. Summerland (Trout Creek) irrigation via Summerland Reservoir;
3. Garnett Valley (Eneas Creek) irrigation.

Since 2008, there have been two major changes in the water distribution system:

- In 2009, the Prairie Valley area water supply was split with separate water distribution to the irrigation. At that time, approximately 7,290 metres of new mostly domestic water main was installed. The separation annually allows an average of 949 ML of water to avoid the Water Treatment Plant and be supplied directly to the Prairie Valley Irrigation system. Maximum daily demands were reduced from approximately 13 ML/day which reduced the times when the WTP was not able to keep up with water demands.
- In 2017, the Garnett Valley system separation project was implemented. This project consisted of the installation of approximately 10,400 metres of domestic water main in Garnett Valley, Jones Flat Road and areas between Garnett Valley and down town Summerland. That project brought all Summerland residents onto the treated water system.

Table 4.5 provides a listing of the key water infrastructure within the Summerland water distribution system. The list includes the water sources, balancing reservoir, booster stations and PRVs. The location of the key infrastructure components is illustrated on Figures 4.5(S) and 4.5(N). Key components of infrastructure are reviewed in this section including the reservoir storage tanks, the water pump stations, and pressure reducing stations.

COMPUTER WATER MODEL UPDATE

In the review of the water supply capacity, the District of Summerland water distribution model was updated with the new pipelines and reconfigured distribution system. The water distribution computer model is the primary tool Agua Consulting Inc. uses to analyze the capacity of the water distribution system. The Summerland computer model was upgraded as part of the overall Water Master Plan by CTQ Consultants. Water mains, pump controls, pump curves and reservoir data were updated within the existing EPANET model. The program EPANET which is a public domain program developed by the USEPA. This program has the capability to provide estimates on water age, chlorine residual levels through the system and all of the hydraulic flow and pressure parameters.

One of the useful attributes of the computer model is that all of the watermains were tagged for material type and year installed. This information was extracted into an EXCEL database of pipe materials to support and inform asset management decisions.

FUTURE COMPUTER APPLICATION STEPS

Future steps to upgrade the distribution system model over time would include the determination of system leakage to a higher degree of accuracy for specific areas of the water distribution system. The addition of chlorine decay rates is a future modeling step that will allow for the estimation of chlorine residual levels throughout the water distribution system. Another useful item in time would be to integrate the water distribution system model with the District's GIS system.

DISTRIBUTION SYSTEM HYDRAULIC CAPACITY REVIEW

The water distribution system was reviewed with respect to hydraulic capacity. The computer model was used for this analysis. The distribution system was reviewed to determine hydraulic performance and to identify restrictions. The model was also run at MDD and PHD conditions to determine where high friction losses exist in the distribution system.

Figure 4.3a and 4.3b provide an illustration of the estimated water age throughout the water distribution system under MDD conditions. The model was run for a 36-hour water age simulation to provide the estimate for a summer condition.

KEY WATER INFRASTRUCTURE LOCATIONS

The important water infrastructure components listed in Table 4.4 are illustrated in Figure 4.4 (North) and Figure 4.5 (South). The pump stations (PS), pressure reducing valve stations (PRV), concrete reservoirs (TANK) and reservoirs are noted on the drawing. Larger diameter transmission mains are identified on these drawings.

PRESSURE ZONE MAPPING

Maps are provided that set out the water service pressure zones. The pressure zones are designated by the normal operating hydraulic grade line in meters of elevation. PZ 587 is the main pressure zone below the water treatment plant. To determine the normal operating water pressure at any location in Summerland, subtract the ground elevation from the PZ elevation to obtain the head (pressure) of the water in meters.

Figures 4.6 (N) and 4.7 (S) provide the pressure zones for the domestic water system.
Figures 4.8 (N) and 4.9 (S) provide the pressure zones for the separated irrigation water system.

Table 4.4 Key Water Infrastructure Components

I.D.	Location	Description
Sources, WTP, Reservoirs		
S-1	Trout Creek Intake	Elevation 594 m (HWL)
S-2	Garnett Lake	Elevation 625 m (HWL)
WTP	Prairie Valley Road	Capacity 75 MLD
CW	WTP Clearwell	6,043 m^3, Twin-cell Concrete Reservoir HWL 590.07 m
R-1	Deer Ridge Res.	423 m^3, Concrete Reservoir. HWL 726.0 m
R-2	Trout Creek Tank	430 m^3, Concrete 2 cell reservoir HWL 470.5 m
Pump Stations		**No. Hp Flow and TDH, Pump Model Voltage and rpm**
PS-1	Dale Meadows Road	2 – 60 hp (48 L/s @ 54.5 m) American Marsh, 600V, 1780 rpm
PS-2	Prairie Valley Road	2 – 50 hp (41.3 L/s @ 54.8 m) Aurora Model 411, 208 / 460V, 1775 rpm
PS-2A	Morrow Avenue	2 – 25 hp (37.9 L/s @ 36.6 m) Peerless Pump 4X4X8A PV, 208V. One pump has VFD
PS-2B	Hermiston Drive	2 – 20 hp Berkeley B1 – 1 ½ ZPL, 208 V
PS-3	Gillard Avenue	2 – 10 hp (9.1 L/s @ 40.2 m) Aurora Model 411, 460V, 1740 rpm.
PS-4	Loomer Road	2 – 25 hp (15.1 L/s @ 79.2 m) Aurora Model 411, 460V, 3500 rpm. 1 – 5 hp winter pump.
PS-5	Simpson Road	2 – 75 hp (83.6 L/s @ 49.7 m) Aurora Model 411, 460V, 1775 rpm. 1 – winter pump.
PS-6	Simpson Road	2 – 30 hp (56.5 L/s @ 32.3 m) Aurora Model 411, 460V, 1730 rpm. 1 – winter pump.
PS-7	Cedar Avenue	3 – 5 hp (5.69 L/s @ 30.6 m) 1 – 100 hp Aurora 2Fire Pump (157.5 L/s @ 35.0 m TDH)
PS-8	Garnett Valley	3 - 7.5 hp (5.67 L/s @ 62.8 m TDH) Grundfos skid unit, no fire pump 208 V
PS-9	Lakeshore	1 – 30 hp (30.3 L/s @ 54.9m TDH) Oliver Pump, 208V (decommissioned)
PS-10	Lower Hunters Hill	2 – 25 hp (16.1 L/s @ 73.3 m TDH) Grundfos, Model CR 45-3-1, VFDs, 600 V
PS-11	Upper Hunters Hill	Proposed, 1 high flow pump, 50 hp-Paco VS-50129, 2 duty pumps – 10 hp Grundfos, CR 32-3-2
PRV Stations		**Main – Bypass Valve Size / Type Inlet – Outlet Pressure m (psi)**
PRV-01	Garnett Valley Road	150mm Clayton 38mm Clayton 88m (125 psi) 63m (90 psi)
PRV-03	Trout Creek Tank	2-150mm Singers 38mm Singer 75.6m (108 psi) Tank Level
PRV-04	McDougal Road	100mm 38mm Clayton 105m (150 psi) 38m (54 psi)
PRV-05	Whitfield Road	150mm (reduced port) 38mm Clayton 114m (162 psi) 45.7m (65 psi)
PRV-06	Slater Road	150mm Clayton- Red. Port, 75x50mm Cla Red. Port 106 m (150 psi) 39 m (55 psi)
PRV-07	Solly Road	200mm Clayton 75mm Clayton 84.4m (120 psi) 45.7m (65 psi)
PRV-08	Solly Road	200mm Clayton 75mm Clayton 116m (165 psi) 45.7m (65 psi)
PRV-09	Lower Town Tank	100mm Clayton 70.0m (100 psi) Tank Level.
PRV-10	Prairie Valley Road	3-300mm Claytons + 100mm Clayton 98.5m (140 psi) 66.3m (95 psi)
PRV-12	Hespeler Road	150mm Clayton 50mm Clayton 91.4m (130 psi) 49.2m (70 psi)
PRV-13	Clark Street	100mm Clayton 50mm Clayton 91.4m (130 psi) 54.1m (77 psi)
PRV-14	Harris Road	150mm Clayton 50mm Clayton 82.3m (117 psi) 45.7m (65 psi)
PRV-15	Hillborne Avenue	250mm Clayton 100mm Clayton (Red-Port) 91.4m (130 psi) 45.7m (65 psi)
PRV-16	Gartrell Road	150mm Clayton 38mm Clayton 119.6m (170 psi) 45.7m (65 psi)
PRV-17	Morgan Street	200mm Clayton 63mm Clayton 112.6m (160 psi) 63.3m (90 psi)
PRV-18	Lower Town	200mm Clayton - installation is part of Lakeshore condominium Project

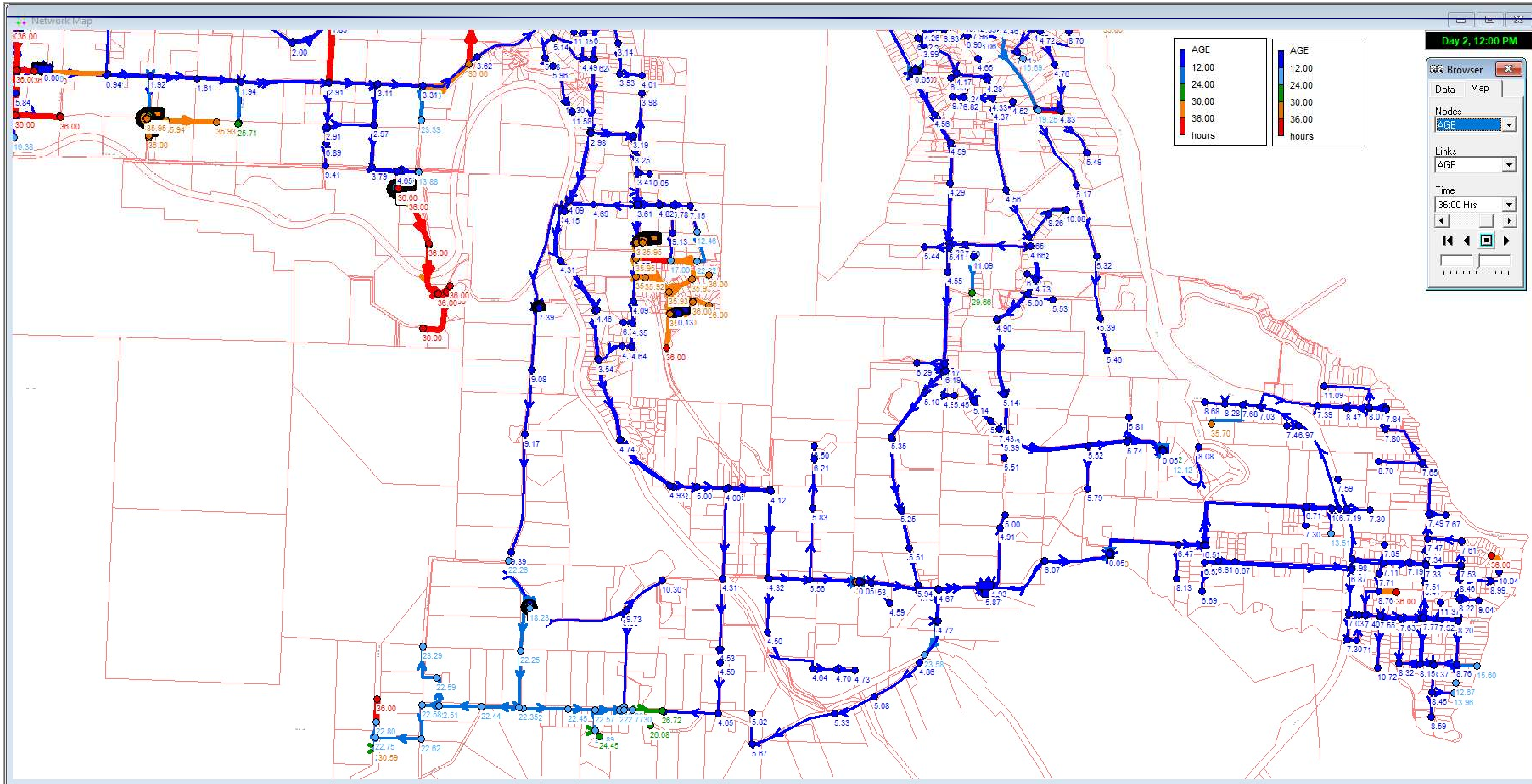


FIGURE 4.3a - SOUTH
WATER AGE (IN HRS.) FOR MAXIMUM DAY USAGE SCALE: NTS

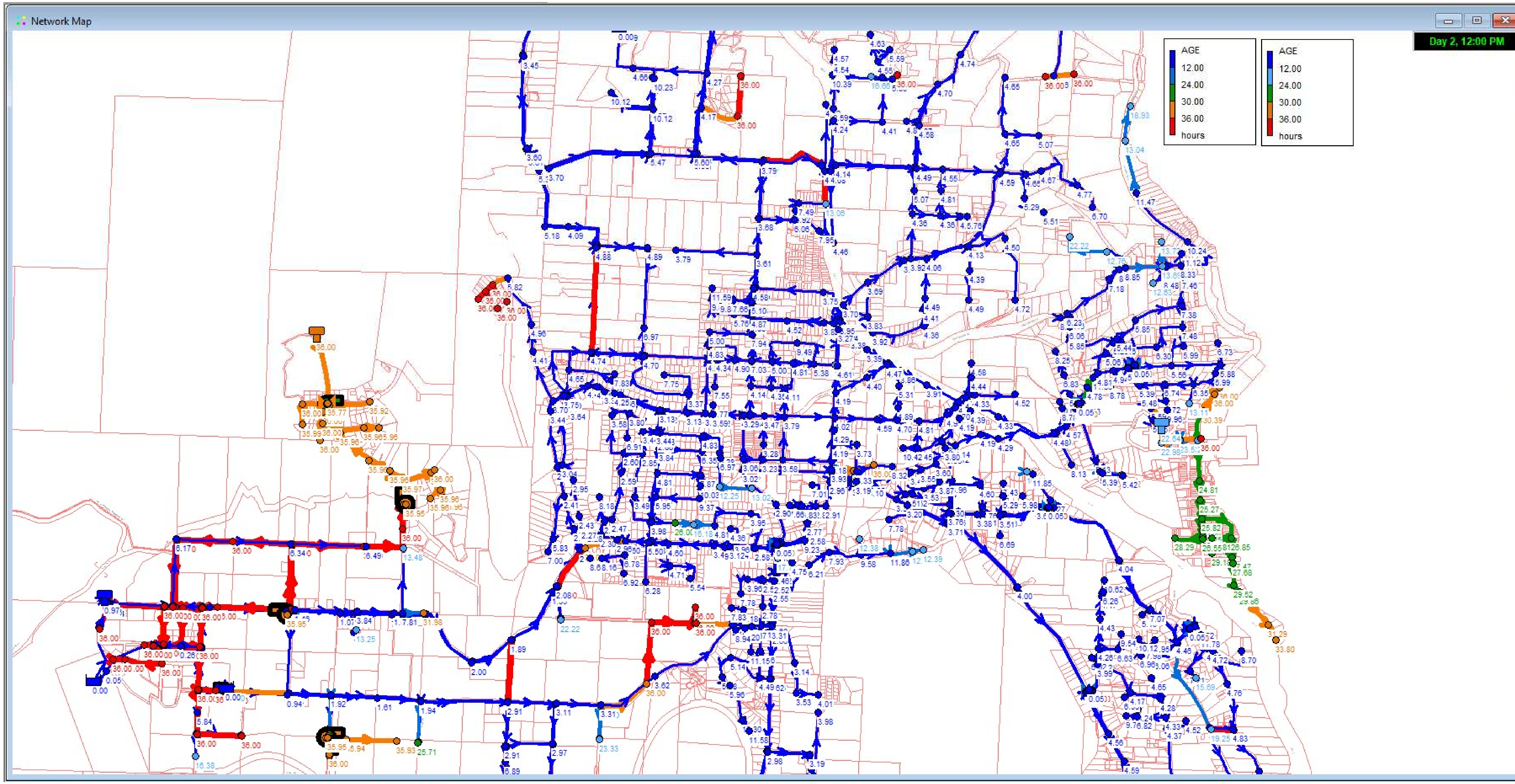


FIGURE 4.3b - NORTH
WATER AGE (IN HRS.) FOR MAXIMUM DAY USAGE
SCALE: NTS

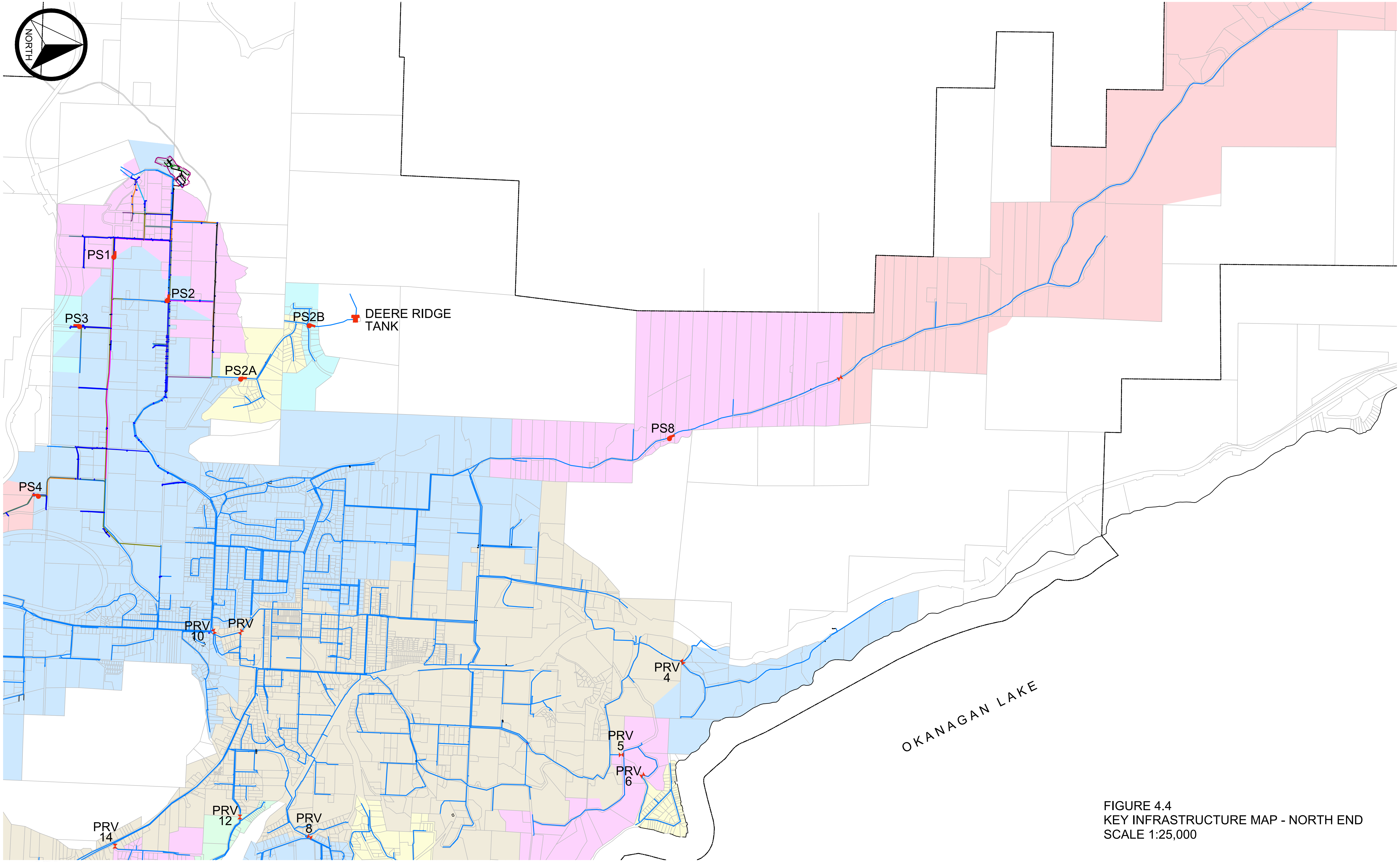


FIGURE 4.4
KEY INFRASTRUCTURE MAP - NORTH END
SCALE 1:25,000

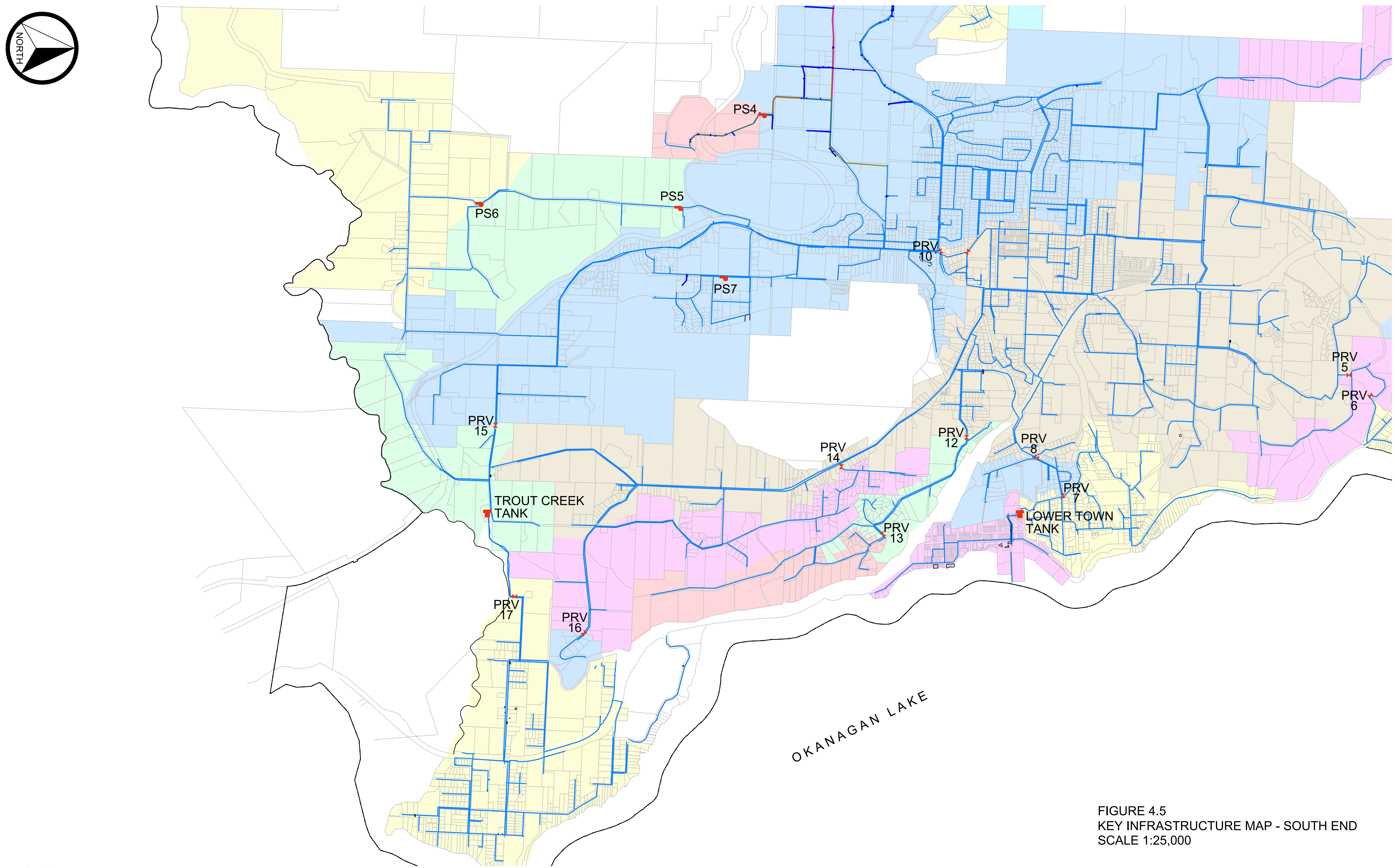


FIGURE 4.5
KEY INFRASTRUCTURE MAP - SOUTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

CTQ

Agua Consulting Inc.
"Engineered Water Solutions"

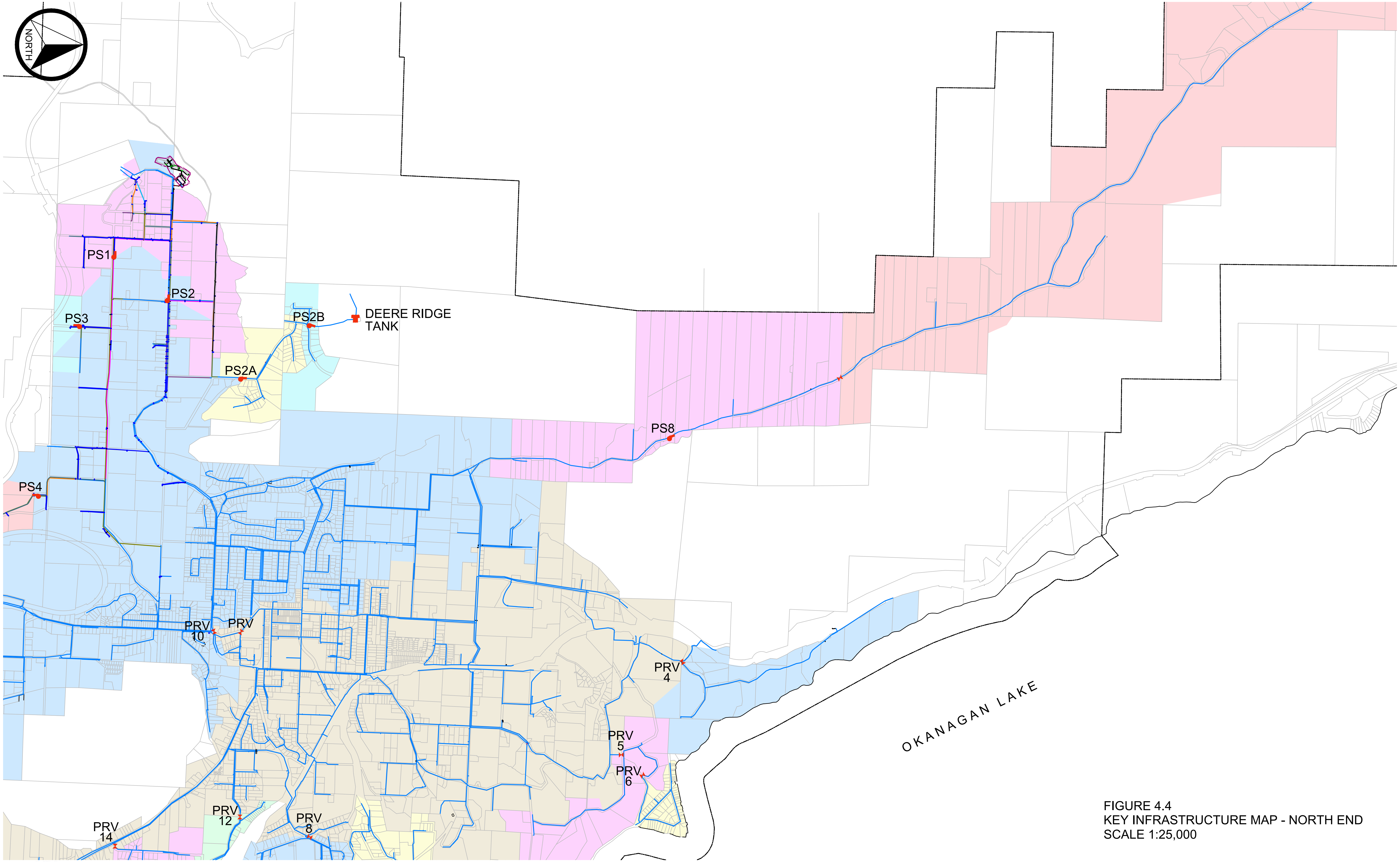


FIGURE 4.4
KEY INFRASTRUCTURE MAP - NORTH END
SCALE 1:25,000

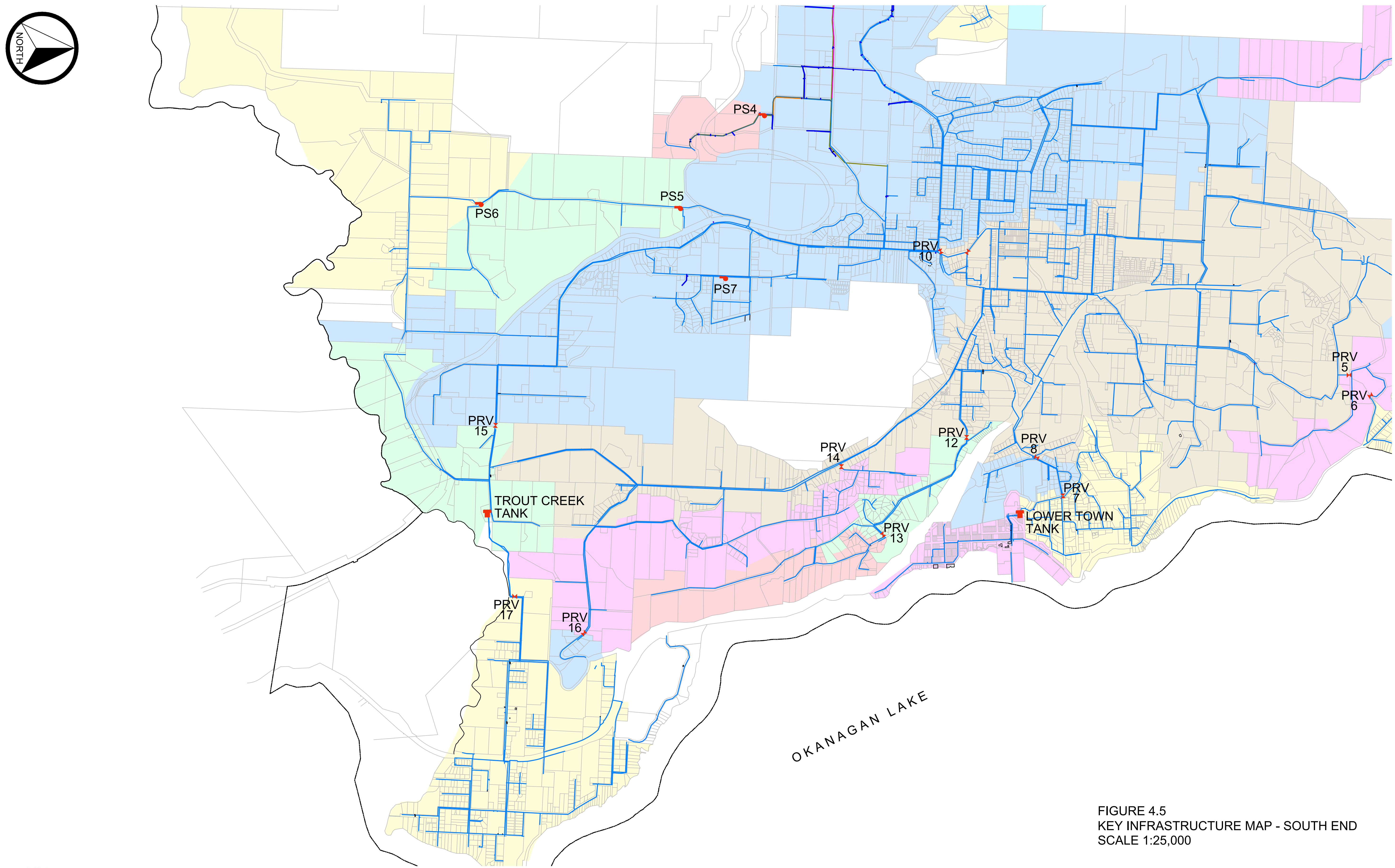


FIGURE 4.5
KEY INFRASTRUCTURE MAP - SOUTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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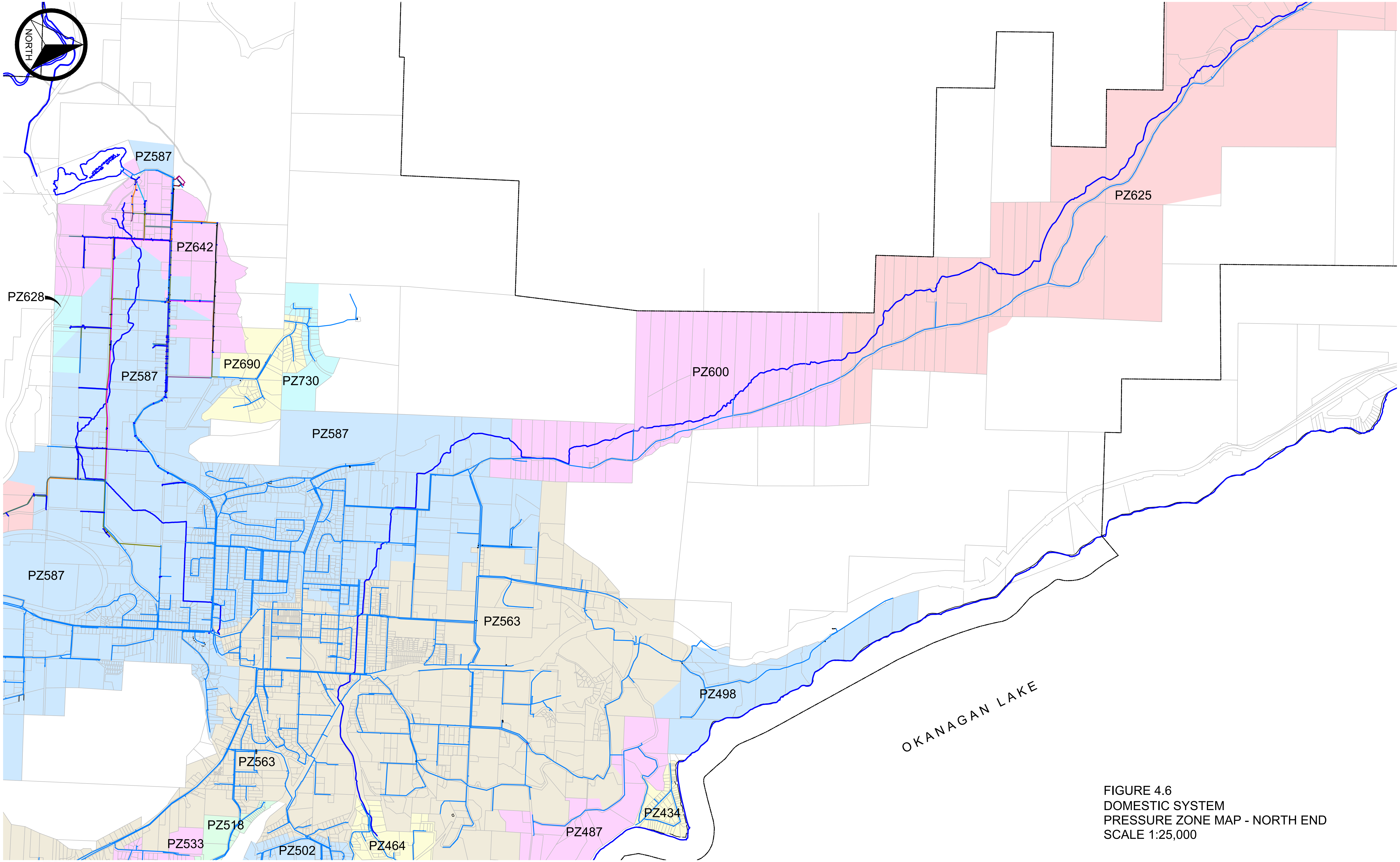

FIGURE 4.6
DOMESTIC SYSTEM
PRESSURE ZONE MAP - NORTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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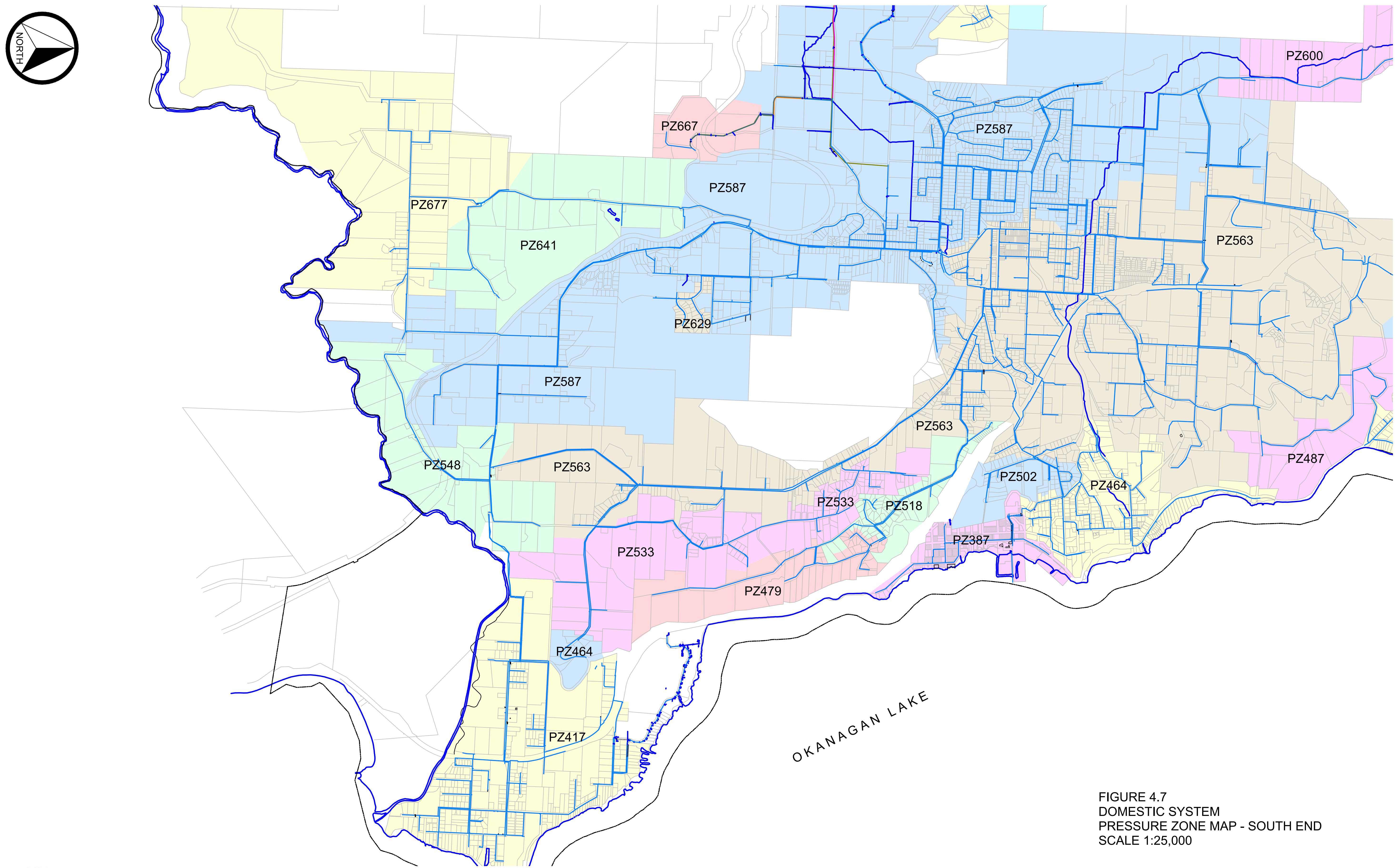

FIGURE 4.7
DOMESTIC SYSTEM
PRESSURE ZONE MAP - SOUTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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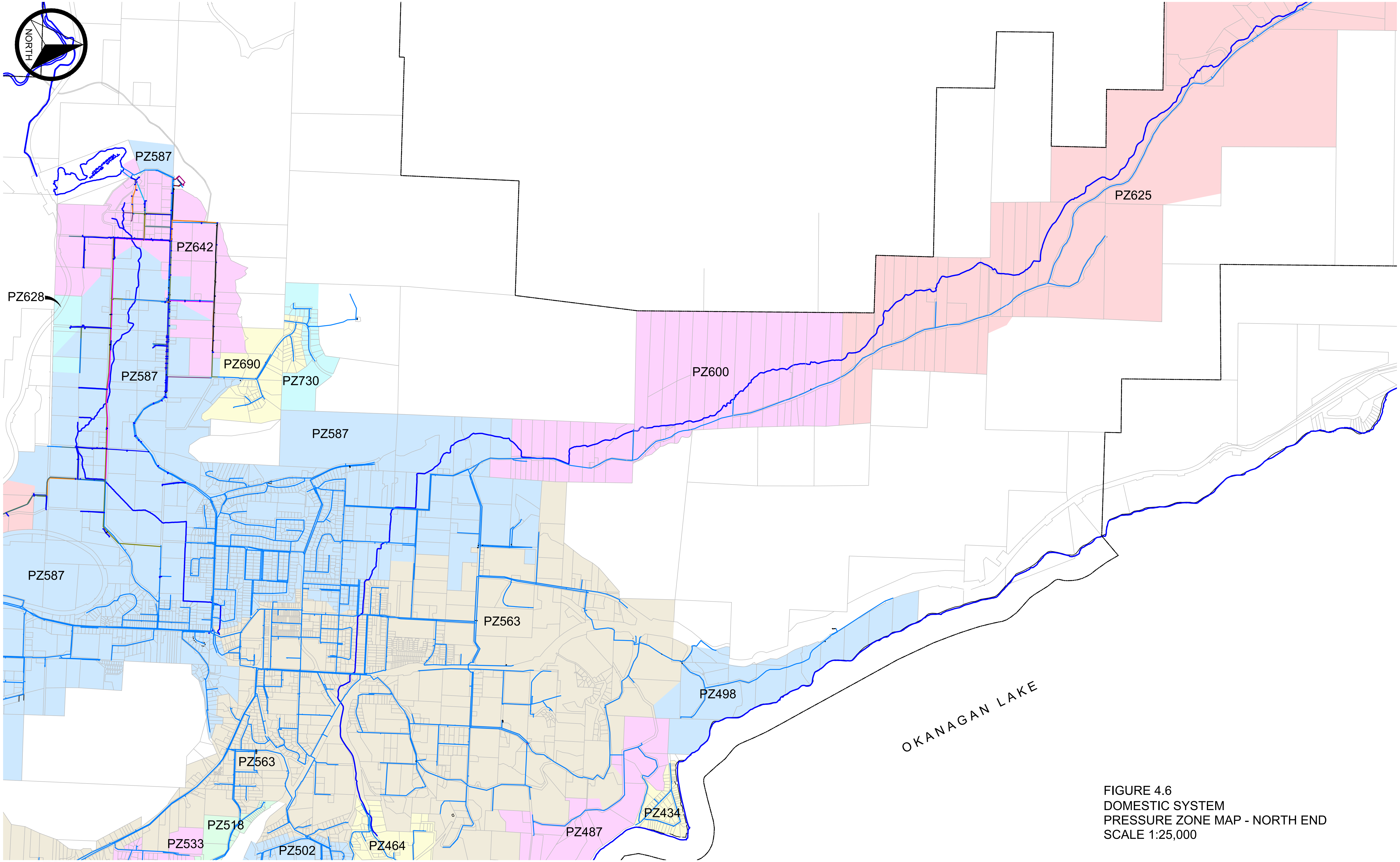

FIGURE 4.6
DOMESTIC SYSTEM
PRESSURE ZONE MAP - NORTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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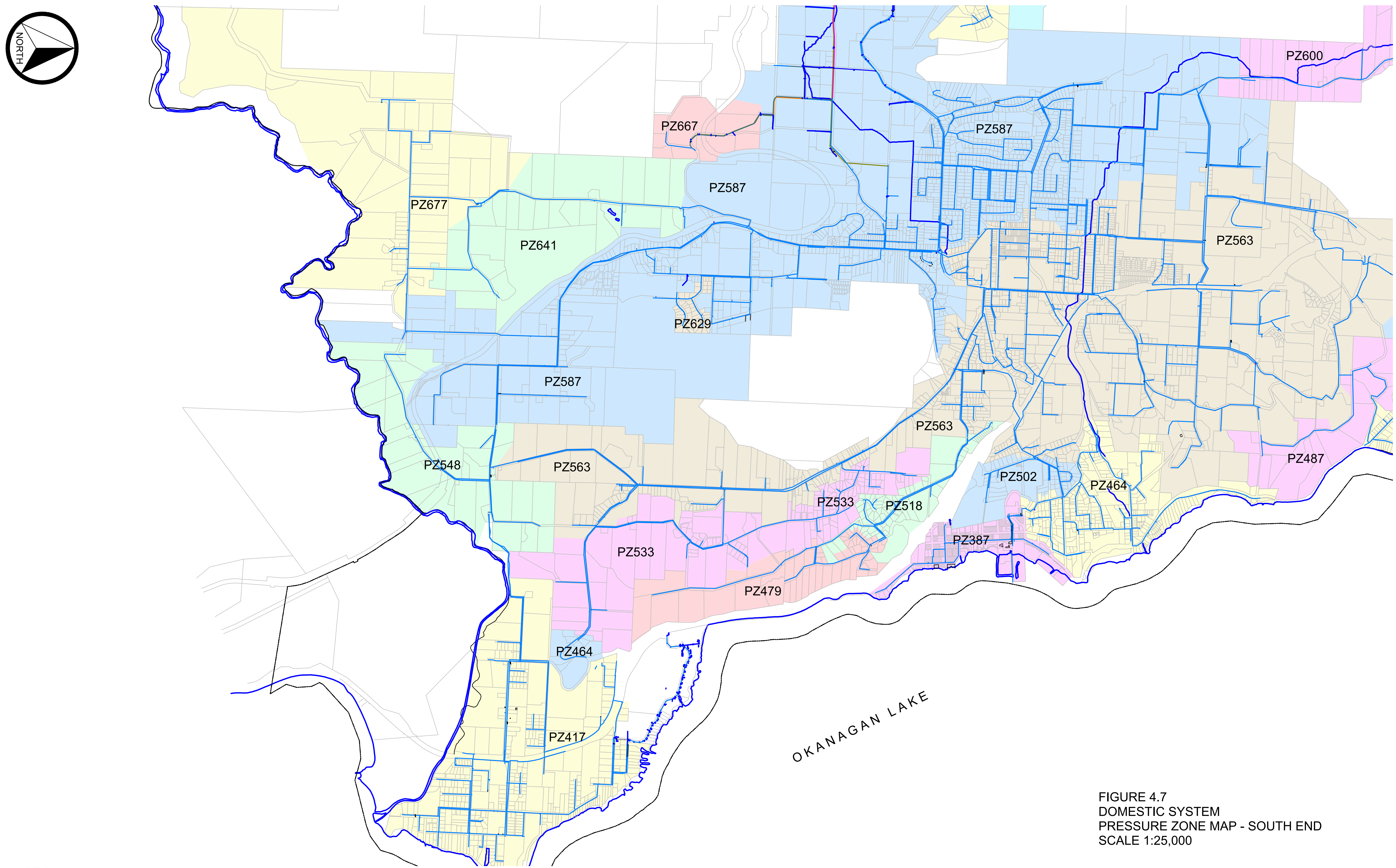

FIGURE 4.7
DOMESTIC SYSTEM
PRESSURE ZONE MAP - SOUTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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"Engineered Water Solutions"

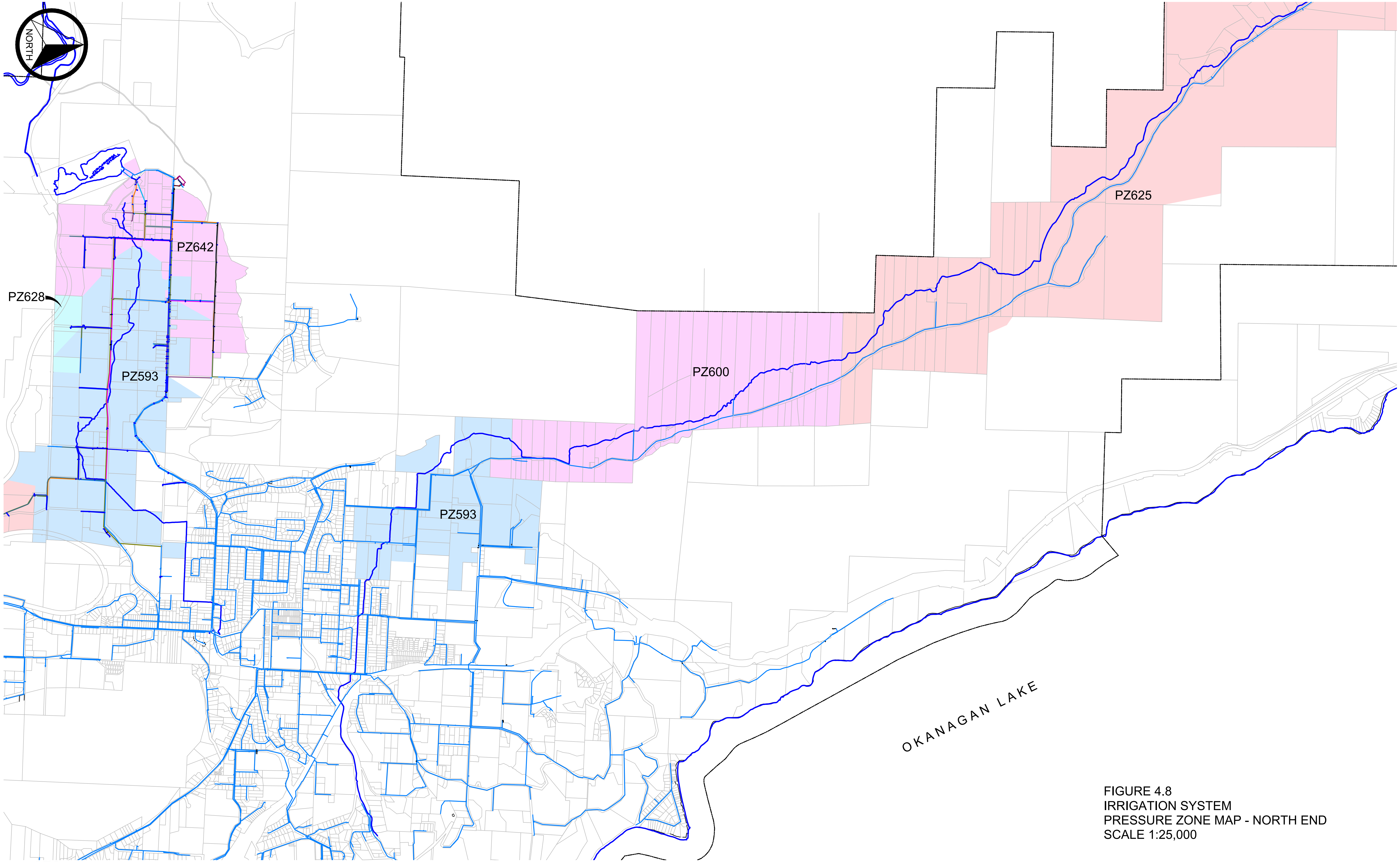

FIGURE 4.8
IRRIGATION SYSTEM
PRESSURE ZONE MAP - NORTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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"Engineered Water Solutions"

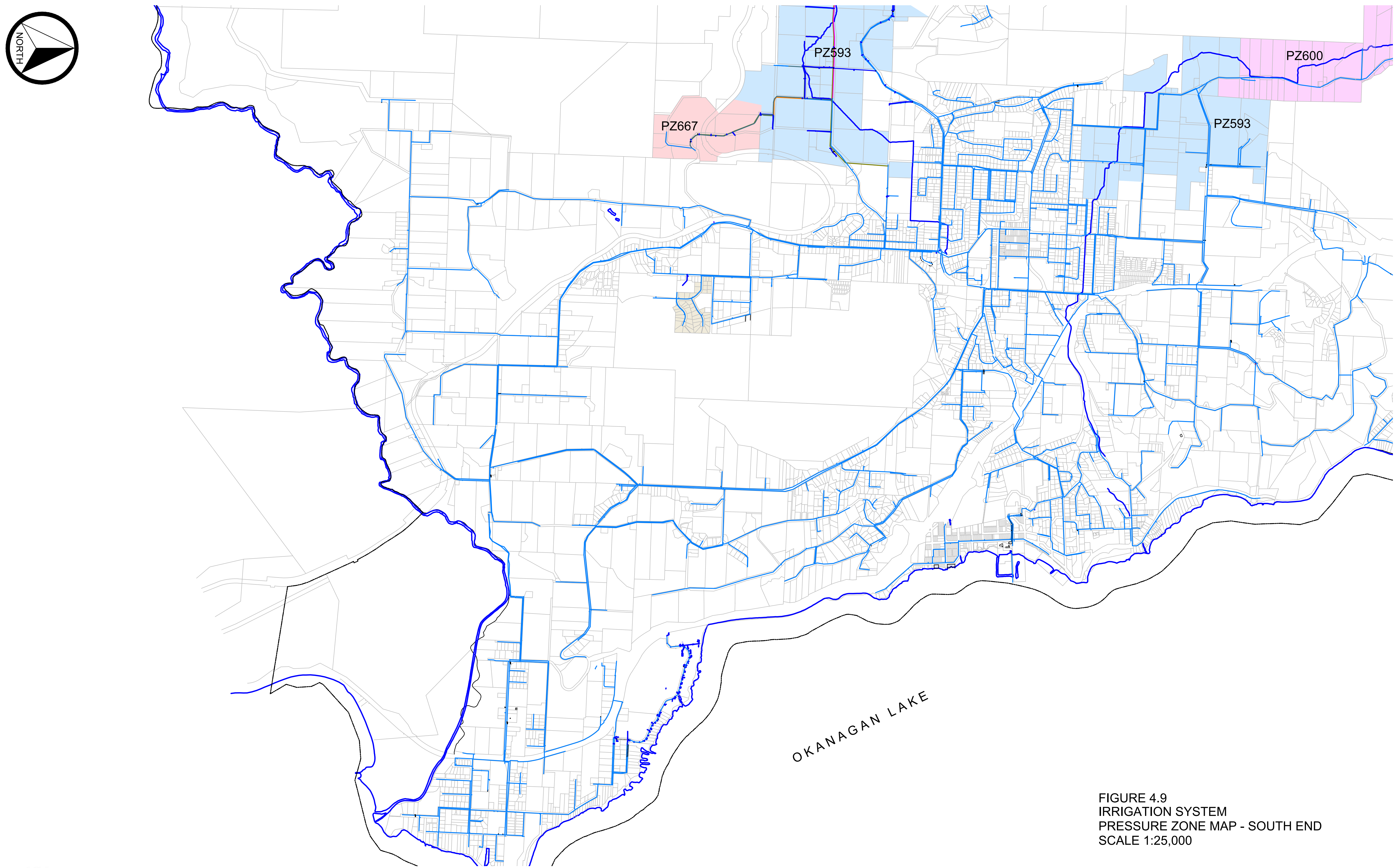

FIGURE 4.9
IRRIGATION SYSTEM
PRESSURE ZONE MAP - SOUTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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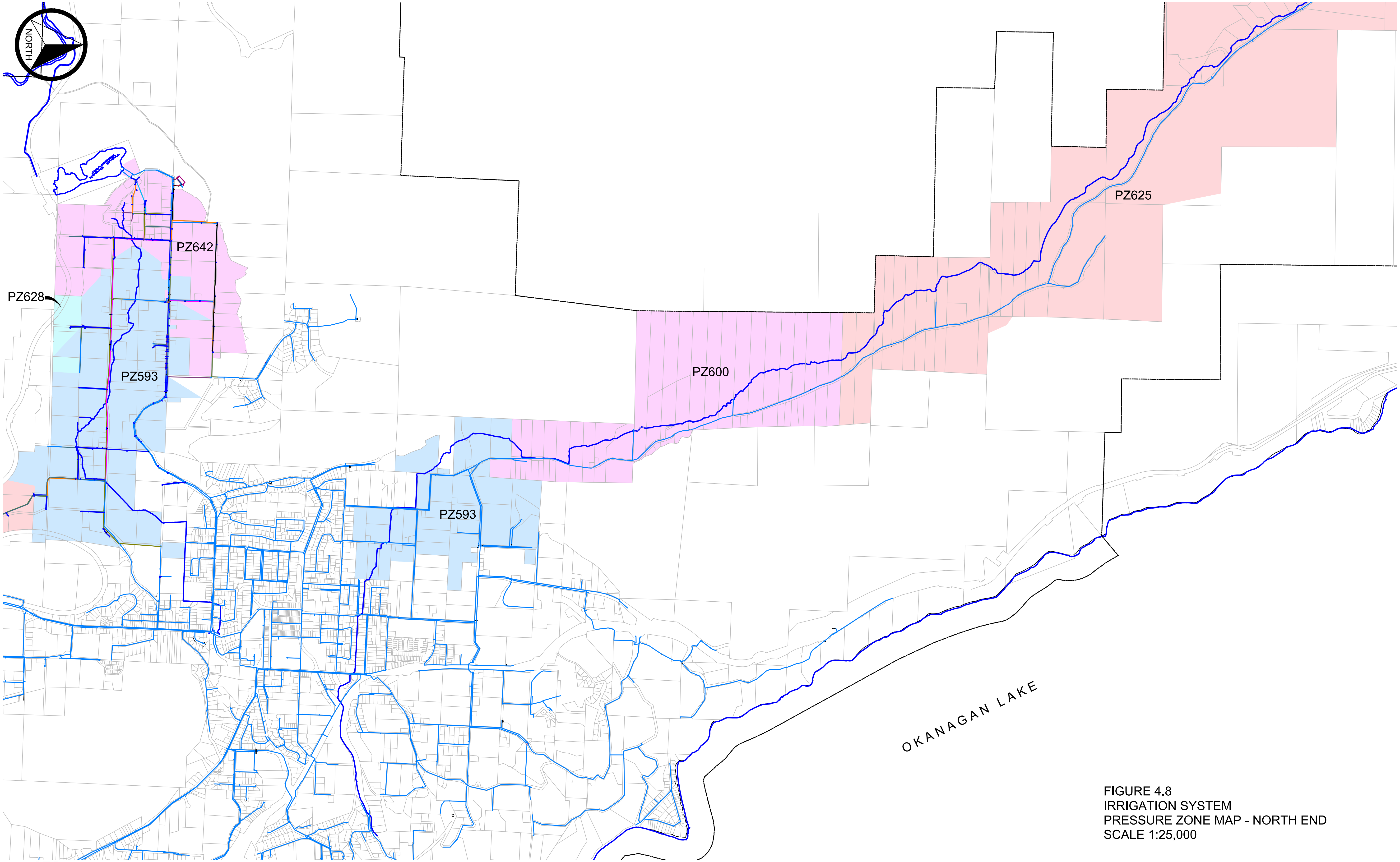

FIGURE 4.8
IRRIGATION SYSTEM
PRESSURE ZONE MAP - NORTH END
SCALE 1:25,000

DISTRICT OF SUMMERLAND

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"Engineered Water Solutions"

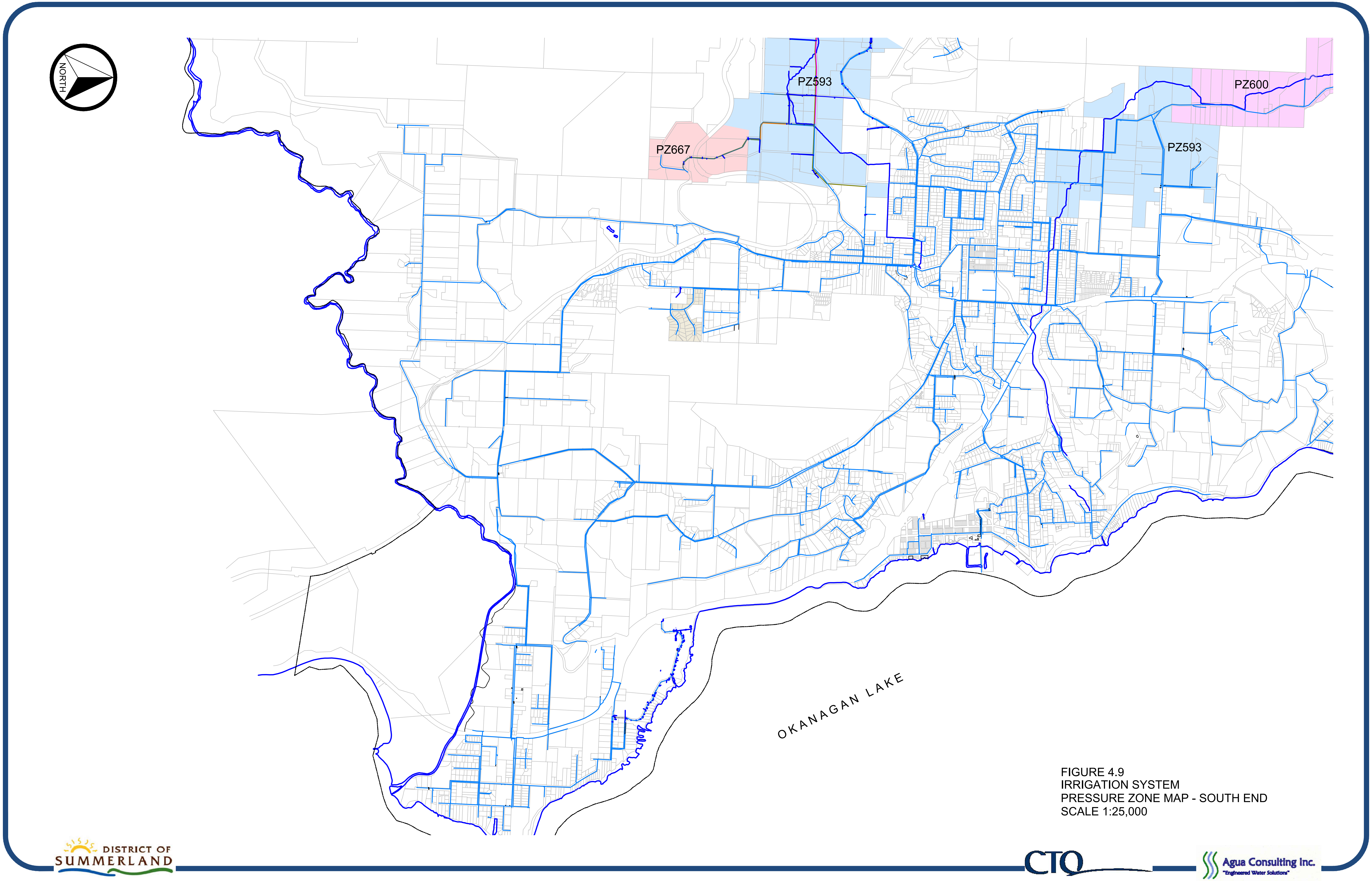


FIGURE 4.9
IRRIGATION SYSTEM
PRESSURE ZONE MAP - SOUTH END
SCALE 1:25,000

4.4 RESERVOIR STORAGE REVIEW

The Summerland domestic water distribution system supplies a significant portion of the irrigation demands. The irrigation demand is generally a steady 24-hour demand to the agriculture areas. Balancing storage is not required for this component of the water demand, however having this large demand on the domestic system reduces the operational time available to deal with system shut-downs and emergencies. The assessment of reservoir storage must account for this demand. As presented earlier In Table 4.4, irrigation demands represented over half of the total annual supply volume.

WTP Clearwell

Summerland supplies the majority of the service area by pumping to the WTP and then gravity from the WTP clearwell to the service area. The WTP clear well, which holds 6,044 m^3 of water, provides the fire protection storage for the downtown core. The maximum design fire flow for the District is a flow of 225 L/s for a duration of 2.875 hours. This equals 2,329 m^3 of water. The remaining water is available for balancing storage. Fortunately, water demand in Summerland is declining and the peak hour and maximum daily demands from the WTP have been reducing.

Operationally, the largest concern with the WTP is the lack of storage in the event of an operational problem at the WTP. With only 3,715 m^3 of storage available for balancing, with a supply rate of 70 ML/day (810 L/s), the amount of time in which the water supply could run out is approximately 1.27 hours. Options to increase the operational water are either

1 Increase reservoir storage volume. The addition of 5,500 m3 of storage would result in an increase in emergency storage times from 1.27 hours to 3.14 hours; or

2 Use the remainder of high-quality water for balancing storage for domestic water supply and in times of emergency use the bypass valve at the WTP to allow Summerland Reservoir to supply chlorinated, but unfiltered water to the fire.

The critical factors to consider when addressing this issue is whether it is more cost effective to build more reservoir storage at the WTP, or is it better to split off more of the irrigation system to increase effective storage in the event of a supply emergency. The price to construct additional storage of 5,500 m^3 is in the range of $5,700,000. This is sufficient to eliminate 15.85 ML/day of flow off of the WTP in mid summer with operational cost benefits. When prioritizing projects, this must be considered. The next two system separation projects identified include Giants Head Road (5.35 ML/day off the WTP, and Lower Jones Flats Road (10.50 ML/day separated)

Water Storage for Pumped Zones

There are several pumped water pressure zones including:

- Simpson Road (PZ 641) and Golf Course area (PZ 677) — All pumped, no genset;
- Morrow Avenue (PZ 690) and Hermiston Drive (PZ 730) — Reservoir at the top;
- Upper Dale Meadows Road (PZ 628) — All pumped;
- Fyffe Road (PZ 667) — All pumped, no genset;
- Trout Creek Reservoir area (PZ 642) — All pumped, no genset;

4.5 PRESSURE REDUCING VALVE STATIONS

The status of the PRV stations was reviewed as part of the works. With the separation of the water system at Garnett Valley and Prairie Valley, and the reduction of water demands, the water moving through the several of these PRV stations has been reduced since 2008.

The largest issue related to the PRV stations is one of access and meeting the requirements of WorkSafeBC. The buried stations are considered to be confined spaces as there is no walk-out access from them. Entry requires harness, man-lift, and a minimum of two persons to access and service the stations. Only Slater Road (PRV 6) is an above ground station. Giants Head Road (PRV 14) is planned for raising in 2022. Table 4.5 provides a summary of the PRV stations including where stations may be above ground or stair access in the long term.

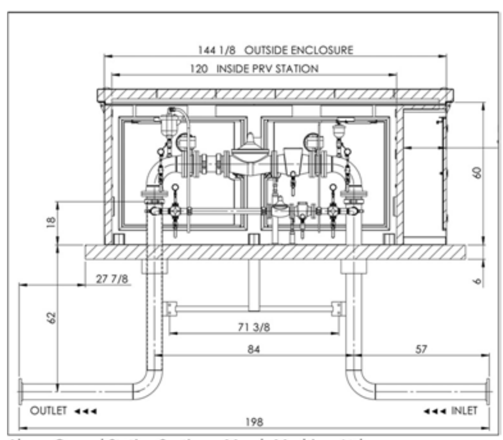
Table 4.5 - PRV Summary Table

					2019	Main Valve		By-pass		MDD	Max Flow based on 5 m/s Max Velocity				Stairs or
PRV ID	LOCATION	Upper PZ	Lower PZ	Stn Elev.	MDD (L/s)	No. Valves	Diam (mm)	No. Valves	Diam (mm)	Velocity (m/s)	Capacity (L/s)	By-Pass (L/s)	TOTAL (L/s)	FF Available (L/s)	Above Grd
1	Garnett Valley - IRR	625	600	537.0	91.5	1	150	1	38	4.9	88.4	5.7	94.0	2.5	Above Grd
4	McDougall Rd - DOM	563	498	461.7	20.6	1	100	1	38	2.3	39.3	5.7	44.9	24.3	Above Grd.
5	Whitfield Rd - DOM	563	487	438.9	20.0	1	150	1	38	1.1	88.4	5.7	94.0	74.0	Above Grd.
6	Slater Rd - DOM	487	434	390.0	3.0	1	150	1	50	0.2	88.4	9.8	98.2	95.2	Above Grd.
7	Lower Solly Rd - DOM	502	464	411.7	92.6	1	200	1	75	2.6	157.1	22.1	179.2	86.6	Above Grd.
8	Upper Solly Rd - DOM	594	502	445.6	99.9	1	200	1	75	2.8	157.1	22.1	179.2	79.3	Above Grd.
10	Victoria-PV Rd - DOM	594	563	493.0	554.5	3	300	1	100	2.5	1060.3	39.3	1099.6	545.1	Stairs
12	Hespeler Rd - DOM	563	518	465.3	42.2	1	150	1	38	2.2	88.4	5.7	94.0	51.8	Above Grd.
13	Clark Street - DOM	518	479	422.5	30.3	1	100	1	38	3.4	39.3	5.7	44.9	14.7	Above Grd.
14	Giants-Head-Rd-DOM	563	533	477.1	74.8	1	150	1	50	3.8	88.4	9.8	98.2	23.4	Above Grd.
15	Hillborn Ave - DOM	594	544	498.5	50.8	1	250	1	75	0.9	245.4	22.1	267.5	216.7	Above Grd.
16	Gartrell Rd - DOM	533	464	407.6	1.5	1	150	1	38	0.1	88.4	5.7	94.0	92.5	Above Grd.
17	Morgan Street - DOM	499	417	360.4	126.5	1	200	1	63	3.7	157.1	15.6	172.7	46.2	Above Grd.

Insufficient Fireflow Capacity
Domestic System
Irrigation System

Summerland is upgrading their pressure reducing stations and valves over time. There are options available to move the stations above ground and these should be considered. A power connection is required so that the station is sited within an insulated kiosk that is at ground level. This allows one man to service the stations which will reduce the long-term operating costs.

A staged approach towards moving the stations above ground would include having power to the stations, replacement of pipe works with the stations requiring upgrade most being done first. See the Project no. 4 – Water System Renewal, in Appendix A.



Above Ground Station Section – Mearls Machines Ltd.

4.6 PUMP STATION CAPACITY REVIEW

The pump stations within the water distribution system were reviewed. All of the pump curves and set points for operations are input into the computer model. An assessment of the pump stations was carried out to determine the capacity in comparison with water demand and design criteria.

Table 4.6 provides a graphical summary of the primary, secondary and tertiary pumped pressure zones. The criteria for reviewing pump station capacity is that, providing there is balancing storage above, the station must provide for the maximum daily demand with the largest station pump out of service.

Table 4.6 provides an estimate of the Maximum Daily Demand (MDD) supplied to each pressure zone.

Table 4.6 Pump Station Capacity Assessment

Pressure Zone ID		MDD (L/s) Local Zone	MDD (L/s) TOTAL	TDH (m)	Required (hp)	Existing (hp)	Spare (hp)
PZ 677 Golf Course	PStn 6	66.68	66.68	39.6	50	30	-20
PZ 641 Simpson Road	PStn 5	34.48	101.16	60.5	117	75	-42
PZ 730 Hermiston Dr.	PStn 2B	0.77	0.77	44.0	1	15	14
PZ 690 Morrow Avenue	PStn 2A	10.65	11.42	114.4	25	25	0
PZ 628 Upper Dale Meadow	PStn 2	9.94	9.94	46.2	9	60	51
PZ 667 Fyffe Road	PStn 4	8.55	8.55	89.1	15	25	10
PZ 715 Upper Hunters Hill	PStn 10	design completed, pumps not yet installed					
PZ 658 Hunters Hill **	PStn 9	< 10.0	32.10	73.3	< 15	50	> 35
PZ 642 Trout Creek Reservoir	PStn 1	64.79	64.79	61.6	76	70	-6
PZ 627 James Lake	PStn 7	0.50	0.50	45.1	0.4	5	5
PZ 625 Garnett Valley (new)	PStn 8	4.00	4.00	62.7	4.8	5	0
PZ 586 Prairie Valley (main supply zone)		307.16	1110.43				
** Pumps set to serve future zones				designates shortfall by single pump			

There are several new pump stations that have been installed in recent years, James Lake near the Public Works Yard, Garnett Valley pump station that supplies only domestic water from the main system grid north to upper Garnett Valley and the Hunter's Hill pump station for that development area. The first two new stations have generators and emergency power and operate using standard system voltages. Upgrades required for the duty pumps at the James Lake station will be covered by new development within the service area for that pump station.

The remainder of the older stations do not have back up power and run either with 240V or 480 V supply power. The older stations are methodically being upgraded, including the system voltage, motor drives, and communications. The District could consider upgrading a station every year or second year.

Costing for the instrumentation and electrical upgrades are provided with Appendix A and Appendix C of this report.

4.7 2018 WATER CONSERVATION PLAN

In 2018, Agua Consulting Inc. developed a water conservation plan for the District of Summerland. This plan is intended to provide direction on water conservation initiatives for the District. The plan objectives are summarized in the points listed below:

1. To promote and facilitate the efficient use of water throughout the community;
2. To improve the ability of the District as a whole, to adapt to extreme drought and flood events and adjust accordingly;
3. To maximize the use of existing infrastructure for appropriate uses;
4. To provide some perspective on the principles of *Cost-to-Provide-Service* and volumetric pricing;
5. To reduce water consumption through the tools and procedures identified within this report;
6. To maintain a green community and continue to maximize the benefit of available water for environment, agriculture and domestic purposes.

Pricing is the single largest influence on water usage. If the community wanted the customers to use less water, it could simply be accomplished by raising the price of water to exceptionally high levels. This must be coupled with the fact that 85% of the cost to supply water to a community is fixed, regardless of the volume of water used.A pitfall for many communities in a semi-arid climate is to only promote reduced water use and implement pricing controls that result in punitive costs for normal water usage.

Summerland water utility is a water provider, not a water restrictor or water regulator. Their objective is to serve their customers and provide water at fair value and cost.

The tools for conserving water as presented in the 2018 Water Conservation Plan, include:

- Universal metering: By installing water meters throughout Summerland the volume of un-metered water and unaccounted for water is reduced. Through this option, it was estimated that 120 ML of water could be saved annually;
- Water loss detection (public and private): With leakage on the system estimated to be in the range of 700 ML/year, finding and repairing the leaks could reduce losses by 50%. This amount could result in up to 550 ML/year. The cost savings would be in the range of $44,000/year;
- Consumption based metering and billing: Although water can be saved through smaller allocations to agricultural growers and to residents, the revenue being generated from the water system is sufficient to maintain operations. Any extreme changes pricing should be associated with critical projects and initiatives and not to punitive fines for overuse. The customers understand that projects and renewal is necessary. They do not accept unnecessary restrictions or allocations just to raise monies. Current water rates and charges in Summerland are well balanced in terms of allocations and higher pricing for overuse;
- Bylaws, codes and standards: A number of regulatory tools available to Summerland were discussed within the Water Conservation Plan. The tools help to inform and provide direction to the District and their customers of best practices for efficient water usage;
- Education: Through on-going education, a 2% savings in the metered water use was estimated to be achievable. This amounts to 148 ML/year;

- Watering Scheduling (restrictions): Water scheduling and monitoring works would result in reducing peak hour demands and overall water usage. Tying watering to soil-moisture tensiometers could result in some savings.

The overall implementation of the Water Conservation Plan is an on-going work project for District staff. The implementation plan is set out in Table 4.7.

Table 4.7 - Water Conservation Plan Implementation

Plan Component	Savings	Budget	Completion	Comment
UFW reduction through Universal metering	120 ML/year	Cost for meters borne by customers	2019 completion	Details to be worked out by staff. Annual savings = \$ 9,600[1] /year
Water Loss Reduction	550 ML/year	\$50,000 to carry out detection plus cost of repairs (from Works maintenance budget)	On-going start in 2019	Decision to be made on external company for leak detection or own forces Annual savings = \$ 44,500[1]
Consumption-Based Metering and Billing	Variable	Work in progress	On-going	Revenue, customer satisfaction and district objectives for green community to be reviewed after first years of implementation
Bylaw-codes-standards	Undetermined	\$ 10,000 per year	On-going	Support tools to enable staff to enforce bylaws. Support tools available for increased knowledge and improved stewardship.
Education	Undetermined	\$ 25,000 per year	On-going	Intangible, investment in resource aware public with a good water ethic
Watering Regulations	Continue as-is	Business as usual	On-going	Review / refine as required

1. The annual savings by each of the options is based on reduced water production cost in the amount of \$0.08/m^3.

4.8 WATER SYSTEM ELECTRICAL, INSTRUMENTATION AND CONTROLS AUDIT

A review of the District water system electrical, instrumentation and controls was conducted by Centrix Control Solutions (formerly IITS). The audit is presented in Appendix C. An objective of the audit was to assess the overall condition of the electrical and instrumentation works, and the specific issues within each of the water infrastructure facilities. The WTP was not reviewed in their assessment.

Summerland has some advantages in carrying out electrical and instrumentation upgrades as they own the electrical utility. That allows them to provide electrical services to the local water infrastructure at a lower cost. Investment in this infrastructure is an on-going expenditure in water system operations. Key findings and recommendations are as follows:

- SCADA communications for all facilities should be set up to use Ethernet based communications using a mixture of optical fibre and wireless connections;
- A communication study is recommended in which pathways information for all sites and repeater location information is documented. Development of a communications network drawing should be part of the study;
- With Thirsk Dam being a key water control site, satellite communications should be reinstated to this facility with upgraded security;
- Control system upgrades are required throughout the water infrastructure sites as many of the older PLCs that are in place do not support Ethernet connections. They systems are functional, however to upgrade their capacity, speed of operations, and the amount of data that can be transferred, as the systems are upgraded the new high-capacity standards should be implemented;
- Human Machine Interface hardware should be standardized throughout the water system. This will allow for easier operations for the Operators;
- There are several PRV stations that are without power or monitoring equipment. Electrical power, ventilation fans, and light are the minimum industry standard for buried PRV stations. Regardless of whether or not the stations are moved above ground or remain vaults, the investment in electrical service to each site is a worthwhile first step;
- Ventilation fans, temperature alarms, and water/flooding alarms should be considered for all below-ground vault installations and should be standard requirements for all new installations;
- The majority of water pump stations are older and are running on voltages that are no longer standard. When the stations are upgraded, the station electrical service should be upgraded to standard voltages;
- Security upgrades for the system should be carried out as each site is upgraded. Alarms for illegal entry or tampering should be included in each major upgrade. Close-circuit internet based cameras that are driven by motion detectors are now becoming very cost effective and can be considered at the most important sites once Ethernet capability is in place.

Overall, the stations are well maintained, but continual upgrading of the technology is needed to ensure functionality and efficiencies. A larger annual budget in the range of $100,000 is recommended to carry out the SCADA upgrade work over time.

4.9 TANGIBLE CAPITAL ASSET ANALYSIS

In 2008, the BC Government required that all municipal governments follow the Public Accounting Standards Board rules for reporting Tangible Capital Assets (TCAs) in their annual reports. The reporting of TCAs, although complicated, is designed to improve the financial management and sustainability of public assets.

Utilizing the computer water model, which included all of the water distribution pipes in Summerland, a database of pipe, pipe material, and estimated date of installation was downloaded from the model into an EXCEL file. The file was sorted by size, pipe material and estimated date of installation. The dates of installation were separated out into 10-year segments. The result of the data management work is summarized in Table 4.8 on the next page.

The pipe information was compared to the water distribution model lengths of 2008, prior to the separation of mains in Prairie Valley, and again in 2016, prior to the separation of mains in Garnett Valley. The total estimated length of main is 185 kilometres. Of that length, Summerland has 24 kilometres of main that are cast iron pipes that were installed in the 1930s. As part of the system renewal, awareness and monitoring of the condition of those mains should be of higher priority.

10-year increments for long term renewal planning is appropriate as there will be a range of times for when renewal of infrastructure is required. The pipe lifecycle is dependent on a variety of factors that include pipe materials, quality of installation, groundwater levels, operating pressures and corrosion potential of the pipe.

There are numerous benefits that result from determining and reporting the Tangible Capital Assets. During the assessment, the renewal cost and expected timing for the reconstruction of major municipal infrastructure is estimated. Knowing this enables the utility to plan for, save sufficient funds, inform the public, avoid rate shock, and carry out utility renewal as an on-going normal part of the utility operations. This report provides the necessary information to inform ratepayers by showing how infrastructure performance and age are linked to annual investments and water rates.

Table 4.8 - Water Distribution Main – Pipe Inventory

Size	Material	1930-39	1940-49	1950-59	1960-69	1970-79	1980-89	1990-99	2000-09	2010-19	TOTAL
1350	Steel					877			51		928
1200	Steel					2470					2470
1050	Steel					1109					1109
750	PCCP					1778					1778
600	Steel				1971	2395					4366
	PCCP					3010					3010
500	PCCP					1615					1615
	AC					187					187
450	AC				346	7862					8208
400	AC					4064					4064
	CI	397									397
	DI					28		552			579
	STEEL					12					12
350	AC				324	7264					7588
	DI					67		921			989
300	AC				100	6725					6825
	CI	3132	882								4014
	DI					89			334		423
	PVC						339			1600	1939
250	AC			1014	1700	5902	105				8721
	CI	1705		456		9					2170
	PVC						1825	2786	285	3205	8102
	STEEL				12						12
200	AC				332	9800	100				10232
	CI	2179									2179
	PVC					298	1091	3681	537	615	6222
150	AC				3665.2	21112	641				25418
	CI	5076		324							5400
	DI						65				65
	PVC					3362	3258	15446	3548	640	26254
	TRANSITE		32.68								33
100	AC				6127	6638	157				12921
	CI	11466		1201	797						13463
	GI	9									9
	PVC					4299	737	377			5412
75	PVC						0	0	0	4483	4483
50	GIP	39			1306						1345
	PVC					455	965				1420
	PE							705	57		762
	TOTALS	**24002**	**915**	**2994**	**16679**	**91427**	**9282**	**24468**	**4812**		**185122**
									2008	175,069	kms
									2016	182,871	kms
									2019	185,122	kms

4.10 SUMMARY – WATER DISTRIBUTION SYSTEM

As for any water distribution system, there are numerous areas of the utility that require attention.

- **System Renewal:** As noted in Table 4.8, there is a significant length of cast iron pipe still in service within the distribution system. The majority of this pipe was installed in the 1930's with a small amount installed in the 1950's. There are many locations in North America where cast iron pipe has been in service for over 100 years. This is a function of the stability of the water and the corrosiveness of the surrounding soils. Summerland must consciously plan for the eventual renewal of these mains as they are expected to be the first mains that will require renewal. The asbestos concrete pipe mains would be the next watermains for renewal;
- **Tangible Capital Asset Summary:** With the information in Table 4.8, a more accurate listing of the overall water system infrastructure can be carried out. This information could be integrated into the larger TCA exercise for the other District infrastructure;
- **System Separation:** A key part of the 2008 Water Master Plan was to over-time separate the irrigation from the domestic water distribution systems. The system separation will reduce WTP operating costs and in-time reduce the kilometres of old cast iron main in the system. The PRV and pump station works associated with the separation will also allow for correction for some of the substandard existing components;
- **Distribution Pumps Stations & Reservoir Storage:** Distribution storage is noted to be lacking in several pressure zones. Generators and fire pumps should be considered for some of the pump stations ensure supply under all conditions. For the main pressure zone in town, there is water for fire protection to a flow of 225 L/s for a duration of 2.875 hours. For flow requirements from new development that are greater than this amount, the building fire demand must be reduced through additional fire walls, sprinkler systems, and or building materials.
- **Pump Station Upgrades:** As listed in the Electrical and Instrumentation Audit, the services for all of the older stations is either 240 or 480 Volt. Standard voltage for all larger new services is 347/600 Volt – 3 phase. New development may correct some of these deficiencies as reservoirs are constructed above the higher serviced lands. Some of the pumping systems will also be upgraded as the system separation work takes place. The spare capacity for some stations will increase as the distribution system is further separated.

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5. WATER QUALITY REVIEW

5.1 INTRODUCTION

This section provides an assessment of the quality of source water and treated domestic water provided to the residents of Summerland. The section identifies a range of risks that may impact the water quality of the existing water sources including Trout Creek, Eneas Creek, groundwater and the future water source of Okanagan Lake.

With the water treatment plant being on-line and performing well since 2007, it is natural to feel confident that the water treatment plant will be able to handle any raw water quality deviation, however this section also raises the awareness of issues that the WTP may not be able to address.

This water quality review section includes comment on:

- Regulatory status for water and what regulatory tools are available to Summerland;
- A summary of existing water quality parameters is provided;
- Identification of water supply risks and how to reduce the risk impacts;
- Gaps in water quality monitoring;
- Operational challenges with respect to water quality;
- Recommendations for protecting and improving water quality.

The District of Summerland provides water for domestic purposes, drinking water and fire protection, and water for irrigation. The District has several available sources of water including Trout Creek, Eneas Creek and groundwater (emergency supply) and is also planning to utilize Okanagan Lake as an additional source.

Since October, 2018, all drinking water to Summerland has been supplied from Trout Creek through the Summerland Water Treatment Plant. The treatment plant is a conventional plant that uses Acti-Flo, which is a ballasted-floc technology that assists in the flocculation process. The process works well and plant has been able to provide a treated water capacity of up to 75 ML/day to Summerland.

With the separation of the Garnett valley water system into domestic water from Trout Creek and irrigation water from Eneas Creek / Garnett Reservoir, Summerland has been able to reduce and almost eliminate the need for water quality advisories and Boil Water Notices to their customers. Eneas Creek/Garnett Reservoir is now used exclusively for irrigation water to the Garnett Valley and Jones Flat areas of Summerland. Even though there are additional domestic connections added to the Summerland WTP, reduced the water demand required through the water treatment plant

5.2 REGULATORY FRAMEWORK

Since the 2008 Water Master Plan, there have been changes to several Acts and Regulations that water suppliers follow within in the Province of BC. Perhaps the largest is the new Water Sustainability Act in 2016 which replaced the Water Act. The regulatory framework in BC is complex, due to the multiple activities that take place in the watersheds. Regarding drinking water, there are 3 layers of government that are involved.

Federal Government – Health Canada

The regulatory authorities addressing drinking water are derived from the Federal and Provincial governments. The Federal Government in consultation with the Provinces has developed the country-wide *Guidelines for Canadian Drinking Water Quality (GCDWQ)*. Based on the best available information that is developed by the water industry, the GCDWQ continue to evolve with the Federal Government updating the microbiological, physical and chemical parameters of water. The link to the GCDWQ is at:

https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

Recent changes in the *GCDWQ* include reductions in the Maximum Acceptable Concentration (MAC) levels for manganese and for lead:

- **Manganese** Manganese previously had an Aesthetic Objective of 0.05 mg/L. There is now a MAC of 0.12 mg/L for manganese. The health risk is that currently some studies suggest an association between manganese in drinking water and neurological effects in children. The Aesthetic Objective (AO) of manganese is also now reduced from 0.05 mg/L to 0.02 mg/L. The intent is to minimize the occurrence of discoloured water associated with manganese;
- **Lead** Lead is usually found in water distribution systems due to lead leaching out of water system components. The lead has been historically used in water systems for service lines, solder and fittings, and plumbing fixture units before the use was prohibited. The MAC for lead is 0.005 mg/L based on a water sample taken at the tap using the appropriate protocol for the type of building being sampled. Lead is classified as probably carcinogenic to humans, but the greater concern is the toxicity based on blood lead levels (BLLs). The health effects include renal dysfunction and increased blood pressure in adults and adverse cognitive and behavioural effects in children. Health Canada has made the statement that "Every effort should be made to maintain lead levels in drinking water as low as reasonably achievable (ALARA).

The parameter limits set by Health Canada are listed in the Water Quality summary tables in this section. For those situations where the development of a set MAC or AO is not possible and where operational and management guidance may be warranted, Health Canada has developed Guidance documents that go out for Public Consultation. The documents include the following:

1. Chloral hydrate in drinking water (2008)
2. Potassium from water softeners (2008)
3. Controlling corrosion in drinking water distribution systems (2009)
4. Heterotrophic plate count (HPC) (2012)
5. Use of microbiological drinking water guidelines (2013)
6. Issuing and rescinding boil water advisories in Canadian drinking water supplies (2015)

Provincial Government

The BC Provincial Government, through the Ministry of Health, oversees the regulatory aspects of drinking water through the Provincial Acts and Regulations. There are numerous activities that take place within watersheds with numerous Ministries and stakeholders involved in the process. As shown in Table 5.1, there are numerous Provincial Acts and regulations that impact drinking water in BC. The table does not show all acts and regulations, but does include those acts and regulations that are most prevalent to the District of Summerland water supply. As noted in Figure 5.1, the Ministry of Health does not have jurisdiction on a wide range of land use and watershed impacting activities.

Human activities that can affect water quality in the watershed include: Logging and forestry work, range / cattle activity, agriculture, recreational activities including trail riding/snowmobiling, human-activities on reservoir lakes, forestry campsites, wastewater and septic tank/tile fields near water courses and mining. The Provincial ministries that are involved or responsible include the Ministry of Forest Land and Natural Resource Operations and Rural Development, Ministry of Agriculture, Ministry of Transportation and Ministry of Energy and Mines.

Community Watersheds

A community watershed is defined under the Forest & Range Practices Act (FRPA) as all or part of the drainage area that is upslope of the lowest point from which water is diverted for human consumption by a licensed waterworks. Referrals for activities under the FRPA would get sent to the downstream water users. Trout Creek is a community watershed. As of 2018, Eneas Creek is no longer considered a community watershed.

What has changed in the past 10 years is the greater recognition of having a balanced, renewable, healthy environment. All of the government regulations have some recognition of the need to protect the natural resources and balance, but the interagency communication and recognition of other ministries has increased. Agencies such as the Okanagan Basin Water Board, which was restructured in 2005, have been leaders in communication and dialogue for stakeholders in the watersheds.

In addition to those activities that can be managed, there are also natural climate induced impacts such as flooding, drought, and forest fires. The provincial agencies, through the Emergency Operations Centres, for flood or drought, are the leaders in dealing with the emergency.

Table 5.1 - BC Provincial Legislation that Impacts Drinking Water Quality in Summerland

Provincial Act and Regulation (2021)	Regulatory Agency Responsible	
	Policy	Operational
Drinking Water Protection Act Drinking Water Protection Regulation	Ministry of Health	Interior Health
Water Sustainability Act Dam Safety Regulation Groundwater Protection Regulation Water Sustainability Fees, Rentals, and Charges Tariff Regulation Water Sustainability Regulation	Ministry of Environment	MoFLNRORD
Public Health Act Health Hazards Regulation Sewerage System Regulation	Ministry of Health	Interior Health
Environmental Management Act Agricultural Waste Control Regulation Code of Practice for Soil Amendments Contaminated Sites Regulation Hazardous Waste Regulation Municipal Wastewater Regulation	Ministry of Environment	Ministry of Environment
Drainage, Ditch and Dyke Act	Min. of FLNRORD	MoFLNRORD
Environmental Assessment Act	Ministry of Environment	ENV Assmt Office
Forest and Range Practices Act Government Actions Regulation Range Planning and Practices Regulation	Min. of FLNRORD	MoFLNRORD
Land Act	Min. of Agriculture	Min. of Agriculture
Local Government Act and the Community Charter	Min of Mun Affairs	Min. of Mun Affairs
Local Services Act and its Regulation	Min. of Mun.Affairs	Min of Transport
Mines Act and the Health, Safety and Reclamation Code for Mines in BC	Ministry of Energy Mines	Federal Gov't
Water Protection Act	Min. of Enviro.	Min. of Enviro.
Park Act and its regulation Park, Conservancy, & Recreation Area Regulation	Min of Environ.	Min of Environ.
Transportation of Dangerous Goods Act	MoT	MoT
Utilities Commission Act	Min. of FLNRORD	Min. of MLNRORD
Water Users' Community Act	Min. of FLNRORD	Min of FLNRORD
Water Utility Act	Min. of FLNRORD	Min of FLNRORD

Table Adapted from "*Clean, Safe and Reliable Drinking Water, An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking Water in British Columbia, Table 2.1*"

The list of acts and regulations in BC are extensive as are the number of activities that can take place within a watershed. With much of the higher elevation lands not privately owned, but rather publicly owned by the Crown, the Provincial government has jurisdiction of what takes place on these lands.

Local Drinking Water Authority – Interior Health

With respect to drinking water authority, the Ministry of Health delegates operational control of drinking water to the Drinking Water Officer, who is typically the assigned Medical Health Officer for the Health Authority. For Summerland the DWO is assigned by Interior Health. Interior Health follows the GCDWQ for parameters and utilizes the 4,3,2,1,0 protocol for water treatment. The protocol has evolved over the past 15 years, but generally has the following requirements for supply of drinking water.

4	Four log (99.99%) inactivation of bacteria and viruses;
3	Three log (99.9%) inactivation of protozoa (Giardia and Cryptosporidium)
2	Two types of treatment and/or disinfection
1	Less than 1.0 turbidity in the water distribution system at all times
0	Zero coliform count in the treated water (Total or *E.Coli*)

In the past, the "less than 1.0 Turbidity units" criteria was the most difficult one to meet. With all water running through the plant and the risk of a flow higher than the plant capacity now being greatly reduced, the most challenging criteria is the 3-log inactivation of *Cryptosporidium*. The criteria are met through the WTP as the filtration plant allows for 2.5 inactivation credit and the remainder is achieved through the chlorine disinfection. For Summerland, the issues to be expected from Interior Health in the next five years include the following items:

- Renewed Conditions on permit. These are expected to be reissued as IH has not issued new conditions in the past few years;
- On-line water quality reporting platform that IH will integrate with;
- Increased focus on sampling of Lead in facilities and structures;
- Corrosion control procedures and monitoring and sampling to ensure that the water is not corrosive;
- Increased sampling for HAAs;
- Testing the water sources for Poly-Fluoro-Alkyld-Substances (Forever chemicals);
- Source protection planning and submission for Okanagan Lake Source.

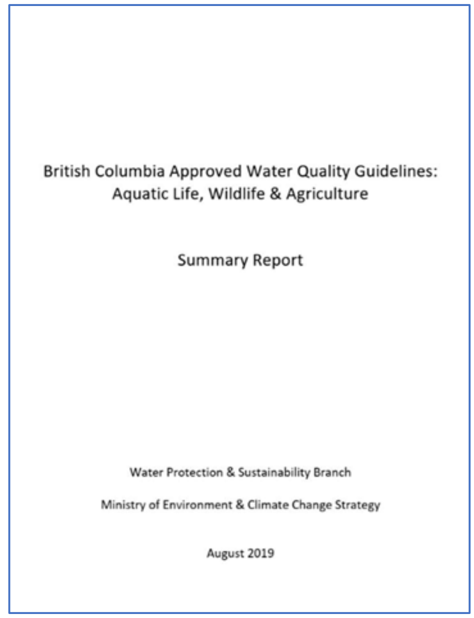
With reduced permissible lead levels, this has highlighted the need to control the corrosion potential within water distribution systems. Corrosion control reduces the corrosion potential on metal pipe so that lead fittings that were used in the past are less susceptible to leaching out in the drinking water. It also increases the lifespan of the water distribution systems.

Interior Health supports the development of Source Protection Plans. Although the water utilities have no jurisdiction to enforce them, Summerland is considered to be a key stakeholder, perhaps the most important stakeholder in the eyes of the Province. As a key stakeholder, they are the closest public body that is active in the watershed. They monitor activities and in many ways are the care-taker of the watershed.

5.3 EXISTING WATER QUALITY

The raw and treated water quality parameters from the various sources were reviewed and are summarized in this section. Data was reviewed from as far back as 2002 to the present time. The physical and chemical parameters of the water are listed in Tables in this section.

It is noted that the majority of information is on the treated water. There is some data on the raw water, but not enough to develop a trend or determine the long-term trends for water quality in the watersheds. A baseline for water quality in the watershed will provide Summerland with an indication of the typical conditions in the watershed and can provide proof of changes should there be new activities that occur.


British Columbia Approved Water Quality Guidelines:
Aquatic Life, Wildlife & Agriculture

Summary Report

Water Protection & Sustainability Branch

Ministry of Environment & Climate Change Strategy

August 2019

Raw Water

The raw water is assessed in comparison with the Provincial Source water guidelines. There are two versions of these guidelines, one for the watershed if the raw water is within a community watershed and is used for drinking water (Trout Creek), the second is if the watershed is used for aquatic life and/or irrigation (Eneas Creek). These guidelines have different objectives and the parameters vary based on keeping quality at an appropriate level for the downstream users. These guidelines are what must be achieved by forestry and logging, mining, RV activities, and agriculture in a watershed.

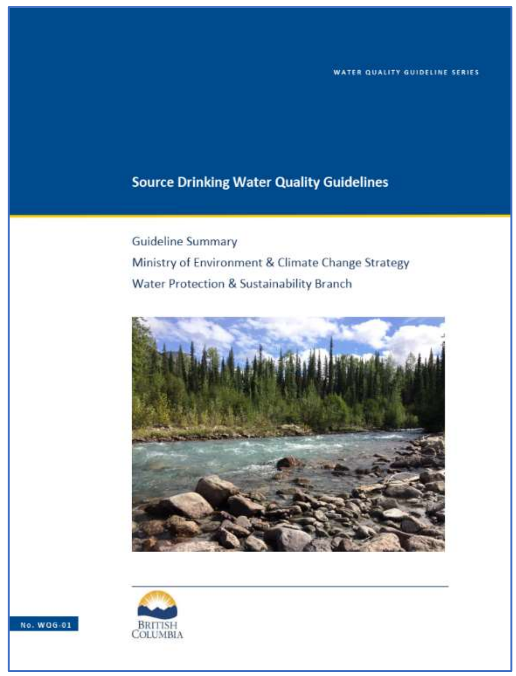
Treated Water

The majority of full parameter testing for Summerland has been on the treated water with samples taken within the water distribution system. For detailed criteria, the Interior Health and the Ministry of Health defer to the Guidelines for Canadian Drinking Water Quality for Maximum Acceptable Concentrations (MACs), Aesthetic Objectives (AOs) and Operational Guidance Values (OGVs) of the water.

The key dates to consider when reviewing the treated water data are:

- 2007 when the Summerland Water Treatment Plant (WTP) was commissioned, and
- 2008 when Thirsk Reservoir was raised by 4.5 metres storing significantly more water in the reservoir each spring freshet;
- Oct 2018 when Garnett Valley distribution system were commissioned thus eliminating Garnett Reservoir as a drinking water source.

The Summerland WTP lowers the colour and turbidity and has provided water that meets the GCDWQ at all times. By having the plant on-line, Summerland could focus their full parameter testing to the source water in Trout Creek, Eneas Creek and the groundwater well.



When Thirsk was raised, there was likely a change in the raw water quality downstream. The settling time within Thirsk Reservoir would have reduced raw water turbidity levels and increased colour. Other parameters such as nutrient levels and/or algae projection also may changed.

By taking Garnett Reservoir fully off-line from domestic water supply, the quality issues and concerns for the Eneas Creek source are reduced. In the event of an emergency, there should be the means in which to still access this source for emergency supply for Summerland.

5.3.1 TROUT CREEK

Raw Water Quality

A limited amount of water quality data is available on the upper watershed reservoirs and in Trout Creek. Only two samples of full parameters were collected in recent years. Those samples are the start of a good baseline of data on all of the physical and chemical parameters of the raw water in the creek.

Of the data collected in April and September of 2019, there are no concerns of any of the parameters being too high. The water is generally quite soft and of low alkalinity, but adjustments can be made at the WTP to adjust the final product.

Treated Water Quality

Sampling is carried out twice per year on water supplied through the WTP and Trout Creek water source. A summary table of the data is provided as Table 5.2. As set out in the table, there is a break in the timeline for when the WTP was commissioned. There are numerous parameters that are improved with the commissioning of the WTP including reduced Trihalomethanes, true colour, turbidity and occasionally iron.

Summerland should consider taking samples of the source water prior to treatment as the water quality produced by the Summerland WTP is very consistent and of high quality. In this case the water treatment process and results are known and fairly well controlled. The raw water is a more highly variable water that has man-made and natural environmental influences. Understanding the raw water characteristics will lead Summerland to better understand the natural and man-made risks in the watershed.

Discussions should take place with Interior Health as to where they would like to see the full parameter sampling.

TABLE 5.2 Trout Creek Raw & Treated Water Quality Parameters

WATER QUALITY PARAMETER	Units	GCDWQ Regulation for MACs	RAW WATER Trout Ck	Trout Ck	TREATED WATER TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System	TC WD System
			2019-04-15	2019-09-23	2002-05-28	2002-11-05	2003-05-27	2003-10-16	2004-05-03	2004-10-07	2005-07-13	2005-12-08	2006-05-24	2006-10-25	2007-05-17	2007-10-31	2008-02-21
Anions																	
Chloride	mg/L	AO < 250	2.86	2.58	6.6	4	5.6	3.76	5.97	4.83	5.57	4.86	6.92	4.73	5.2	5.09	9.81
Flouride	mg/L	MAC = 1.50	0.11	<0.10	0.09	0.1	0.1	0.112	0.113	0.114	0.120	0.125	0.09	0.124	0.094	0.10	<0.10
Nitrate (as N)	mg/L	MAC = 10	0.034	0.010	<0.005	0.006	0.012	<0.0050	<0.0050	<0.0050	<0.0050	0.0064	< 0.005	0.0069	<0.0050	<0.010	0.054
Nitrite (as N)	mg/L	MAC = 1.00	< 0.010	<0.010	0.002	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.002	<0.0010	<0.0010	<0.010	<0.010
Sulfate	mg/L	AO<500	7.5	5.0	3	6	4	6	5.4	5.3	4.16	7.26	2.74	6.04	2.66	6.3	10.2
Calculated Parameters																	
Total Trihalomethanes	mg/L	MAC=0.100															
Cation / Anion Balance		N/A															
Hardness, Total (as CaCO3)	mg/L	N/A	64.2	51.6	28.6	58.1	32.5	56.4	35.6	48.6	43.5	62.8	27	60.9	28.1	69.1	71.4
Langlier Index		N/A	-0.30	-0.90													
Solids, Total Dissolved	mg/L	AO<500	85.1	64.9	71	83	68	94	91	82	76	97	52	88.3	70	109	121
General Parameters																	
Alkalinity, Total (as CaCO3)	mg/L	N/A	74.1	54.7	18	57	25	54	28	44.4	35.3	70.9	17.4	63.6	18.5	53.0	59.7
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A	< 1.0	< 1.0													
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A	74.1	54.7													
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A	< 1.0	< 1.0													
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A	< 1.0	< 1.0													
Colour, True	mg/L	AO<15	17	18	26	<5	16	<5.0	22.7	7.3	10.6	<5.0	35	<5	27.3	<5	<5
Conductivity (EC)	umhos/cm	N/A	163	120	71	132	82	135	92.6	118	97.1	148	67	141	70.4	122	180
Cyanide, Total	mg/L	MAC = 0.20	< 0.0020	< 0.0020	0.015	0.007	0.014	0.005	0.0096	0.0072	<0.0050	<0.0050	< 0.01	0.0075	0.0142	<0.01	<0.01
pH	pH units	7.0-10.5	8.00	7.58	7.63	7.67	7.37	7.97	7.66	7.63	7.70	7.44	6.89	7.92	7.44	6.8	6.9
Temperature at pH	°C	N/A	23.0	23.6													
Turbidity	NTU	< 1.00 NTU	1.22	1.05	4.4	0.8	2	0.62	2.43	1.23	2.01	0.78	2.5	0.85	3.75	1.3	<0.1
UV transmittance	%																
Microbiological Parameters																	
Coliforms, Total	CFU/100ml	MAC = 0		76													
Background Colonies	CFU/100ml	N/A		> 200													
E.Coli	CFU/100ml	MAC = 0		3													
Total Metals																	
Aluminum, Total	mg/L	OG<1.00	0.0384	0.0394	0.22	<0.01	0.11	<0.010	0.185	0.028	0.041	<0.010	0.19	0.013	0.202	0.01	<0.05
Antimony, Total	mg/L	MAC=0.006	< 0.00020	< 0.00020	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	< 0.001	<0.00050	<0.00050	<0.0006	<0.0030
Arsenic, Total	mg/L	MAC=0.01	< 0.00050	< 0.00050	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	0.00023	0.00019	< 0.001	0.00021	0.00023	<0.001	<0.005
Barium, Total	mg/L	MAC=1.00	0.0436	0.0380	0.03	0.04	0.03	0.035	0.029	0.032	0.027	0.036	0.024	0.037	0.024	0.040	0.045
Beryllium													< 0.001			<0.0005	<0.0020
Bismuth													< 0.001			<0.0001	<0.0005
Boron, Total	mg/L	MAC=5	0.0276	0.0276	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	< 0.05	<0.010	<0.10	<0.004	<0.020
Cadmium, Total	mg/L	MAC=0.005	< 0.000010	< 0.000010	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.00004	18.9	<0.00020	<0.00002	<0.00010
Calcium, Total *(Dissolved, Ital.)*	mg/L	N/A	19.0	15.8	9	18.5	9.9	17.7	11.1	15.2	13.5	20.2	8.57	<0.00020	8.9	22.5	22.7
Chromium, Total	mg/L	MAC=0.05	< 0.00050	< 0.00050	<0.002	<0.002	<0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	< 0.001	<0.0020	<0.0020	0.003	<0.015
Cobalt, Total	mg/L	N/A	< 0.00010	< 0.00010									< 0.001			<0.0001	<0.0005
Copper, Total	mg/L	MAC=2.00	0.00170	0.00316	0.03	<0.01	0.02	0.22	0.02	0.016	0.0131	0.142	0.007	0.0051	0.0077	0.532	<0.0030
Iron, Total	mg/L	MAC=0.30	0.131	0.128	0.33	0.1	0.22	0.066	0.253	0.173	0.170	0.105	0.32	0.154	0.295	0.22	<0.20
Lead, Total	mg/L	MAC=0.005	< 0.00020	< 0.00020	0.001	<0.001	<0.001	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	0.0010	<0.0010
Lithium													< 0.001			0.0018	0.0026
Magnesium, Total *(Dissolved, Ital.)*	mg/L	N/A	4.06	2.94	1.5	2.9	1.9	2.98	1.89	2.55	2.36	3.02	1.41	3.32	1.44	3.15	3.59
Manganese, Total	mg/L	MAC=0.120	0.0207	0.0395	0.031	0.012	0.026	0.0215	0.0274	0.0337	0.0135	0.0062	0.026	0.0183	0.0294	0.022	<0.005
Mercury, Total	mg/L	MAC=0.001	<0.000040	<0.000040	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.02	<0.00020	<0.00020	<0.00005	<0.00030
Molybdenum, Total	mg/L	N/A	0.00342	0.00342	0.001	0.003	0.002	0.0034	0.0019	0.0024		0.0028	0.0014			0.0029	0.0039
Nickel, Total	mg/L	N/A	< 0.00040	0.00044													
Phosphorus																	
Potassium, Total *(Dissolved, Ital.)*	mg/L	N/A	1.44	1.39	1	1.4	1	1.52	1.08	1.27	1.10	1.42	1	1.56		1.68	1.35
Selenium, Total	mg/L	MAC=0.05	< 0.00050	< 0.00050	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	<0.001	<0.005
Silicon																	
Silver																	
Sodium, Total *(Dissolved, Ital.)*	mg/L	AO<200	4.88	3.85	2	4	3	3.7	3.3	3.6	2.7	4.1	2.38	5.1	2.7	4.38	4.68
Strontium, Total	mg/L	7	0.279	225													
Sulphur																	
Tellerium																	
Thallium																	
Thorium																	
Tin																	
Titanium																	
Uranium, Total	mg/L	MAC=0.02	0.00504	0.00155	0.0011	0.0022	0.001	0.00243	0.0014	0.00109	0.00103	0.00234	0.001	0.00332	0.00107	0.0021	0.001
Vanadium																	
Zinc, Total	mg/L	AO<5	< 0.0040	0.0066	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	0.013	<0.050	<0.050	0.005	<0.030
Zirconium																	
Volatile Organic Compounds (VOC)																	
Bromodichloromethane	mg/L	MAC = 0.016															
Bromoform	mg/L																
Chloroform	mg/L																
Dibromochloromethane	mg/L																
Total Trihalomethanes	mg/L	MAC = 0.100															
Surrogate: Toluene-d8	%																
Surrogate: 4-Bromofluorobenzene	%																

WATER QUALITY PARAMETER	PH 2	PH 2	PH 2	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 6	PH 8	PRV 17
	2011-06-14	2012-05-30	2012-09-25	2013-05-28	2013-09-18	2014-05-27	2014-10-09	2015-05-15	2015-10-21	2016-05-17	2016-09-28	2017-03-27	2017-08-31	2018-04-25	2018-09-04	2019-04-04	2019-09-23	2018-04-25	2011-11-14
Anions																			
Chloride	18.4	14.6	13.9	15.7	14.7	15.3	11.7	16.1	10.1	16.5	12.7	10.4	15.3	12.5	15.7	10.6	11.9	11.6	10.6
Flouride	< 0.01	< 0.010	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.12	0.16	< 0.10	0.10	< 0.10	0.13	< 0.10
Nitrate (as N)	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	0.013	0.041	< 0.010	0.016	< 0.010	0.065	< 0.010	0.014	0.010
Nitrite (as N)	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	< 0.010	< 0.01
Sulfate	2.5	3	4.1	2.1	3.5	2.0	4.3	3.3	3.4	2.60	3.6	5.6	4.1	8.6	5.2	7.7	5.5	8.6	5.5
Calculated Parameters																			
Total Trihalomethanes	0.091	0.113	0.052	0.076	0.086	0.074	0.060	0.054	0.053	0.062	0.071	0.054	0.0651	0.0439	0.0532		0.104	0.0458	0.085
Cation / Anion Balance			101																
Hardness, Total (as CaCO3)	27.7	26.8	49.5	28.9	42.8	24.5	45.9	36.3	49.3	28.6	47.2	56.4	53	72.4	59.7	66.1	54.4	73.7	58.5
Langlier Index											-0.9	-0.7	-0.8	-0.6	-1.1	-0.3	-1.0	-0.5	
Solids, Total Dissolved	74	47.6	71	51.3	66.1	49.7	66.2	59.3	63	55.4	72.0	75.3	81.1	94.2	85.6	94.4	77.1	95	74
General Parameters																			
Alkalinity, Total (as CaCO3)	16.0	21	43	22.0	41.0	24.0	41.0	28.0	42.0	24.0	45	50.0	48.8	63.0	53.0	72.0	51.3	64.2	50.7
Alkalinity, Phenolphthalein (as CaCO3)											< 1.0	< 1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Alkalinity, Bicarbonate (as CaCO3)											45	50.0	48.8	63.0	53.0	72.0	51.3	64.2	
Alkalinity, Carbonate (as CaCO3)											< 1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Alkalinity, Hydroxide (as CaCO3)											< 1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Colour, True	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 5	< 5	< 5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5
Conductivity (EC)	99	101	136	100	134	103	136	111	123	104	138	150	152	182	166	186	143	185	146
Cyanide, Total	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 00020	< 0.0020	< 0.0020	< 0.0050	< 0.0020	< 0.0020	< 0.0020	< 0.0050	< 0.01
pH	7.02	7.40	7.56	6.76	7.54	7.22	7.61	7.46	7.55	7.38	7.71	7.71	7.76	7.70	7.37	8.00	7.50	7.75	7.67
Temperature at pH											21	24	22	22.5	21.6	22.9	23.4	22.4	
Turbidity	0.3	< 0.1	0.1	0.4	< 0.1	< 0.1	< 0.1	0.3	0.10	0.14	< 0.10	0.10	< 0.10	< 0.10	< 0.10	0.10	0.12	0.12	0.1
UV transmittance	81.1	84.7	90.0	85.6	90.2	89.5	90.2	90.2	91.9	89.5									88.9
Microbiological Parameters																			
Coliforms, Total		< 1	< 1	< 1	< 1	< 1	<1	<1	<1	<1		<1	<1	< 1	< 1		< 1	< 1	< 1
Background Colonies																			
E.Coli		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1		< 1	< 1	< 1
Total Metals																			
Aluminum, Total	0.131	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05	0.07	< 0.050	0.013	0.0287	0.0121	0.0239	0.0159	0.0224	0.0128	< 0.050
Antimony, Total	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0001	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.0200
Arsenic, Total	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.0050
Barium, Total	< 0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.050	0.031	0.036	0.0431	0.0398	0.0423	0.0391	0.0428	< 0.050
Beryllium	< 0.0010	< 0.001	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001									< 0.0010
Bismuth	< 0.0010	< 0.001																	< 0.0010
Boron, Total	< 0.040	< 0.04	< 0.04	< 0.040	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	< 0.04	< 0.040	0.012	0.0236	0.0062	0.0096	0.0078	0.09082	0.0068	< 0.040
Cadmium, Total	< 0.00010	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	<0.00001	0.000011	<0.000010	<0.000010	<0.000010	0.000018	<0.000010	< 0.00010
Calcium, Total *(Dissolved, Ital.)*	8.7	8.0	15.0	9.0	13.0	7.7	14.2	11.1	15.9	8.8	14.8	17.8	16.3	22.5	18.6	20.2	17.1	22.7	18.2
Chromium, Total	< 0.00050	< 0.005	< 0.005	< 0.00050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00050	0.0006	0.0005	<0.00050	<0.00050	< 0.00050	< 0.00050	<0.00050	< 0.00050
Cobalt, Total	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00005	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00050
Copper, Total	0.0043	0.239	0.002	0.005	0.007	0.003	0.004	0.006	< 0.002	< 0.002	0.003	0.0008	0.00285	0.00248	0.00246	0.00152	0.00956	0.00613	0.0055
Iron, Total	< 0.10	< 0.1	< 0.1	0.2	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.13	< 0.10	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.10
Lead, Total	< 0.0010	0.002	< 0.001	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0001	0.00021	< 0.00020	< 0.00020	<0.00020	0.00031	< 0.00020	< 0.0010
Lithium	0.0011	0.001																	0.0013
Magnesium, Total *(Dissolved, Ital.)*	1.44	1.6	2.7	1.60	2.20	1.3	2.5	2.1	2.3	1.6	2.47	2.89	2.94	3.93	3.22	3.81	2.84	4.11	3.14
Manganese, Total	0.0099	0.0080	< 0.002	0.007	< 0.002	< 0.002	< 0.002	0.004	0.002	0.035	< 0.0020	0.0051	0.00331	0.00283	0.00111	0.00345	0.00751	0.00153	< 0.0020
Mercury, Total	< 0.00020	< 0.0002	< 0.0002	< 0.00020	< 0.0002	< 0.0002	< 0.0002	< 0.00002	< 0.0002	< 0.00002	< 0.0002	< 0.00002	< 0.000010	< 0.000010	< 0.000010	< 0.000040	< 0.000040	< 0.000010	< 0.00020
Molybdenum, Total	0.0015	0.002	0.002	0.002	0.003	0.001	0.003	0.001	0.003	0.002	0.0030	0.0022	0.0032	0.00326	0.00332	0.00345	0.00342	0.00340	0.0030
Nickel, Total	< 0.0020	0.002	< 0.002	< 0.0020	< 0.0020	< 0.0020	< 0.002	0.002	< 0.002	< 0.002	< 0.0020	< 0.0002	< 0.00040	< 0.00040	< 0.00040	< 0.00040	< 0.00040	< 0.00040	< 0.0020
Phosphorus	< 0.20	< 0.2	< 0.2	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2									< 0.20
Potassium, Total *(Dissolved, Ital.)*	0.93	1.1	1.4	1.30	1.20	< 0.20	1.3	1.4	0.9	1.3	1.37	1.39	1.47	1.53	1.44	1.46	1.43	1.58	1.15
Selenium, Total	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	< 0.0050
Silicon	< 5.0	< 5	< 5	7.0	6.0	6.0	6	6	< 5	7									6.1
Silver	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005									< 0.00050
Sodium, Total *(Dissolved, Ital.)*	8.22	6.1	7.3	8.30	5.90	10.10	6.9	8.5	4.5	9.7	9.44	6.78	11.1	6.67	9.10	6.49	7.01	7.27	5.48
Strontium, Total	0.098	0.11												0.291	0.244	0.288	0.238	0.293	0.225
Sulphur		< 10																	
Tellerium	< 0.0020	< 0.002																	< 0.0020
Thallium	< 0.00020	< 0.0002																	< 0.00020
Thorium	< 0.0010	< 0.001																	< 0.0010
Tin	< 0.0020	< 0.002																	< 0.0020
Titanium	< 0.050	< 0.05																	< 0.050
Uranium, Total	< 0.00020	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00020	0.00037	0.000103	0.00138	0.000236	0.0024	0.000255	0.00148	0.00043
Vanadium	< 0.010	0.003	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01									< 0.010
Zinc, Total	< 0.040	0.23	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.32	< 0.004	< 0.004	0.0058	0.0047	< 0.0040	0.0060	0.0118	0.0060	< 0.040
Zirconium	< 0.0010	< 0.001																	< 0.0010
Volatile Organic Compounds (VOC)																			
Bromodichloromethane	0.002	0.002	0.002	0.002	0.005	0.002	0.004	0.002	0.004	0.002	0.004	0.005	0.0053	0.0082	0.0052		0.0059	0.0085	0.005
Bromoform	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	< 0.0010	< 0.0010		< 0.0010	< 0.0010	< 0.001
Chloroform	0.089	0.111	0.050	0.074	0.081	0.071	0.056	0.052	0.050	0.060	0.066	0.049	0.0598	0.0340	0.0479		0.0981	0.0355	0.080
Dibromochloromethane	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	0.0016	< 0.0010		< 0.0010	0.0018	< 0.001
Total Trihalomethanes	0.091	0.113	0.052	0.076	0.086	0.074	0.06	0.054	0.053	0.062	0.071	0.054	0.0651	0.0439	0.0532		0.104	0.0458	0.085
Surrogate: Toluene-d8		*71*	*80*	*89*	*112*	*99*	*99*	*92*	*105*	*82*	*93*	*77*	*98*	*117*	*76*		*85*	*120*	
Surrogate: 4-Bromofluorobenzene	*88*	*84*	*75*	*89*	*108*	*96*	*90*	*80*	*82*	*80*	*81*	*93*	*113*	*94*	*78*		*76*	*100*	*83*

*__OGV__ - Operational Guidance Value (Health Canada) **MAC** - Max. Acceptable Concentration **AE** - Aesthetic Objective **__IHA__ Requirement ***__USEPA__ recomm. **#** No. of Samples

Data is based on raw values for the most recent "full year" of data available. Obvious parameters like free and total chlorine, THM's etc… are based on treated.

UV Transmissivity

UV transmissivity data was collected on Trout Creek water between November 2002 to April 2004 and then again from 2011 to 2016. Before the installation of the Water Treatment Plant, the UVT of the water after chlorination averaged 85.7%. After the WTP was installed, the UVT was slightly higher averaging 88.3% UVT. The data is listed on Table 5.3.

The UVT of Garnett Reservoir water also sufficiently high enough that with a UV reactor and chlorination, that source could remain as an emergency supply source. With UV disinfection not in the immediate plans, the collection of UVT data was not continued after 2016.

Table 5.3 - UV_{254} Transmissivity in Summerland Source Water

	TROUT CREEK SYSTEM WATER		GARNET VALLEY SYSTEM WATER	
Sample Date	% Transmittance before chlorination	% Transmittance after chlorination	% Transmittance before chlorination	% Transmittance after chlorination
2002-11-14	81	85	88	91
2002-12-09	87	87	90	93
2003-01-09	88	89	87	90
2003-02-12	89	90	91	93
2003-03-13	88	91	89	92
2003-04-08	88	92	90	93
2003-05-13	** 45	** 65	90	91
2003-06-11	56	65	90	92
2003-07-21	79	83	94	96
2003-09-04	90	78	90	92
2003-10-09	84	84	89	93
2003-11-24	83	85	81	91
2003-12-10	87	86	89	92
2004-01-21	88	89	89	91
2004-02-26	89	89	89	92
2004-03-17	87	91	89	91
2004-04-07	56	87		
2011-06-14		81.1		76.0
				90.2
2012-05-30		84.7		93.0
2012-09-25		90.0		92.8
2013-05-28		85.6		86.1
2013-09-18		90.2		91.2
2014-05-27		89.5		98.7
2014-10-09		90.2		93.2
2015-05-15		90.2		93.8
2015-10-21		91.9		92.8
2016-05-17		89.5		85.6
Average 2002-04		**85.7**		**92.1**
Average 2012-16		**88.3**		**90.3**
AVERAGE		**86.7**		**91.3**

THM Data

The majority of Trihalomethane production is as chloroform. The average THM levels for the Trout Creek source prior to the WTP being in-service was 141 ppb with the levels exceeding 100 on most samples. Garnett Reservoir samples were much lower averaging 55ppb. THM production in the raw water is affected by the organic load, the chlorine dose, contact time and water temperature. Garnett Reservoir is highly influenced by groundwater supply from the west.

As shown in Table 5.4 and illustrated in Figure 5.1, since the WTP was commissioned in 2007 the THM levels in the main system have dropped averaging only 63 ppb. The WTP removes organic compounds and colour in the raw water prior to chlorination.

Table 5.4 - THM Data before and After WTP commissioning

Jan 1994 - Current	TROUT CREEK SYSTEM		GARNET VALLEY SYSTEM	
DATE:	Chloroform (ppb)	Total THMs (ppb)	Chloroform (ppb)	Total THMs (ppb)
January 27, 1994	120	126	34	40
March 4, 1994	110	113	53	60
March 25, 1994	150	154	22	27
April 28, 1994	190	192	39	45
May 27, 1994	170	172	33	38
July 21, 1994	160	163	35	41
August 23, 1994	100	104	36	43
September 23, 1994	120	123	36	43
October 24, 1994	88	92	46	54
November 16, 1994	89	93	25	32
December 15, 1994	78	82	39	46
January 23, 1995	52	55	21	27
February 20, 1995	56	60	27	33
March 16, 1995	95	96	48	56
April 20, 1995	122	126	16	18
May 24, 1995	151	153	24	28
June 20, 1995	153	156	35	41
July 24, 1995	160	163	26	30
August 23, 1995	153	155	42	48
September 26, 1995	106	108	50	50
October 26, 1995	159	162	121	130
November 21, 1995	163	166	54	62
December 20, 1995	154	158	26	33
January 22, 1996	166	169	34	42
February 20, 1996	128	131	47	55
March 13, 1996	137	140	52	60
April 25, 1996	142	145	64	73
May 28, 1996	234	236	38	42
June 27, 1996	240	242	88	95
July 22, 1996	170	173	73	80
August 14, 1996	113	116	43	49
September 26, 1996	142	146	106	119
October 23, 1996	144	148	103	113
November 26, 1996	166	171	55	62
December 18, 1996	138	142	83	92
February 5, 1997	99	101	64	72
May 27, 1997	276	278	64	67
July 2, 1997	272	274	61	65
November 25, 1997	156	160	54	60
January 22, 1998	171	175	58	67
May 27, 1998	274	276	100	111
August 4, 1998	209	212	35	41
November 18, 1998	156	161	52	57
March 1, 1999	108	113	61	70
July 19, 1999	204	206	55	61
October 25, 1999	146	149	88	97
December 20, 1999	127	130	55	63
February 24, 2000	123	155	36	43

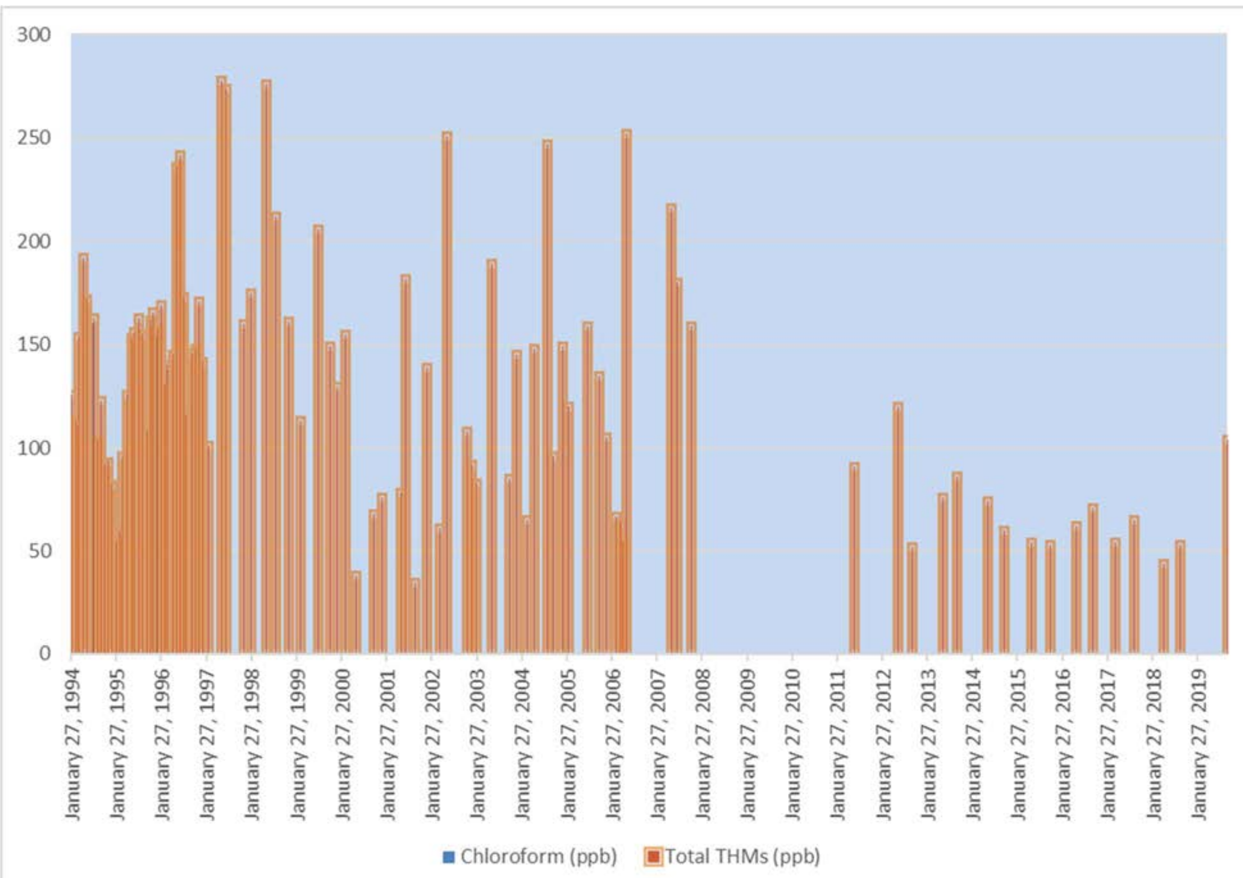
Jan 1994 - Current	TROUT CREEK SYSTEM		GARNET VALLEY SYSTEM	
DATE:	Chloroform (ppb)	Total THMs (ppb)	Chloroform (ppb)	Total THMs (ppb)
May 17, 2000	38	38	8	11
October 6, 2000	66	68	34	42
December 20, 2000	73	76	29	34
May 23, 2001	77	78	13	13
June 27, 2001	180	182	33	41
September 14, 2001	32	35	29	33
December 14, 2001	135	139	155	163
April 4, 2002	57	61	36	44
May 25, 2002	249	251	52	59
November 5, 2002	104	108	60	70
December 11, 2002	89	92	67	75
January 17, 2003	80	83	80	89
May 27, 2003	188	189	36	41
October 16, 2003	82	85	45	54
December 17, 2003	140	145	75	81
March 4, 2004	62	65	39	47
May 3, 2004	148	148	22	25
August 17, 2004	243	247	40	45
October 7, 2004	94	96	29	34
December 20, 2004	146	149	43	50
February 5, 2005	117	120	47	55
July 13, 2005	159	159	47	54
October 12, 2005	133	135	50	59
December 8, 2005	101	105	42	48
February 27, 2006	63	67	43	51
March 30, 2006	59	64	32	38
April 18, 2006	51	55	21	27
May 24, 2006	250	252	56	65
May 17, 2007	214	216	46	53
July 4, 2007	175	180	28.4	34.8
October 31, 2007	156	159	46	53
Average (ppb)	**138**	**141**	**49**	**55**
June 14, 2011	89	91		
May 30, 2012	111	0		
September 25, 2012	50	52		
May 28, 2013	74	76		
September 18, 2013	81	86		
May 27, 2014	71	74		
October 9, 2014	56	60		
May 15, 2015	52	54		
October 21, 2015	50	53		
May 17, 2016	60	62		
September 28, 2016	66	71		
March 27, 2017	49	54		
August 31, 2017	59.8	65.1		
April 25, 2018	34	43.9		
September 4, 2018	47.9	53.2		
April 4, 2019	0	0		
September 23, 2019	98.1	104		
April 25, 2018	35.5	45.8		
November 14, 2011	80	85		
Average (ppb)	**61**	**59**		

THMs form as a by-product of the chlorination disinfection process. They are defined by the USEPA as "One of a family of organic compounds named as derivatives of methane. THMs are generally the by-product from chlorination of drinking water that contains organic material. The resulting compounds (THMs) are suspected of causing cancer."

The Health Canada guideline statement for THMs is as follows:
"*The maximum acceptable concentration (MAC) for trihalomethanes (THMs) in drinking water is 0.100 mg/L (100 ug/L) based on a locational running annual average of a minimum of quarterly samples taken at the point in the distribution system with the highest potential THM levels.*

Utilities should make every effort to maintain concentrations as low as reasonably achievable ***without compromising the effectiveness of disinfection***."

Figure 5.1 – Trended THM Levels – 1994 - 2019



5.3.2 GARNETT RESERVOIR / ENEAS CREEK WATER QUALITY

The raw and treated water quality from the Eneas Creek water source was reviewed. The raw water comes directly from Eneas Creek with influence from the groundwater supply that comes from Meadow Valley. Garnett Reservoir has clearer water than most local upper watershed reservoirs and appears to have some groundwater influence resulting in its low turbidity and clarity.

Raw Water Quality

There is a limited amount of water quality data is available for the upper watershed or Garnett Reservoirs. Baseline data for what appears to be the Eneas Creek source was assembled from a forestry study done from 1992-1994. The alkalinity and conductivity match up with lower Eneas Creek where it is groundwater influenced. That study collected a number of physical and chemical parameters for a raw water source near Summerland that appears to be Eneas Creek. The data is useful in that it shows the variation in natural raw water quality for each month in the years 1992 and 1993.

As summarized within Table 5.5, the raw water quality in Eneas Creek is within the recommended physical and chemical parameter criteria. The guideline criteria parameters are the BC Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture (yellow column).

The challenges for this source over the years has been the high level of nutrients and high probability of algae blooms. Aeration, flushing and treatment of the water have been attempted over the years with varying degrees of success.

Since October, 2018, Garnett Reservoir/Eneas Creek water has been used solely for irrigation water and for fire protection, but not for domestic purposes. For this reason, trending of UVT and Trihalomethanes on this source is no longer required.

Treated Water Quality

The treated water quality for Garnett Reservoir is listed in Table 5.6. The domestic and treated water quality in Tables 5.5 and 5.6 are very similar. The only treatment for Garnett Reservoir water was chlorination. As of October, 2018, the new pump station on Garnett Valley Road was commissioned and the 90 domestic connections in Garnett Valley are now supplied from the Summerland WTP. These customers are supplied with water from Trout Creek and the Summerland Water Treatment Plant.

Moving forward, this source is for irrigation and fire flow. Sampling should continue to verify that activities in the watershed have not significantly changed.

Table 5.5 Garnett Valley Raw Water Quality Parameters

W. QUALITY PARAMETER	Units	GCDWQ MAC regulations	1992-01-13	1992-02-22	1992-03-25	1992-04-27	1992-05-20	1992-06-23	1992-07-23	1992-08-20	1992-09-24	1992-10-21	1992-11-24	1992-12-14	1993-01-21	1993-02-11	1993-03-25	1993-04-19	1993-05-19	1993-06-23	1993-07-22	1993-08-18	1993-09-21	1993-10-19	1993-11-21	1993-12-16	1994-01-19	1994-04-18	1994-07-11	1994-10-19
			Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site
Anions																														
Chloride	mg/L	AO < 250	1.9	2.3	3.5	2	1.9	2	3.1	1.7	2	2.2	1.7	2.3	3.5	3.7	2.9	1.7	1.8	2	1.7	2	2.2	1.9	2.1	2.4	2.8	3.6	2.5	1.9
Flouride	mg/L	MAC = 1.50																												
Nitrate (as N)	mg/L	MAC = 10	0.02	0.11	0.46	< 0.01	< 0.01	0.2	< 0.01	0.19	0.02	0.21	0.09	0.09	0.12	0.94	0.28	0.09	0.05	< 0.01	0.01	< 0.01	0.21	0.14	0.21	0.09	0.45	0.75	0.04	0.07
Nitrite (as N)	mg/L	MAC = 1.00																												
Sulfate	mg/L	AO<500	33.7	35	41	33.8	28.5	50	37.3	35	30	35	39	33	31	36	49	34	39	35	40	35	34	31	38	42	34	40	53	30
Calculated Parameters																														
Total Trihalomethanes	mg/L	MAC=0.100																												
Cation / Anion Balance		N/A																												
Hardness, Total (as CaCO3)	mg/L	N/A																												
Langlier Index		N/A																												
Solids, Total Dissolved	mg/L	AO<500	160	174	202	154	158	214	184	190	138	194	166	154	162	220	200	162	148	164	162	154	176	200	190	154	220	214	182	170
General Parameters																														
Alkalinity, Total (as CaCO3)	mg/L	N/A	120	120	118	110	114	148	164	174	160	172	134	123	150	143	131	112	108	103	104	103	119	123	118	111	108	113	104	108
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A																												
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A																												
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A																												
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A																												
Colour, True	mg/L	AO<15																												
Conductivity (EC)	umhos/cm	N/A	295	305	342	271	274	329	283	293	285	254	305	284	310	343	351	290	284	274	277	275	300	308	315	298	346	361	321	289
Cyanide, Total	mg/L	MAC = 0.20																												
pH	pH units	7.0-10.5	8.22	8.32	8.58	8.45	8.51	8.53	8.56	8.60	8.43	8.40	8.30	8.31	8.23	8.36	8.45	8.46	8.41	8.39	8.40	8.42	8.41	8.43	8.25	8.03	8.12	8.17	8.13	8.04
Temperature at pH	°C	N/A	2	3	10	10	14	24	22	22	16	12	4	5	0	6	8	9	14	20	19	21	15	13	7	5				
Turbidity	NTU	OG<1.00																												
UV transmittance	%																													
Microbiological Parameters																														
Coliforms, Total	CFU/100ml	MAC = 0																												
Background Colonies	CFU/100ml	N/A																												
E.Coli	CFU/100ml	MAC = 0																												
Total Metals																														
Aluminum, Total	mg/L	OG<1.00	0.013	0.034	0.009	0.016	0.017	0.012	0.022	0.039	0.024	0.018	0.041	0.021	0.353	0.019	76	0.008	0.268	0.019	0.049	0.019	0.022	0.043	0.022	0.005	0.01	0.03	0.021	0.014
Antimony, Total	mg/L	MAC=0.006																												
Arsenic, Total	mg/L	MAC=0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Barium, Total	mg/L	MAC=1.00																												
Beryllium																														
Bismuth																														
Boron, Total	mg/L	MAC=5																												
Cadmium, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium, Total	mg/L	N/A	31	31	44	30	31	43	34	37	34	36	33	35	34	45	42	32	37	34	34	34	35	39	38	37	44	41	34	33
Chromium, Total	mg/L	MAC=0.05																												
Cobalt, Total	mg/L	N/A																												
Copper, Total	mg/L	MAC=2.00	< 0.001	0.005	0.003	0.003	0.001	0.003	0.002	0.001	0.002	0.003	< 0.001	0.002	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Iron, Total	mg/L	MAC=0.30	0.026	0.051	0.019	0.011	0.011	0.023	0.061	0.073	0.061	0.037	0.11	**0.496**	**0.68**	0.051	0.131	0.002	0.039	0.035	0.123	0.017	0.033	0.11	0.036	0.009	0.025	0.055	0.029	0.034
Lead, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Lithium																														
Magnesium, Total	mg/L	N/A	9.3	9.3	11.3	8.9	8.6	11.2	8.6	8.9	9.7	9.4	8.9	8.5	8.0	8.0	12.1	8.9	10.4	9.8	10.4	9.0	9.7	9.7	9.8	9.0	9.0	7.0	11.4	9.6
Manganese, Total	mg/L	MAC=0.120	0.001	0.001	0.003	0.005	0.002	0.009	0.004	0.005	0.004	0.002	0.003	0.013	0.019	0.003	0.006	0.001	0.004	0.007	0.009	0.006	0.002	0.005	0.003	0.002	0.002	0.004	0.011	0.003
Mercury, Total	mg/L	MAC=0.001																												
Molybdenum, Total	mg/L	N/A	0.005	0.004	0.006	0.004	0.007	0.005	0.005	0.008	0.005	0.005	0.005	0.006	0.006	0.008	0.008	0.006	0.007	0.004	0.005	0.005	0.006	0.005	0.006	0.006	0.008	0.006	0.004	0.005
Nickel, Total	mg/L	N/A																												
Phosphorus																														
Potassium, Total	mg/L	N/A	2.2	2.2	2.8	2.1	2.2	2.9	2.5	2.6	2.4	2.4	2.9	2.7	2.8	2.8	3.2	2.6	2.6	2.5	2.8	2.7	2.6	3.0	2.7	2.5	3	2.8	2.4	2.3
Selenium, Total	mg/L	MAC=0.05																												
Silicon																														
Silver																														
Sodium, Total	mg/L	AO<200	9.5	10.8	10.9	10.2	9.9	10.9	9.7	10.6	9.4	10.2	9.5	9.4	10.1	11.1	10.7	9.8	9.6	9.2	9.4	9.2	9.8	9.2	10.0	9.0	10.4	10.8	9.8	9.6
Strontium, Total	mg/L	7																												
Sulphur																														
Tellerium																														
Thallium																														
Thorium																														
Tin																														
Titanium																														
Uranium, Total	mg/L	MAC=0.02																												
Vanadium																														
Zinc, Total	mg/L	AO<5	< 0.001	0.001	0.007	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.002	0.003	< 0.001	0.001	< 0.001	0.001	0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Zirconium																														

Table 5.6 Garnett Valley Treated Water Quality Parameters

TREATED WATER

W. QUALITY PARAMETER	Units	GCDWQ MAC regulations	GV Spray floor 2002-05-28	GV Spray floor 2002-11-05	GV Spray floor 2003-05-27	GV Spray floor 2003-10-16	GV Spray floor 2004-05-03	GV Spray floor 2004-10-07	GV Spray floor 2005-07-13	GV Spray floor 2005-12-08	GV Spray floor 2006-05-24	GV Spray floor 2006-10-25	GV Spray floor 2007-05-17	GV Spray floor 31-Oct-07	GV Spray floor 2008-02-21
Anions															
Chloride	mg/L	AO < 250	5	4.6	4.5	5.69	5.08	4.62	4.72	7.45	5.29	5.47	4.6	4.28	5.36
Flouride	mg/L	MAC = 1.50	0.23	0.23	0.28	0.291	0.317	0.319	0.323	0.346	0.32	0.316	0.268	0.29	0.28
Nitrate (as N)	mg/L	MAC = 10	<0.005	0.031	0.005	0.024	<0.0050	<0.0050	<0.0050	0.0298	< 0.005	<0.0050	0.0058	<0.010	0.168
Nitrite (as N)	mg/L	MAC = 1.00	0.002	<0.001	0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.002	<0.0010	<0.0010	<0.010	<0.010
Sulfate	mg/L	AO<500	9	9	9	9.2	9.2	9.6	11.2	11.1	11.2	9.97	10.1	10.5	11
Calculated Parameters															
Total Trihalomethanes	mg/L	MAC=0.100													
Cation / Anion Balance		N/A													
Hardness, Total (as CaCO3)	mg/L	N/A	156	163	155	156	165	159	171	170	156	155	168	166	172
Langlier Index		N/A													
Solids, Total Dissolved	mg/L	AO<500	196	196	192	214	222	197	178	216	220	197	207	217	205
General Parameters															
Alkalinity, Total (as CaCO3)	mg/L	N/A	163	173	166	171	188	165	161	191	158	187	176	161	177
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A													
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A													
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A													
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A													
Colour, True	mg/L	AO<15	<5	<5	<5	<5.0	<5.0	<5.0	<5.0	<5.0	< 5	<5.0	<5.0	<5	<5
Conductivity (EC)	umhos/cm	N/A	333	338	335	348	364	343	328	358	320	328	336	322	368
Cyanide, Total	mg/L	MAC = 0.20	<0.005	<0.005	0.017	0.0096	<0.0050	<0.0050	<0.0050	<0.0050	< 0.01	0.0057	0.0061	<0.01	<0.01
pH	pH units	7.0-10.5	8.2	8.1	8.18	8.27	8.17	8.23	8.27	7.85	8.16	8.2	8.34	7.5	7.7
Temperature at pH	°C	N/A													
Turbidity	NTU	OG<1.00	1.8	0.6	3	0.49	6.54	2.31	2.40	0.92	0.45	0.62	1.39	0.7	0.3
UV transmittance	%														
Microbiological Parameters															
Coliforms, Total	CFU/100ml	MAC = 0													
Background Colonies	CFU/100ml	N/A													
E.Coli	CFU/100ml	MAC = 0													
Total Metals															
Aluminum, Total	mg/L	OG<1.00	0.02	<0.01	0.02	<0.010	0.078	0.020	<0.010	<0.010	0.007	<0.010	0.011	<0.01	<0.05
Antimony, Total	mg/L	MAC=0.006	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	< 0.001	<0.00050	<0.00050	<0.0006	<0.0030
Arsenic, Total	mg/L	MAC=0.01	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	0.00053	0.00058	< 0.001	0.00054	0.00046	<0.001	<0.005
Barium, Total	mg/L	MAC=1.00	0.04	0.05	0.04	0.045	0.049	0.046	0.037	0.049	0.042	0.044	0.043	0.049	0.053
Beryllium															
Bismuth															
Boron, Total	mg/L	MAC=5	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	< 0.05	<0.10	<0.10	0.005	<0.020
Cadmium, Total	mg/L	MAC=0.005	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.00004	<0.00020	<0.00020	<0.00002	<0.00010
Calcium, Total	mg/L	N/A	49.5	52.4	48.2	48.6	52.9	50.0	55.0	54.1	50	49.6	54.8	51.9	55.8
Chromium, Total	mg/L	MAC=0.05	<0.002	<0.002	<0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	< 0.001	<0.0020	<0.0020	0.002	<0.015
Cobalt, Total	mg/L	N/A													
Copper, Total	mg/L	MAC=2.00	<0.01	<0.01	<0.01	0.011	<0.010	0.015	0.0028	0.0207	0.004	0.0112	0.0045	0.017	0.0124
Iron, Total	mg/L	MAC=0.30	<0.03	<0.03	<0.03	<0.030	0.075	<0.030	<0.030	<0.030	< 0.05	<0.030	<0.030	0.16	<0.20
Lead, Total	mg/L	MAC=0.005	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	0.0003	<0.0010
Lithium															
Magnesium, Total	mg/L	N/A	7.8	7.7	8.5	8.35	7.97	8.22	8.31	8.53	7.45	7.59	7.66	8.92	8
Manganese, Total	mg/L	MAC=0.120	0.015	0.02	0.007	0.0125	0.0291	0.0092	0.0041	0.0383	0.007	0.0054	0.0068	0.017	0.013
Mercury, Total	mg/L	MAC=0.001	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.02	<0.00020	<0.00020	<0.00005	<0.00030
Molybdenum, Total	mg/L	N/A	0.004	0.004	0.004	0.0047	0.0038	0.0042		0.0041	0.0037			0.0040	0.0042
Nickel, Total	mg/L	N/A													
Phosphorus															
Potassium, Total	mg/L	N/A	2.2	2.5	2.3	2.63	2.31	2.44	2.22	2.50	2.1	2.31	2.3	2.74	2.41
Selenium, Total	mg/L	MAC=0.05	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	<0.001	<0.005
Silicon															
Silver															
Sodium, Total	mg/L	AO<200	8.0	9.0	8.0	8.9	8.4	8.4	7.3	8.4	7.6	8.7	8.4	8.90	8.0
Strontium, Total	mg/L	7													
Sulphur															
Tellerium															
Thallium															
Thorium															
Tin															
Titanium															
Uranium, Total	mg/L	MAC=0.02	0.0093	0.0089	0.0089	0.00992	0.00952	0.00885	0.00807	0.00951	0.0084	0.00829	0.00884	0.0083	0.0096
Vanadium															
Zinc, Total	mg/L	AO<5	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	< 0.005	<0.050	<0.050	0.005	<0.030
Zirconium															
Volatile Organic Compounds (VOC)															
Bromodichloromethane	mg/L														
Bromoform	mg/L														
Chloroform	mg/L														
Dibromochloromethane	mg/L														
Total Trihalomethanes	mg/L	MAC = 0.100													
Surrogate: Toluene-d8	%														
Surrogate: 4-Bromofluorobenzene	%														
Radioactivity Parameter															
Gross Alpha Activity	Bq/L	MAC = 0.5													
Gross Beta Activity	Bq/L	MAC = 1													

W. QUALITY PARAMETER	Garnett/MSP 2011-06-14	Garnett/MSP 2011-11-14	Garnett/MSP 2012-05-30	Garnett/MSP 2012-09-25	Garnett/MSP 2013-05-28	Garnett/MSP 2013-09-18	Garnett/MSP 2014-05-27	Garnett/MSP 2014-10-09	Garnett/MSP 2015-05-15	Garnett/MSP 2015-10-21	Garnett/MSP 2016-05-17	Garnett/MSP 2016-09-28	Garnett/MSP 2017-03-27	Garnett/MSP 2017-08-31	Garnett/MSP 2018-06-29	Garnett/MSP 2018-09-04	Garnett/MSP 2019-04-15
Anions																	
Chloride	4.83	5.25	4.61	4.66	4.54	4.00	1.60	4.69	5.38	5.74	5.83	5.68	6.47	5.14	4.95	5.77	4.04
Flouride	0.23	0.19	0.18	< 0.10	0.19	0.24	0.15	0.21	0.21	0.22	0.27	0.15	0.26	0.36	0.28	0.35	0.29
Nitrate (as N)	< 0.01	0.020	< 0.010	< 0.010	< 0.010	< 0.010	0.205	< 0.010	< 0.010	< 0.010	< 0.010	0.030	0.161	< 0.010	< 0.010	< 0.010	0.132
Nitrite (as N)	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.026	< 0.010
Sulfate	8.6	9.4	10.1	9.9	9.2	9.2	14.9	10.8	12.2	9.2	11.6	11.8	10.9	12.2	14	16.5	13.9
Calculated Parameters																	
Total Trihalomethanes				0.029	0.074	0.066	0.040	0.049	0.033	0.056	0.061	0.052	0.0385	0.0831	0.0713		
Cation / Anion Balance				109											-5.35		
Hardness, Total (as CaCO3)	147	172	152	150	154	131	165	147	190	157	165	151	166	153	167		168
Langlier Index												0.3	0.5	0.4	2.6		0.8
Solids, Total Dissolved	187	182	172	164	172	147	173	161	203	169	180	170	197	170	204		214
General Parameters																	
Alkalinity, Total (as CaCO3)	141	155.0	152	140	151.0	127.0	155.0	135.0	169.0	139.0	148.0	142	176.0	140.0	186	163	201.0
Alkalinity, Phenolphthalein (as CaCO3)												< 1.0	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Alkalinity, Bicarbonate (as CaCO3)												142	176.0	140.0	186	163	1201.0
Alkalinity, Carbonate (as CaCO3)												< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Alkalinity, Hydroxide (as CaCO3)												< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Colour, True	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 5	< 5	7	< 5.0	8.5	< 5.0	< 5.0	5.7
Conductivity (EC)	285	327	329	297	310	274	324	299	328	298	301	304	363	302	346	348	384
Cyanide, Total	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
pH	7.85	8.03	8.15	8.04	7.97	8.15	7.83	7.99	8.08	7.93	7.91	7.99	7.93	8.06	7.92	7.96	8.21
Temperature at pH												21	23	22	0.0	23.0	22
Turbidity	0.8	0.7	0.9	0.5	0.7	0.3	0.5	0.40	1.00	0.40	0.60	0.38	0.45	0.66	1.21	0.53	0.78
UV transmittance	76.0	90.2	93.0	92.8	86.1	91.2	98.7	93.2	93.8	92.8	85.6						
Microbiological Parameters																	
Coliforms, Total		< 1	< 1	< 1	< 1	< 1	< 1	<1	<1	<1	<1		<1	<1	> 4	<1	
Background Colonies															> 200		
E.Coli		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	
Total Metals																	
Aluminum, Total	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.050	< 0.005	0.0056	0.0246	< 0.0050	< 0.0050
Antimony, Total	< 0.0010	< 0.0200	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0001	< 0.00020	< 0.00020	< 0.00020	< 0.00020
Arsenic, Total	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.00050	0.00055	0.00065	0.00067	< 0.00050
Barium, Total	0.052	0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.050	< 0.05	< 0.05	< 0.050	0.049	0.0426	0.0455	0.0493	0.0529
Beryllium	< 0.0010	< 0.0010	< 0.001	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001						
Bismuth	< 0.0010	< 0.0010	< 0.001														
Boron, Total	< 0.040	< 0.040	< 0.04	< 0.04	< 0.040	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	< 0.04	< 0.040	0.006	0.0141	0.0153	< 0.0050	< 0.0050
Cadmium, Total	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	<0.000010	< 0.000010	0.000012	< 0.000010	< 0.000010
Calcium, Total	48.4	54.0	48.0	46.0	50.0	42.0	54.3	45.3	61.3	47.6	53.6	46.3	52.4	46.1	54.4	50.2	53.0
Chromium, Total	< 0.00050	< 0.00050	< 0.005	< 0.005	< 0.00050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00050	0.0005	< 0.00050	< 0.00050	0.0005	< 0.00050
Cobalt, Total	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00010	< 0.00010	< 0.00050	< 0.00010	< 0.00010
Copper, Total	0.0219	0.0252	0.026	0.024	0.011	0.119	0.034	0.044	0.029	0.035	0.016	0.0243	0.0365	0.00238	0.0234	0.0182	0.00404
Iron, Total	< 0.10	< 0.10	< 0.1	< 0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.010	< 0.010	0.030	< 0.010	0.044
Lead, Total	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.0010	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	0.0002	< 0.00020	0.00027	< 0.00020	0.00025
Lithium	0.0042	0.0050	0.005														
Magnesium, Total	6.35	8.89	8.0	8.3	7.20	6.50	7.1	8.1	9.1	9.4	7.5	8.59	8.45	9.12	7.65	8.93	8.66
Manganese, Total	0.0089	0.0288	0.0120	0.0090	0.009	0.004	0.009	0.007	0.014	0.006	0.008	0.0071	0.0100	0.0119	0.0203	0.00888	0.0249
Mercury, Total	< 0.00020	< 0.00020	< 0.0002	< 0.0002	< 0.00020	< 0.0002	< 0.0002	< 0.0002	< 0.00002	< 0.0002	< 0.00002	< 0.00020	< 0.000040	< 0.000010	< 0.000010	< 0.000010	< 0.00040
Molybdenum, Total	0.0032	0.0064	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.0040	0.0030	0.00404	0.00473	0.00498	0.0046
Nickel, Total	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.0020	< 0.0020	< 0.0020	< 0.002	0.003	< 0.002	< 0.002	< 0.0020	< 0.00040	< 0.00040	< 0.00040	0.00043	0.00093
Phosphorus	< 0.20	< 0.20	< 0.2	< 0.2	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2						
Potassium, Total	1.76	2.38	2.2	2.1	2.30	1.80	1.2	2.1	2.7	2.6	2.4	2.31	2.52	2.20	2.41	2.2	2.33
Selenium, Total	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	<0.00050	<0.00050	< 0.00050	< 0.00050	< 0.00050
Silicon	< 5.0	9.4	6.0	< 5	8.0	7.0	8.0	10	8	11	9						
Silver	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005						
Sodium, Total	6.10	8.54	6.2	8.0	7.10	6.40	6.70	7.6	8.9	9.7	8.5	8.89	8.62	9.13	7.62	9.22	853
Strontium, Total	0.312	0.44	0.41												0.403	0.456	0.485
Sulphur			< 10														
Tellerium	< 0.0020	< 0.0020	< 0.002														
Thallium	< 0.00020	< 0.00020	< 0.0002														
Thorium	< 0.0010	< 0.0010	< 0.001														
Tin	< 0.0020	< 0.0020	< 0.002														
Titanium	< 0.050	< 0.050	< 0.05														
Uranium, Total	0.00564	0.00756	0.0070	0.0076	0.00680	0.0058	0.0081	0.0074	0.0098	0.0097	0.007	0.00758	0.00777	0.00830	0.00915	0.0109	0.0127
Vanadium	< 0.010	< 0.010	0.004	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01						
Zinc, Total	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	0.07	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.0040	0.010	< 0.0040	0.0094	0.0043	0.0121
Zirconium	< 0.0010	< 0.0010	< 0.001														
Volatile Organic Compounds (VOC)																	
Bromodichloromethane			0.004	0.004	0.006	0.008	0.004	0.008	0.005	0.009	0.004	0.008	0.007	0.0091	0.0049		
Bromoform			< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	< 0.0010		
Chloroform		missing	0.033	0.024	0.068	0.058	0.036	0.041	0.028	0.047	0.057	0.044	0.031	0.0740	0.0664		
Dibromochloromethane		file	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	< 0.0010		
Total Trihalomethanes			0.037	0.029	0.074	0.066	0.040	0.049	0.033	0.056	0.061	0.052	0.0385	0.0831	0.0713		
Surrogate: Toluene-d8			*86*	*67*	*87*	*99*	*101*	*98*	*94*	*104*	*82*	*100*	*79*	*98*	*75*		
Surrogate: 4-Bromofluorobenzene			*89*	*71*	*86*	*95*	*97*	*89*	*81*	*81*	*80*	*90*	*94*	*113*	*78*		
Radioactivity Parameter																	
Gross Alpha Activity																0.17	
Gross Beta Activity																0.15	

***OGV** - Operational Guidance Value (Health Canada)   **MAC** - Max. Acceptable Concentration   **AE** - Aesthetic Objective   ****IHA** Requirement   *****USEPA** recomm.   **#** No. of Samples

Data is based on raw values for the most recent "full year" of data available. Obvious parameters like free and total chlorine, THM's etc… are based on treated.

5.3.3 GROUNDWATER WELLS – EXISTING WATER QUALITY

As summarized in Section 3, there are three wells owned by Summerland located in the Rodeo grounds above Summerland Reservoir. These are a back-up source for DoS and when utilized, they pump directly into the flume line and have limited capacity. These wells have not been utilized in the past 10 years.

The Rodeo well water quality is summarized on Table 5.7 with the following characteristics:

- Similar hardness to Garnett Valley Reservoir (150 – 160 mg/L as $CaCO_3$);
- pH measured between 7.80 and 8.10;
- Nitrate and phosphate concentrations at acceptable levels;
- Uranium levels in the well were consistently at a level of approximately half of the Maximum Acceptable Concentration (MAC) of < 0.02 mg/L. IHA had earlier provided instructions for the operation of the well to flush the wells prior to bringing them on-line and blending the water with Trout Creek water at a ratio to reduce raw water uranium levels;
- Low turbidity, low colour, high clarity and high UV transmissivity of over 90%;

The long-term utilization for these wells should be reviewed. The is an on-going cost for Summerland is to continue to operate and monitor the wells. Similarly, there is also a cost to properly decommission the three wells. The wells provide a small volume of water with the largest well producing only 4.3 L/s. This flow is only 370 m^3/day or 135 ML/year.

Legally, the all wells in the province now must be licensed. To license existing wells, the well owner must provide records of installation to obtain a priority date, and records of usage to obtain a volume of for well capacity and withdrawal volumes. As the wells have not been used and are for emergency supply purposes, there may be some challenges through the licensing process. Because the annual volumes are small and there are very few surrounding users, these issues should be resolvable.

5.3.4 OKANAGAN LAKE – EXISTING WATER QUALITY

Okanagan Lake is not yet a source for Summerland however planning work is underway to develop a domestic water supply intake at Powell Beach. Sampling work has been underway by Larratt Aquatic Consultants for water quality and assessing the length, depth, lake currents and water quality in the vicinity of the planned intake. This sampling has been collected monthly over a period of two years. The report from Larratt will be available in the near future. Preliminary information from that report was reviewed in this assessment.

For the development of a new surface water source, Interior Health has a new process that involves:

- Watershed characterization (e.g. hydrology, water quality, trends)
- Contaminant survey results that identify hazards in a watershed and have the potential to impact water quality;
- Risk characterization including consequences to drinking water;
- Source protection measures to be considered or implemented.

Interior Health require that the Comprehensive Drinking Water Source-to-Tap Assessment Guidelines be followed, specifically with the applicant addressing:

- Module 1, Delineate and Characterize drinking water source;
- Module 2, Conduct contaminant source inventory;
- Module 7, Characterize risks from source to tap, and
- Module 8, Recommend actions to improve drinking water protection.

Raw Water Chemical and Physical Parameters

Generally, Okanagan Lake water chemistry is excellent for potable water, with its low color, low turbidity, pH usually between 7.8 and 8.3 and low nutrient concentrations. A representative summary of water quality parameters is presented in Table 5.8.

The Larratt report reviews water quality over a 20 to 40 m depth range. The 20-metre depth allows the water intake to be below the summer thermocline. The 40 m depth evades summer seiches and is the lower limit to where local diving companies can reach.

Raw Water Biology

Okanagan Lake is oligotrophic. The number and type of algae found in Okanagan Lake provide excellent water quality for most of the year. Like most large temperate lakes, Okanagan Lake experiences peak algal production in the spring when nutrients and dissolved organic material are circulated to the surface water by the spring overturn. But unlike most large lakes, Okanagan Lake deviates from the typical summer algae populations of flagellates and green algae and instead develops colonial blue-green dominance by late June.

Based on the information from Larratt Aquatic, Okanagan lake water is of sufficiently high-water quality that the current plan for this source of disinfection with UV light followed by chlorination is still viable.

Table 5.5 Garnett Valley Raw Water Quality Parameters

W. QUALITY PARAMETER	Units	GCDWQ MAC regulations	1992-01-13	1992-02-22	1992-03-25	1992-04-27	1992-05-20	1992-06-23	1992-07-23	1992-08-20	1992-09-24	1992-10-21	1992-11-24	1992-12-14	1993-01-21	1993-02-11
			Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site
Anions																
Chloride	mg/L	AO < 250	1.9	2.3	3.5	2	1.9	2	3.1	1.7	2	2.2	1.7	2.3	3.5	3.7
Flouride	mg/L	MAC = 1.50														
Nitrate (as N)	mg/L	MAC = 10	0.02	0.11	0.46	< 0.01	< 0.01	0.2	< 0.01	0.19	0.02	0.21	0.09	0.09	0.12	0.94
Nitrite (as N)	mg/L	MAC = 1.00														
Sulfate	mg/L	AO<500	33.7	35	41	33.8	28.5	50	37.3	35	30	35	39	33	31	36
Calculated Parameters																
Total Trihalomethanes	mg/L	MAC=0.100														
Cation / Anion Balance		N/A														
Hardness, Total (as CaCO3)	mg/L	N/A														
Langlier Index		N/A														
Solids, Total Dissolved	mg/L	AO<500	160	174	202	154	158	214	184	190	138	194	166	154	162	220
General Parameters																
Alkalinity, Total (as CaCO3)	mg/L	N/A	120	120	118	110	114	148	164	174	160	172	134	123	150	143
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A														
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A														
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A														
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A														
Colour, True	mg/L	AO<15														
Conductivity (EC)	umhos/cm	N/A	295	305	342	271	274	329	283	293	285	254	305	284	310	343
Cyanide, Total	mg/L	MAC = 0.20														
pH	pH units	7.0-10.5	8.22	8.32	8.58	8.45	8.51	8.53	8.56	8.60	8.43	8.40	8.30	8.31	8.23	8.36
Temperature at pH	°C	N/A	2	3	10	10	14	24	22	22	16	12	4	5	0	6
Turbidity	NTU	OG<1.00														
UV transmittance	%															
Microbiological Parameters																
Coliforms, Total	CFU/100ml	MAC = 0														
Background Colonies	CFU/100ml	N/A														
E.Coli	CFU/100ml	MAC = 0														
Total Metals																
Aluminum, Total	mg/L	OG<1.00	0.013	0.034	0.009	0.016	0.017	0.012	0.022	0.039	0.024	0.018	0.041	0.021	0.353	0.019
Antimony, Total	mg/L	MAC=0.006														
Arsenic, Total	mg/L	MAC=0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Barium, Total	mg/L	MAC=1.00														
Beryllium																
Bismuth																
Boron, Total	mg/L	MAC=5														
Cadmium, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium, Total	mg/L	N/A	31	31	44	30	31	43	34	37	34	36	33	35	34	45
Chromium, Total	mg/L	MAC=0.05														
Cobalt, Total	mg/L	N/A														
Copper, Total	mg/L	MAC=2.00	< 0.001	0.005	0.003	0.003	0.001	0.003	0.002	0.001	0.002	0.003	< 0.001	0.002	< 0.001	< 0.001
Iron, Total	mg/L	MAC=0.30	0.026	0.051	0.019	0.011	0.011	0.023	0.061	0.073	0.061	0.037	0.11	**0.496**	**0.68**	0.051
Lead, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Lithium																
Magnesium, Total	mg/L	N/A	9.3	9.3	11.3	8.9	8.6	11.2	8.6	8.9	9.7	9.4	8.9	8.5	8.0	8.0
Manganese, Total	mg/L	MAC=0.120	0.001	0.001	0.003	0.005	0.002	0.009	0.004	0.005	0.004	0.002	0.003	0.013	0.019	0.003
Mercury, Total	mg/L	MAC=0.001														
Molybdenum, Total	mg/L	N/A	0.005	0.004	0.006	0.004	0.007	0.005	0.005	0.008	0.005	0.005	0.005	0.006	0.006	0.008
Nickel, Total	mg/L	N/A														
Phosphorus																
Potassium, Total	mg/L	N/A	2.2	2.2	2.8	2.1	2.2	2.9	2.5	2.6	2.4	2.4	2.9	2.7	2.8	2.8
Selenium, Total	mg/L	MAC=0.05														
Silicon																
Silver																
Sodium, Total	mg/L	AO<200	9.5	10.8	10.9	10.2	9.9	10.9	9.7	10.6	9.4	10.2	9.5	9.4	10.1	11.1
Strontium, Total	mg/L	7														
Sulphur																
Tellerium																
Thallium																
Thorium																
Tin																
Titanium																
Uranium, Total	mg/L	MAC=0.02														
Vanadium																
Zinc, Total	mg/L	AO<5	< 0.001	0.001	0.007	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.002	0.003	< 0.001
Zirconium																

W. QUALITY PARAMETER	Units	GCDWQ MAC regulations	1993-03-25	1993-04-19	1993-05-19	1993-06-23	1993-07-22	1993-08-18	1993-09-21	1993-10-19	1993-11-21	1993-12-16	1994-01-19	1994-04-18	1994-07-11	1994-10-19
			Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site	Summerld Forestry site
Anions																
Chloride	mg/L	AO < 250	2.9	1.7	1.8	2	1.7	2	2.2	1.9	2.1	2.4	2.8	3.6	2.5	1.9
Flouride	mg/L	MAC = 1.50														
Nitrate (as N)	mg/L	MAC = 10	0.28	0.09	0.05	< 0.01	0.01	< 0.01	0.21	0.14	0.21	0.09	0.45	0.75	0.04	0.07
Nitrite (as N)	mg/L	MAC = 1.00														
Sulfate	mg/L	AO<500	49	34	39	35	40	35	34	31	38	42	34	40	53	30
Calculated Parameters																
Total Trihalomethanes	mg/L	MAC=0.100														
Cation / Anion Balance		N/A														
Hardness, Total (as CaCO3)	mg/L	N/A														
Langlier Index		N/A														
Solids, Total Dissolved	mg/L	AO<500	200	162	148	164	162	154	176	200	190	154	220	214	182	170
General Parameters																
Alkalinity, Total (as CaCO3)	mg/L	N/A	131	112	108	103	104	103	119	123	118	111	108	113	104	108
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A														
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A														
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A														
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A														
Colour, True	mg/L	AO<15														
Conductivity (EC)	umhos/cm	N/A	351	290	284	274	277	275	300	308	315	298	346	361	321	289
Cyanide, Total	mg/L	MAC = 0.20														
pH	pH units	7.0-10.5	8.45	8.46	8.41	8.39	8.40	8.42	8.41	8.43	8.25	8.03	8.12	8.17	8.13	8.04
Temperature at pH	°C	N/A	8	9	14	20	19	21	15	13	7	5				
Turbidity	NTU	OG<1.00														
UV transmittance	%															
Microbiological Parameters																
Coliforms, Total	CFU/100ml	MAC = 0														
Background Colonies	CFU/100ml	N/A														
E.Coli	CFU/100ml	MAC = 0														
Total Metals																
Aluminum, Total	mg/L	OG<1.00	76	0.008	0.268	0.019	0.049	0.019	0.022	0.043	0.022	0.005	0.01	0.03	0.021	0.014
Antimony, Total	mg/L	MAC=0.006														
Arsenic, Total	mg/L	MAC=0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Barium, Total	mg/L	MAC=1.00														
Beryllium																
Bismuth																
Boron, Total	mg/L	MAC=5														
Cadmium, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium, Total	mg/L	N/A	42	32	37	34	34	34	35	39	38	37	44	41	34	33
Chromium, Total	mg/L	MAC=0.05														
Cobalt, Total	mg/L	N/A														
Copper, Total	mg/L	MAC=2.00	0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Iron, Total	mg/L	MAC=0.30	0.131	0.002	0.039	0.035	0.123	0.017	0.033	0.11	0.036	0.009	0.025	0.055	0.029	0.034
Lead, Total	mg/L	MAC=0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Lithium																
Magnesium, Total	mg/L	N/A	12.1	8.9	10.4	9.8	10.4	9.0	9.7	9.7	9.8	9.0	9.0	7.0	11.4	9.6
Manganese, Total	mg/L	MAC=0.120	0.006	0.001	0.004	0.007	0.009	0.006	0.002	0.005	0.003	0.002	0.002	0.004	0.011	0.003
Mercury, Total	mg/L	MAC=0.001														
Molybdenum, Total	mg/L	N/A	0.008	0.006	0.007	0.004	0.005	0.005	0.006	0.005	0.006	0.006	0.008	0.006	0.004	0.005
Nickel, Total	mg/L	N/A														
Phosphorus																
Potassium, Total	mg/L	N/A	3.2	2.6	2.6	2.5	2.8	2.7	2.6	3.0	2.7	2.5	3	2.8	2.4	2.3
Selenium, Total	mg/L	MAC=0.05														
Silicon																
Silver																
Sodium, Total	mg/L	AO<200	10.7	9.8	9.6	9.2	9.4	9.2	9.8	9.2	10.0	9.0	10.4	10.8	9.8	9.6
Strontium, Total	mg/L	7														
Sulphur																
Tellerium																
Thallium																
Thorium																
Tin																
Titanium																
Uranium, Total	mg/L	MAC=0.02														
Vanadium																
Zinc, Total	mg/L	AO<5	0.001	< 0.001	0.001	0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Zirconium																

Table 5.6 Garnett Valley Treated Water Quality Parameters

TREATED WATER

W. QUALITY PARAMETER	Units	GCDWQ MAC regulations	GV Spray floor 2002-05-28	GV Spray floor 2002-11-05	GV Spray floor 2003-05-27	GV Spray floor 2003-10-16	GV Spray floor 2004-05-03	GV Spray floor 2004-10-07	GV Spray floor 2005-07-13	GV Spray floor 2005-12-08	GV Spray floor 2006-05-24	GV Spray floor 2006-10-25	GV Spray floor 2007-05-17	GV Spray floor 31-Oct-07	GV Spray floor 2008-02-21
Anions															
Chloride	mg/L	AO < 250	5	4.6	4.5	5.69	5.08	4.62	4.72	7.45	5.29	5.47	4.6	4.28	5.36
Flouride	mg/L	MAC = 1.50	0.23	0.23	0.28	0.291	0.317	0.319	0.323	0.346	0.32	0.316	0.268	0.29	0.28
Nitrate (as N)	mg/L	MAC = 10	<0.005	0.031	0.005	0.024	<0.0050	<0.0050	<0.0050	0.0298	< 0.005	<0.0050	0.0058	<0.010	0.168
Nitrite (as N)	mg/L	MAC = 1.00	0.002	<0.001	0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.002	<0.0010	<0.0010	<0.010	<0.010
Sulfate	mg/L	AO<500	9	9	9	9.2	9.2	9.6	11.2	11.1	11.2	9.97	10.1	10.5	11
Calculated Parameters															
Total Trihalomethanes	mg/L	MAC=0.100													
Cation / Anion Balance		N/A													
Hardness, Total (as CaCO3)	mg/L	N/A	156	163	155	156	165	159	171	170	156	155	168	166	172
Langlier Index		N/A													
Solids, Total Dissolved	mg/L	AO<500	196	196	192	214	222	197	178	216	220	197	207	217	205
General Parameters															
Alkalinity, Total (as CaCO3)	mg/L	N/A	163	173	166	171	188	165	161	191	158	187	176	161	177
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A													
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A													
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A													
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A													
Colour, True	mg/L	AO<15	<5	<5	<5	<5.0	<5.0	<5.0	<5.0	<5.0	< 5	<5.0	<5.0	<5	<5
Conductivity (EC)	umhos/cm	N/A	333	338	335	348	364	343	328	358	320	328	336	322	368
Cyanide, Total	mg/L	MAC = 0.20	<0.005	<0.005	0.017	0.0096	<0.0050	<0.0050	<0.0050	<0.0050	< 0.01	0.0057	0.0061	<0.01	<0.01
pH	pH units	7.0-10.5	8.2	8.1	8.18	8.27	8.17	8.23	8.27	7.85	8.16	8.2	8.34	7.5	7.7
Temperature at pH	°C	N/A													
Turbidity	NTU	OG<1.00	1.8	0.6	3	0.49	6.54	2.31	2.40	0.92	0.45	0.62	1.39	0.7	0.3
UV transmittance	%														
Microbiological Parameters															
Coliforms, Total	CFU/100ml	MAC = 0													
Background Colonies	CFU/100ml	N/A													
E.Coli	CFU/100ml	MAC = 0													
Total Metals															
Aluminum, Total	mg/L	OG<1.00	0.02	<0.01	0.02	<0.010	0.078	0.020	<0.010	<0.010	0.007	<0.010	0.011	<0.01	<0.05
Antimony, Total	mg/L	MAC=0.006	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	< 0.001	<0.00050	<0.00050	<0.0006	<0.0030
Arsenic, Total	mg/L	MAC=0.01	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	0.00053	0.00058	< 0.001	0.00054	0.00046	<0.001	<0.005
Barium, Total	mg/L	MAC=1.00	0.04	0.05	0.04	0.045	0.049	0.046	0.037	0.049	0.042	0.044	0.043	0.049	0.053
Beryllium															
Bismuth															
Boron, Total	mg/L	MAC=5	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	< 0.05	<0.10	<0.10	0.005	<0.020
Cadmium, Total	mg/L	MAC=0.005	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.00004	<0.00020	<0.00020	<0.00002	<0.00010
Calcium, Total	mg/L	N/A	49.5	52.4	48.2	48.6	52.9	50.0	55.0	54.1	50	49.6	54.8	51.9	55.8
Chromium, Total	mg/L	MAC=0.05	<0.002	<0.002	<0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	< 0.001	<0.0020	<0.0020	0.002	<0.015
Cobalt, Total	mg/L	N/A													
Copper, Total	mg/L	MAC=2.00	<0.01	<0.01	<0.01	0.011	<0.010	0.015	0.0028	0.0207	0.004	0.0112	0.0045	0.017	0.0124
Iron, Total	mg/L	MAC=0.30	<0.03	<0.03	<0.03	<0.030	0.075	<0.030	<0.030	<0.030	< 0.05	<0.030	<0.030	0.16	<0.20
Lead, Total	mg/L	MAC=0.005	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	0.0003	<0.0010
Lithium															
Magnesium, Total	mg/L	N/A	7.8	7.7	8.5	8.35	7.97	8.22	8.31	8.53	7.45	7.59	7.66	8.92	8
Manganese, Total	mg/L	MAC=0.120	0.015	0.02	0.007	0.0125	0.0291	0.0092	0.0041	0.0383	0.007	0.0054	0.0068	0.017	0.013
Mercury, Total	mg/L	MAC=0.001	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	< 0.02	<0.00020	<0.00020	<0.00005	<0.00030
Molybdenum, Total	mg/L	N/A	0.004	0.004	0.004	0.0047	0.0038	0.0042		0.0041	0.0037			0.0040	0.0042
Nickel, Total	mg/L	N/A													
Phosphorus															
Potassium, Total	mg/L	N/A	2.2	2.5	2.3	2.63	2.31	2.44	2.22	2.50	2.1	2.31	2.3	2.74	2.41
Selenium, Total	mg/L	MAC=0.05	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	< 0.001	<0.0010	<0.0010	<0.001	<0.005
Silicon															
Silver															
Sodium, Total	mg/L	AO<200	8.0	9.0	8.0	8.9	8.4	8.4	7.3	8.4	7.6	8.7	8.4	8.90	8.0
Strontium, Total	mg/L	7													
Sulphur															
Tellerium															
Thallium															
Thorium															
Tin															
Titanium															
Uranium, Total	mg/L	MAC=0.02	0.0093	0.0089	0.0089	0.00992	0.00952	0.00885	0.00807	0.00951	0.0084	0.00829	0.00884	0.0083	0.0096
Vanadium															
Zinc, Total	mg/L	AO<5	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	< 0.005	<0.050	<0.050	0.005	<0.030
Zirconium															
Volatile Organic Compounds (VOC)															
Bromodichloromethane	mg/L														
Bromoform	mg/L														
Chloroform	mg/L														
Dibromochloromethane	mg/L														
Total Trihalomethanes	mg/L	MAC = 0.100													
Surrogate: Toluene-d8	%														
Surrogate: 4-Bromofluorobenzene	%														
Radioactivity Parameter															
Gross Alpha Activity	Bq/L	MAC = 0.5													
Gross Beta Activity	Bq/L	MAC = 1													

W. QUALITY PARAMETER	Garnett/MSP 2011-06-14	Garnett/MSP 2011-11-14	Garnett/MSP 2012-05-30	Garnett/MSP 2012-09-25	Garnett/MSP 2013-05-28	Garnett/MSP 2013-09-18	Garnett/MSP 2014-05-27	Garnett/MSP 2014-10-09	Garnett/MSP 2015-05-15	Garnett/MSP 2015-10-21	Garnett/MSP 2016-05-17	Garnett/MSP 2016-09-28	Garnett/MSP 2017-03-27	Garnett/MSP 2017-08-31	Garnett/MSP 2018-06-29	Garnett/MSP 2018-09-04	Garnett/MSP 2019-04-15
Anions																	
Chloride	4.83	5.25	4.61	4.66	4.54	4.00	1.60	4.69	5.38	5.74	5.83	5.68	6.47	5.14	4.95	5.77	4.04
Flouride	0.23	0.19	0.18	< 0.10	0.19	0.24	0.15	0.21	0.21	0.22	0.27	0.15	0.26	0.36	0.28	0.35	0.29
Nitrate (as N)	< 0.01	0.020	< 0.010	< 0.010	< 0.010	< 0.010	0.205	< 0.010	< 0.010	< 0.010	< 0.010	0.030	0.161	< 0.010	< 0.010	< 0.010	0.132
Nitrite (as N)	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.026	< 0.010
Sulfate	8.6	9.4	10.1	9.9	9.2	9.2	14.9	10.8	12.2	9.2	11.6	11.8	10.9	12.2	14	16.5	13.9
Calculated Parameters																	
Total Trihalomethanes				0.029	0.074	0.066	0.040	0.049	0.033	0.056	0.061	0.052	0.0385	0.0831	0.0713		
Cation / Anion Balance				109											-5.35		
Hardness, Total (as CaCO3)	147	172	152	150	154	131	165	147	190	157	165	151	166	153	167		168
Langlier Index												0.3	0.5	0.4	2.6		0.8
Solids, Total Dissolved	187	182	172	164	172	147	173	161	203	169	180	170	197	170	204		214
General Parameters																	
Alkalinity, Total (as CaCO3)	141	155.0	152	140	151.0	127.0	155.0	135.0	169.0	139.0	148.0	142	176.0	140.0	186	163	201.0
Alkalinity, Phenolphthalein (as CaCO3)												< 1.0	< 1	< 1.0	< 1.0	< 1.0	< 1.0
Alkalinity, Bicarbonate (as CaCO3)												142	176.0	140.0	186	163	1201.0
Alkalinity, Carbonate (as CaCO3)												< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Alkalinity, Hydroxide (as CaCO3)												< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Colour, True	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	< 5	< 5	7	< 5.0	8.5	< 5.0	< 5.0	5.7
Conductivity (EC)	285	327	329	297	310	274	324	299	328	298	301	304	363	302	346	348	384
Cyanide, Total	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
pH	7.85	8.03	8.15	8.04	7.97	8.15	7.83	7.99	8.08	7.93	7.91	7.99	7.93	8.06	7.92	7.96	8.21
Temperature at pH												21	23	22	0.0	23.0	22
Turbidity	0.8	0.7	0.9	0.5	0.7	0.3	0.5	0.40	1.00	0.40	0.60	0.38	0.45	0.66	1.21	0.53	0.78
UV transmittance	76.0	90.2	93.0	92.8	86.1	91.2	98.7	93.2	93.8	92.8	85.6						
Microbiological Parameters																	
Coliforms, Total		< 1	< 1	< 1	< 1	< 1	< 1	<1	<1	<1	<1		<1	<1	> 4	<1	
Background Colonies															> 200		
E.Coli		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	
Total Metals																	
Aluminum, Total	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.050	< 0.005	0.0056	0.0246	< 0.0050	< 0.0050
Antimony, Total	< 0.0010	< 0.0200	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0001	< 0.00020	< 0.00020	< 0.00020	< 0.00020
Arsenic, Total	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.00050	0.00055	0.00065	0.00067	< 0.00050
Barium, Total	0.052	0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.050	< 0.05	< 0.05	< 0.050	0.049	0.0426	0.0455	0.0493	0.0529
Beryllium	< 0.0010	< 0.0010	< 0.001	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.001	< 0.001						
Bismuth	< 0.0010	< 0.0010	< 0.001														
Boron, Total	< 0.040	< 0.040	< 0.04	< 0.04	< 0.040	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	< 0.04	< 0.040	0.006	0.0141	0.0153	< 0.0050	< 0.0050
Cadmium, Total	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	<0.000010	< 0.000010	0.000012	< 0.000010	< 0.000010
Calcium, Total	48.4	54.0	48.0	46.0	50.0	42.0	54.3	45.3	61.3	47.6	53.6	46.3	52.4	46.1	54.4	50.2	53.0
Chromium, Total	< 0.00050	< 0.00050	< 0.005	< 0.005	< 0.00050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00050	0.0005	< 0.00050	< 0.00050	0.0005	< 0.00050
Cobalt, Total	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00050	< 0.00010	< 0.00010	< 0.00050	< 0.00010	< 0.00010
Copper, Total	0.0219	0.0252	0.026	0.024	0.011	0.119	0.034	0.044	0.029	0.035	0.016	0.0243	0.0365	0.00238	0.0234	0.0182	0.00404
Iron, Total	< 0.10	< 0.10	< 0.1	< 0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.010	< 0.010	0.030	< 0.010	0.044
Lead, Total	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.0010	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	0.0002	< 0.00020	0.00027	< 0.00020	0.00025
Lithium	0.0042	0.0050	0.005														
Magnesium, Total	6.35	8.89	8.0	8.3	7.20	6.50	7.1	8.1	9.1	9.4	7.5	8.59	8.45	9.12	7.65	8.93	8.66
Manganese, Total	0.0089	0.0288	0.0120	0.0090	0.009	0.004	0.009	0.007	0.014	0.006	0.008	0.0071	0.0100	0.0119	0.0203	0.00888	0.0249
Mercury, Total	< 0.00020	< 0.00020	< 0.0002	< 0.0002	< 0.00020	< 0.0002	< 0.0002	< 0.0002	< 0.00002	< 0.0002	< 0.00002	< 0.00020	< 0.000040	< 0.000010	< 0.000010	< 0.000010	< 0.00040
Molybdenum, Total	0.0032	0.0064	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.0040	0.0030	0.00404	0.00473	0.00498	0.0046
Nickel, Total	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.0020	< 0.0020	< 0.0020	< 0.002	0.003	< 0.002	< 0.002	< 0.0020	< 0.00040	< 0.00040	< 0.00040	0.00043	0.00093
Phosphorus	< 0.20	< 0.20	< 0.2	< 0.2	< 0.20	< 0.20	< 0.20	< 0.2	< 0.2	< 0.2	< 0.2						
Potassium, Total	1.76	2.38	2.2	2.1	2.30	1.80	1.2	2.1	2.7	2.6	2.4	2.31	2.52	2.20	2.41	2.2	2.33
Selenium, Total	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0050	<0.00050	<0.00050	< 0.00050	< 0.00050	< 0.00050
Silicon	< 5.0	9.4	6.0	< 5	8.0	7.0	8.0	10	8	11	9						
Silver	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005						
Sodium, Total	6.10	8.54	6.2	8.0	7.10	6.40	6.70	7.6	8.9	9.7	8.5	8.89	8.62	9.13	7.62	9.22	853
Strontium, Total	0.312	0.44	0.41												0.403	0.456	0.485
Sulphur			< 10														
Tellerium	< 0.0020	< 0.0020	< 0.002														
Thallium	< 0.00020	< 0.00020	< 0.0002														
Thorium	< 0.0010	< 0.0010	< 0.001														
Tin	< 0.0020	< 0.0020	< 0.002														
Titanium	< 0.050	< 0.050	< 0.05														
Uranium, Total	0.00564	0.00756	0.0070	0.0076	0.00680	0.0058	0.0081	0.0074	0.0098	0.0097	0.007	0.00758	0.00777	0.00830	0.00915	0.0109	0.0127
Vanadium	< 0.010	< 0.010	0.004	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01						
Zinc, Total	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	0.07	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.0040	0.010	< 0.0040	0.0094	0.0043	0.0121
Zirconium	< 0.0010	< 0.0010	< 0.001														
Volatile Organic Compounds (VOC)																	
Bromodichloromethane			0.004	0.004	0.006	0.008	0.004	0.008	0.005	0.009	0.004	0.008	0.007	0.0091	0.0049		
Bromoform			< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	< 0.0010		
Chloroform		missing	0.033	0.024	0.068	0.058	0.036	0.041	0.028	0.047	0.057	0.044	0.031	0.0740	0.0664		
Dibromochloromethane		file	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.001	< 0.0010	< 0.0010		
Total Trihalomethanes			0.037	0.029	0.074	0.066	0.040	0.049	0.033	0.056	0.061	0.052	0.0385	0.0831	0.0713		
Surrogate: Toluene-d8			*86*	*67*	*87*	*99*	*101*	*98*	*94*	*104*	*82*	*100*	*79*	*98*	*75*		
Surrogate: 4-Bromofluorobenzene			*89*	*71*	*86*	*95*	*97*	*89*	*81*	*81*	*80*	*90*	*94*	*113*	*78*		
Radioactivity Parameter																	
Gross Alpha Activity																0.17	
Gross Beta Activity																0.15	

*OGV - Operational Guidance Value (Health Canada)   **MAC** - Max. Acceptable Concentration   **AE** - Aesthetic Objective   ****IHA** Requirement   *****USEPA** recomm.   **#** No. of Samples

Data is based on raw values for the most recent "full year" of data available. Obvious parameters like free and total chlorine, THM's etc… are based on treated.

5.3.3 GROUNDWATER WELLS – EXISTING WATER QUALITY

As summarized in Section 3, there are three wells owned by Summerland located in the Rodeo grounds above Summerland Reservoir. These are a back-up source for DoS and when utilized, they pump directly into the flume line and have limited capacity. These wells have not been utilized in the past 10 years.

The Rodeo well water quality is summarized on Table 5.7 with the following characteristics:

- Similar hardness to Garnett Valley Reservoir (150 – 160 mg/L as $CaCO_3$);
- pH measured between 7.80 and 8.10;
- Nitrate and phosphate concentrations at acceptable levels;
- Uranium levels in the well were consistently at a level of approximately half of the Maximum Acceptable Concentration (MAC) of < 0.02 mg/L. IHA had earlier provided instructions for the operation of the well to flush the wells prior to bringing them on-line and blending the water with Trout Creek water at a ratio to reduce raw water uranium levels;
- Low turbidity, low colour, high clarity and high UV transmissivity of over 90%;

The long-term utilization for these wells should be reviewed. The is an on-going cost for Summerland is to continue to operate and monitor the wells. Similarly, there is also a cost to properly decommission the three wells. The wells provide a small volume of water with the largest well producing only 4.3 L/s. This flow is only 370 m^3/day or 135 ML/year.

Legally, the all wells in the province now must be licensed. To license existing wells, the well owner must provide records of installation to obtain a priority date, and records of usage to obtain a volume of for well capacity and withdrawal volumes. As the wells have not been used and are for emergency supply purposes, there may be some challenges through the licensing process. Because the annual volumes are small and there are very few surrounding users, these issues should be resolvable.

5.3.4 Okanagan Lake – Existing Water Quality

Okanagan Lake is not yet a source for Summerland however planning work is underway to develop a domestic water supply intake at Powell Beach. Sampling work has been underway by Larratt Aquatic Consultants for water quality and assessing the length, depth, lake currents and water quality in the vicinity of the planned intake. This sampling has been collected monthly over a period of two years. The report from Larratt will be available in the near future. Preliminary information from that report was reviewed in this assessment.

For the development of a new surface water source, Interior Health has a new process that involves:

- Watershed characterization (e.g. hydrology, water quality, trends)
- Contaminant survey results that identify hazards in a watershed and have the potential to impact water quality;
- Risk characterization including consequences to drinking water;
- Source protection measures to be considered or implemented.

Interior Health require that the Comprehensive Drinking Water Source-to-Tap Assessment Guidelines be followed, specifically with the applicant addressing:

- Module 1, Delineate and Characterize drinking water source;
- Module 2, Conduct contaminant source inventory;
- Module 7, Characterize risks from source to tap, and
- Module 8, Recommend actions to improve drinking water protection.

Raw Water Chemical and Physical Parameters

Generally, Okanagan Lake water chemistry is excellent for potable water, with its low color, low turbidity, pH usually between 7.8 and 8.3 and low nutrient concentrations. A representative summary of water quality parameters is presented in Table 5.8.

The Larratt report reviews water quality over a 20 to 40 m depth range. The 20-metre depth allows the water intake to be below the summer thermocline. The 40 m depth evades summer seiches and is the lower limit to where local diving companies can reach.

Raw Water Biology

Okanagan Lake is oligotrophic. The number and type of algae found in Okanagan Lake provide excellent water quality for most of the year. Like most large temperate lakes, Okanagan Lake experiences peak algal production in the spring when nutrients and dissolved organic material are circulated to the surface water by the spring overturn. But unlike most large lakes, Okanagan Lake deviates from the typical summer algae populations of flagellates and green algae and instead develops colonial blue-green dominance by late June.

Based on the information from Larratt Aquatic, Okanagan lake water is of sufficiently high-water quality that the current plan for this source of disinfection with UV light followed by chlorination is still viable.

Table 5.7 Rodeo Well - Raw Water Quality Parameters

			TREATED WATER							
			Rodeo	Rodeo	Rodeo	Rodeo	Rodeo	Rodeo	Rodeo	Rodeo
W. QUALITY PARAMETER	Units	GCDWQ Parameters for MACs	2011-06-14	2011-11-14	2012-05-30	2012-09-25	2013-05-28	2013-09-18	2014-05-27	2019-04-15
Ave. or Most Recent Samples										
Anions										
Chloride	mg/L	AO < 250	1.62	1.54	1.57	1.58	1.72	1.62	3.74	1.87
Flouride	mg/L	MAC = 1.50	0.18	0.14	0.10	< 0.10	0.14	0.16	0.22	0.16
Nitrate (as N)	mg/L	MAC = 10	0.17	0.180	0.161	0.121	0.168	0.194	< 0.010	0.222
Nitrite (as N)	mg/L	MAC = 1.00	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Sulfate	mg/L	AO<500	15.6	15.6	15.9	16.5	15.1	15.8	9.7	14.8
Calculated Parameters										
Total Trihalomethanes	mg/L	MAC=0.100	**0.11**							
Cation / Anion Balance		N/A				105				
Hardness, Total (as CaCO3)	mg/L	N/A	161	160	145	159	153	153	153	133
Langlier Index		N/A								0.5
Solids, Total Dissolved	mg/L	AO<500	190	182	172	187	184	189	181	178
General Parameters										
Alkalinity, Total (as CaCO3)	mg/L	N/A	162	155.0	146	158	158.0	168.0	148.0	164.0
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	N/A								< 1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	N/A								164.0
Alkalinity, Carbonate (as CaCO3)	mg/L	N/A								< 1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	N/A								< 1.0
Colour, True	mg/L	AO<15	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0
Conductivity (EC)	umhos/cm	N/A	324	324	322	326	329	332	315	316
Cyanide, Total	mg/L	MAC = 0.20	< 0.01	< 0.01	< 0.010	< 0.010	< 0.010	< 0.010		< 0.0020
pH	pH units	7.0-10.5	7.86	8.08	8.06	7.98	7.57	8.07	7.96	8.13
Temperature at pH	^{o}C	N/A								21.6
Turbidity	NTU	OG<1.00	0.6	0.2	0.1	0.5	0.3	0.3	0.9	0.54
UV transmittance	%		90.7	98.5	95.0	98.3	97.9	98.7	90.8	
Microbiological Parameters										
Coliforms, Total	CFU/100ml	MAC = 0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Background Colonies	CFU/100ml	N/A								
E.Coli	CFU/100ml	MAC = 0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Total Metals										
Aluminum, Total	mg/L	OG<1.00	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.0074
Antimony, Total	mg/L	MAC=0.006	< 0.0010	< 0.0200	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00020
Arsenic, Total	mg/L	MAC=0.01	< 0.0050	< 0.0050	< 0.005	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.00050
Barium, Total	mg/L	MAC=1.00	0.083	0.066	0.07	0.07	0.070	0.07	0.06	0.0640
Beryllium			< 0.0010	< 0.0010	< 0.001	< 0.0010	< 0.0010	< 0.0010	< 0.0010	
Bismuth			< 0.0010	< 0.0010	< 0.001					
Boron, Total	mg/L	MAC=5	< 0.040	< 0.040	< 0.04	< 0.04	< 0.040	< 0.040	< 0.040	0.0052
Cadmium, Total	mg/L	MAC=0.005	< 0.00010	< 0.00010	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.00010	<0.000010
Calcium, Total	mg/L	N/A	50.0	49.7	43.0	49.0	47.0	48.0	47.6	40.5
Chromium, Total	mg/L	MAC=0.05	< 0.00050	< 0.00050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	0.00066
Cobalt, Total	mg/L	N/A	< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	< 0.00010
Copper, Total	mg/L	MAC=2.00	0.0180	0.0082	0.128	0.072	0.027	0.028	0.047	0.0164
Iron, Total	mg/L	MAC=0.30	< 0.10	< 0.10	< 0.1	< 0.1	< 0.10	< 0.10	< 0.10	0.050
Lead, Total	mg/L	MAC=0.005	< 0.0010	< 0.0010	< 0.001	< 0.001	< 0.0010	0.004	< 0.001	<0.00020
Lithium			0.0041	0.0035	0.004					
Magnesium, Total	mg/L	N/A	8.63	8.78	8.9	8.9	8.70	7.70	8.4	7.69
Manganese, Total	mg/L	MAC=0.120	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.002	0.004	< 0.002	0.00086
Mercury, Total	mg/L	MAC=0.001	< 0.00020	< 0.00020	< 0.0002	< 0.0002	< 0.00020	< 0.0002	< 0.0002	< 0.000040
Molybdenum, Total	mg/L	N/A	0.0077	0.0081	0.008	0.007	0.008	0.008	0.007	0.00752
Nickel, Total	mg/L	N/A	< 0.0020	< 0.0020	< 0.002	< 0.002	< 0.0020	< 0.0020	< 0.0020	< 0.00040
Phosphorus			< 0.20	< 0.20	< 0.2	< 0.2	< 0.20	< 0.20	< 0.20	
Potassium, Total	mg/L	N/A	2.82	2.54	3.1	3.0	3.10	2.70	2.8	2.64
Selenium, Total	mg/L	MAC=0.05	< 0.0050	< 0.0050	< 0.005	< 0.005	< 0.0050	< 0.0050	< 0.0050	<0.00050
Silicon			5.5	7.6	7.0	< 5	8.0	7.0	8.0	
Silver			< 0.00050	< 0.00050	< 0.0005	< 0.0005	< 0.00050	< 0.00050	< 0.00050	
Sodium, Total	mg/L	AO<200	10.7	10.30	9.4	10.8	10.60	9.50	10.10	9.57
Strontium, Total	mg/L	7	0.394	0.405	0.42					0.410
Sulphur					< 10					
Tellerium			< 0.0020	< 0.0020	< 0.002					
Thallium			< 0.00020	< 0.00020	< 0.0002					
Thorium			< 0.0010	< 0.0010	< 0.001					
Tin			< 0.0020	< 0.0020	< 0.002					
Titanium			< 0.050	< 0.050	< 0.05					
Uranium, Total	mg/L	MAC=0.02	0.00923	0.00939	0.0080	0.0093	0.0088	0.0087	0.0082	0.00923
Vanadium			< 0.010	< 0.010	0.006	< 0.01	< 0.01	< 0.01	< 0.01	
Zinc, Total	mg/L	AO<5	< 0.040	< 0.040	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.0042
Zirconium			< 0.0010	< 0.0010	< 0.001					
Volatile Organic Compounds (VOC)										
Bromodichloromethane	mg/L		0.006							
Bromoform	mg/L		< 0.001							
Chloroform	mg/L		0.099							
Dibromochloromethane	mg/L		< 0.001							
Total Trihalomethanes	mg/L	MAC = 0.100	**0.11**							
Surrogate: Toluene-d8	%									
Surrogate: 4-Bromofluorobenzene	%		*85*							
Radioactivity Parameter										
Gross Alpha Activity	Bq/L	MAC = 0.5								
Gross Beta Activity	Bq/L	MAC = 1								

***OGV** - Operational Guidance Value (Health Canada) **MAC** - Max. Acceptable Concentration **AE** - Aesthetic Objective ****IHA** Requirement *****USEPA** recomm. **#** No. of Samples

Data is based on raw values for the most recent "full year" of data available. Obvious parameters like free and total chlorine, THM's etc… are based on treated.

Table 5.8 Okanagan Lake - Powell Beach Point at Depth

RAW WATER @ 20 metre depth

WATER QUALITY PARAMETER	Units	GCDWQ Regulation	20m Site 2018-10-03	20m Site 2018-11-06	20m Site 2018-12-03	20m Site 2019-01-14	20m Site 2019-03-21	20m Site 2019-04-15	20m Site 2019-05-01	20m Site 2019-05-23	20m Site 2019-06-05	20m Site 2019-07-09	20m Site 2019-08-06	20m Site 2019-09-13
Hardness, Total (as CaCO3)	mg/L	N/A	114	116	126	121	116	110	119	125	118	113	108	121
General Parameters														
Total Organic Carbon	mg/L	N/A	5.34	4	4.15	4.27	4.02	4.2	4.3	4.46	4.3	4.36	4.14	4.29
Total Dissolved Organic Carbon	mg/L	n/a	5	3.9	3.85	3.76	3.9	3.95	4.12	4.03	4.02	4.3	3.84	3.96
Colour, True	mg/L	AO<15	<5.0	<5.0	6.1	<5.0	7.9	<5.0	<5.0	<5.0	<5.0	7.1	<5.0	6.8
Conductivity (EC)	umhos/cm	N/A	283	277	269	282	278	282	264	273	272	282	277	268
pH	pH units	7.0-10.5	8.07	8.05	7.98	8.1	8.13	8.22	8.2	8.23	8.16	8.17	8.14	8.09
Turbidity	NTU	OG<1.00	0.47	0.2	0.26	0.26	0.35	0.38	0.35	0.43	0.31	0.38	0.4	0.42
UV transmittance	%		80.5	85.1	85	NA	86.2	84.3	85.6	86.4	85.4	85.2	84.8	84.4
Microbiological Parameters														
Coliforms, Total	CFU/100ml	MAC = 0	>= 1	5	>= 1	<1	1	<1	<1	<1	<1	<1	>= 3	>= 3
Background Colonies	CFU/100ml	N/A	> 200	NA	> 200	> 200	NA	NA	NA	NA	NA	> 200	> 200	> 200
E.Coli	CFU/100ml	MAC = 0	1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	2
Total Metals														
Aluminum, Total	mg/L	OG<1.00	1.08E-02	5.80E-03	5.70E-03	<0.0050	9.10E-03	1.66E-02	5.30E-03	9.90E-03	5.30E-03	5.20E-03	6.30E-03	<0.0050
Antimony, Total	mg/L	MAC=0.006	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	3.00E-04	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, Total	mg/L	MAC=0.01	<0.00050	5.50E-04	5.70E-04	5.30E-04	6.50E-04	<0.00050	5.00E-04	5.60E-04	5.70E-04	5.40E-04	5.90E-04	<0.00050
Barium, Total	mg/L	MAC=1.00	0.0217	0.0225	0.0243	0.0233	0.0218	0.0218	0.0226	0.0219	0.021	0.023	0.0226	0.0255
Beryllium	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron, Total	mg/L	MAC=5	0.0143	0.017	0.0143	0.0092	0.0139	0.0128	0.012	0.0163	0.0204	0.0119	0.0102	0.0159
Cadmium, Total	mg/L	MAC=0.005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	1.30E-05	<0.000010	<0.000010	1.20E-05	1.00E-05	<0.000010
Calcium, Total *(Dissolved, Ital.)*	mg/L	N/A	31.2	31.1	34.3	32.8	29	28.8	32.5	34.2	31.3	30.1	30.1	32.7
Chromium, Total	mg/L	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	8.00E-04	7.70E-04	7.00E-04	8.90E-04	8.10E-04	<0.00050	<0.00050
Cobalt, Total	mg/L	N/A	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper, Total	mg/L	MAC=2.00	0.00068	0.00075	0.00083	0.00145	0.00095	0.00111	0.00126	0.00104	0.00105	0.00309	0.00086	0.00085
Iron, Total	mg/L	MAC=0.30	<0.010	<0.010	<0.010	<0.010	<0.010	1.40E-02	0.01	1.10E-02	1.30E-02	<0.010	<0.010	1.50E-02
Lead, Total	mg/L	MAC=0.005	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	mg/L		0.0037	0.00365	0.00364	0.00331	0.00325	0.00338	0.00342	0.00356	0.00375	0.00357	0.00322	0.00339
Magnesium, Total *(Dissolved, Ital.)*	mg/L	N/A	8.75	9.41	9.84	9.51	10.5	9.17	9.25	9.71	9.75	9.15	8.02	9.62
Manganese, Total	mg/L	MAC=0.120	0.00107	0.00092	0.00074	0.00078	0.00103	0.00098	0.00109	0.0011	0.00045	0.00139	0.00119	0.00145
Mercury, Total	mg/L	MAC=0.001	NA	NA	<0.000010	<0.000040	1.22E-04	<0.000040	<0.000040	<0.000040	<0.000040	NA	NA	NA
Molybdenum, Total	mg/L	N/A	0.00349	0.00353	0.00372	0.00357	0.00376	0.0037	0.00368	0.00358	0.00349	0.00372	0.00329	0.00378
Nickel, Total	mg/L	N/A	5.50E-04	<0.00040	4.10E-04	<0.00040	<0.00040	1.28E-03	4.20E-04	4.90E-04	4.90E-04	4.30E-04	4.10E-04	4.40E-04
Phosphorus	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium, Total *(Dissolved, Ital.)*	mg/L	N/A	2.05	2.3	2.6	2.19	2.41	2.21	2.37	2.4	2.39	2.28	2.15	2.21
Selenium, Total	mg/L	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon	mg/L		3.6	4.3	4	3.5	4	3.8	3.8	3.7	3.7	3.9	3.4	3.5
Silver	mg/L		5.80E-05	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	8.00E-05
Sodium, Total *(Dissolved, Ital.)*	mg/L	AO<200	10.5	11.2	11.8	11.5	12.2	11	11.7	11.6	12.6	10.6	9.54	11.3
Strontium, Total	mg/L	7	0.26	0.247	0.287	0.264	0.276	0.268	0.284	0.278	0.269	0.291	0.267	0.278
Sulphur	mg/L		8.1	10.2	11.2	7.9	10.5	10	10.2	11.9	10.3	11.1	10.7	9.6
Tellurium	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium	mg/L		<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thorium	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	mg/L		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, Total	mg/L	MAC=0.02	0.0026	0.00245	0.00263	0.00231	0.00253	0.00264	0.00254	0.0025	0.00261	0.00272	0.00234	0.00264
Vanadium	mg/L		1.00E-03	<0.0010	1.00E-03	1.10E-03	1.10E-03	1.30E-03	<0.0010	<0.0010	1.80E-03	1.00E-03	<0.0010	<0.0010
Zinc, Total	mg/L	AO<5	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Zirconium	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

RAW WATER @ 30 metre depth

WATER QUALITY PARAMETER	30m Site 2018-10-03	30m Site 2018-11-06	30m Site 2018-12-03	30m Site 2019-01-14	30m Site 2019-03-21	30m Site 2019-04-15	30m Site 2019-05-01	30m Site 2019-05-23	30m Site 2019-06-05	30m Site 2019-07-09	30m Site 2019-08-06	30m Site 2019-09-13
Hardness, Total (as CaCO3)	115	112	130	120	113	109	120	125	115	104	112	122
General Parameters												
Total Organic Carbon	4.75	0.9	4.33	4.11	3.97	4.2	4.06	4.06	4.37	4.4	4.31	4.16
Total Dissolved Organic Carbon	4.61	0.9	4.04	3.78	3.96	3.91	4.05	3.81	4.01	4.17	3.81	3.76
Colour, True	<5.0	<5.0	5.6	<5.0	7.7	<5.0	<5.0	<5.0	<5.0	6.9	<5.0	6.4
Conductivity (EC)	285	274	271	281	279	283	264	276	267	283	279	271
pH	7.96	8.04	8.02	8.09	8.14	8.22	8.19	8.16	8.15	8.16	8.11	8.06
Turbidity	0.44	0.13	0.26	0.21	0.25	0.23	0.33	0.26	0.27	0.24	0.24	0.38
UV transmittance	82	86	85.7	NA	86.4	84.3	85.4	85.4	85.4	85.7	85.6	85.1
Microbiological Parameters												
Coliforms, Total	>= 5	7	>= 1	<1	<1	<1	<1	1	1	>= 8	>= 4	>= 24
Background Colonies	> 200	NA	> 200	> 200	NA	NA	NA	NA	NA	> 200	> 200	> 200
E.Coli	2	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	1
Total Metals												
Aluminum, Total	1.06E-02	<0.0050	5.40E-03	<0.0050	5.10E-03	<0.0050	6.40E-03	1.14E-02	<0.0050	5.70E-03	1.04E-02	5.20E-03
Antimony, Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, Total	<0.00050	5.40E-04	5.90E-04	5.20E-04	6.50E-04	<0.00050	5.10E-04	5.40E-04	5.60E-04	5.80E-04	6.50E-04	5.10E-04
Barium, Total	0.0219	0.0216	0.0267	0.0238	0.0216	0.0218	0.0229	0.0218	0.0207	0.0224	0.0242	0.0253
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron, Total	0.0115	0.0149	0.0142	0.0088	0.0126	0.0121	0.012	0.0151	0.017	0.0101	0.0102	0.0143
Cadmium, Total	<0.000010	<0.000010	<0.000010	<0.000010	2.00E-05	<0.000010	<0.000010	<0.000010	1.10E-05	<0.000010	1.10E-05	<0.000010
Calcium, Total *(Dissolved, Ital.)*	31.5	29.6	34	32.2	28.4	28.7	32.8	33.9	30.5	26.4	31.1	32.9
Chromium, Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	7.80E-04	7.50E-04	7.70E-04	1.05E-03	1.10E-03	<0.00050	<0.00050
Cobalt, Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper, Total	0.00078	0.00084	0.00089	8.00E-04	0.00094	0.00118	0.00096	0.00102	0.00101	0.00083	0.00109	0.00069
Iron, Total	1.30E-02	<0.010	<0.010	<0.010	<0.010	<0.010	1.10E-02	1.30E-02	3.80E-02	<0.010	1.40E-02	<0.010
Lead, Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.00375	0.00349	0.00368	0.00321	0.00312	0.00336	0.00343	0.00352	0.00362	0.00318	0.00335	0.00343
Magnesium, Total *(Dissolved, Ital.)*	8.93	9.17	11	9.5	10.3	9.08	9.32	9.79	9.4	9.15	8.28	9.58
Manganese, Total	0.00137	0.00079	0.00083	0.00077	0.00088	0.00084	0.001	0.00109	0.00035	0.0011	0.00138	0.00111
Mercury, Total	NA	NA	<0.000010	<0.000040	7.10E-05	<0.000040	<0.000040	<0.000040	<0.000040	NA	NA	NA
Molybdenum, Total	0.00348	0.0035	0.00408	0.00351	0.00369	0.00371	0.00366	0.00349	0.00341	0.00363	0.00355	0.00379
Nickel, Total	4.20E-04	<0.00040	4.70E-04	<0.00040	<0.00040	<0.00040	5.00E-04	5.10E-04	6.10E-04	5.20E-04	5.40E-04	4.40E-04
Phosphorus	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium, Total *(Dissolved, Ital.)*	2.08	2.23	2.87	2.17	2.37	2.17	2.38	2.46	2.29	2.27	2.23	2.21
Selenium, Total	5.00E-04	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon	3.7	4.1	4.5	3.2	3.9	3.6	3.8	3.8	3.6	4	3.7	3.6
Silver	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, Total *(Dissolved, Ital.)*	10.7	10.9	13	11.3	12	10.8	11.8	11.7	12.1	10.6	9.89	11.3
Strontium, Total	0.263	0.239	0.314	0.264	0.272	0.265	0.288	0.274	0.261	0.29	0.278	0.284
Sulphur	8.6	9.8	12.9	7.6	10.1	9.7	9.6	12.7	9.5	10.9	11.6	9.8
Tellurium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thorium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, Total	0.00256	0.00237	0.00261	0.0023	0.00248	0.00264	0.00258	0.00251	0.00255	0.0024	0.00245	0.00268
Vanadium	1.00E-03	<0.0010	1.10E-03	1.00E-03	1.10E-03	1.30E-03	<0.0010	<0.0010	1.80E-03	1.10E-03	<0.0010	<0.0010
Zinc, Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	4.40E-03	<0.0040	<0.0040	5.70E-03	<0.0040
Zirconium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

RAW WATER @ 40 metre depth

WATER QUALITY PARAMETER	40m Site 2018-10-03	40m Site 2018-11-06	40m Site 2018-12-03	40m Site 2019-01-14	40m Site 2019-03-21	40m Site 2019-04-15	40m Site 2019-05-01	40m Site 2019-05-23	40m Site 2019-06-05	40m Site 2019-07-09	40m Site 2019-08-06	40m Site 2019-09-13
Hardness, Total (as CaCO3)	119	114	125	124	115	112	117	127	121	113	119	123
General Parameters												
Total Organic Carbon	4.62	1	4.15	4.48	3.99	4.19	4.09	3.93	4.31	4.2	4.16	4.2
Total Dissolved Organic Carbon	4.31	0.9	4.02	4.26	3.87	3.98	4.05	3.89	3.96	4.11	3.74	4.16
Colour, True	<5.0	<5.0	5.7	<5.0	8.3	<5.0	<5.0	<5.0	<5.0	6.4	<5.0	5.8
Conductivity (EC)	289	276	271	279	281	281	266	277	267	281	279	269
pH	7.99	8.04	8.04	8.09	8.15	8.22	8.17	8.21	8.15	8.15	8.12	8.07
Turbidity	0.24	0.14	0.22	0.24	0.29	0.24	0.26	0.25	0.24	0.15	0.2	0.28
UV transmittance	84.3	86	85.1	NA	86.2	85.2	85.2	86.8	85.6	86.1	85.7	85.1
Microbiological Parameters												
Coliforms, Total	<1	2	1	1	<1	<1	<1	<1	<1	>= 4	>= 1	>= 31
Background Colonies	> 200	NA	NA	> 200	NA	NA	NA	NA	NA	> 200	> 200	> 200
E.Coli	<1	<1	1	1	<1	<1	<1	<1	<1	<1	<1	<1
Total Metals												
Aluminum, Total	1.04E-02	7.70E-03	5.00E-03	<0.0050	8.00E-03	6.70E-03	5.10E-03	5.90E-03	5.60E-03	<0.0050	<0.0050	<0.0050
Antimony, Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, Total	<0.00050	5.20E-04	5.80E-04	5.40E-04	6.40E-04	<0.00050	<0.00050	5.40E-04	5.40E-04	5.80E-04	6.60E-04	<0.00050
Barium, Total	0.0221	0.0218	0.0244	0.0242	0.0217	0.0221	0.0227	0.022	0.0217	0.0229	0.0249	0.0252
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron, Total	0.0112	0.0151	0.0133	0.0091	0.0122	0.0122	0.0112	0.0143	0.0155	0.0117	0.0129	0.0135
Cadmium, Total	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium, Total *(Dissolved, Ital.)*	32.4	30.2	33.8	33.6	28.8	29.5	32.1	34.5	32.3	30	32.9	33.4
Chromium, Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	6.60E-04	8.10E-04	8.60E-04	8.80E-04	1.07E-03	<0.00050	<0.00050
Cobalt, Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	4.80E-04	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper, Total	0.00099	0.00077	0.00086	0.00079	0.00087	0.00106	0.00104	0.00094	0.00097	0.00083	0.00104	0.00079
Iron, Total	1.50E-02	<0.010	<0.010	1.10E-02	<0.010	<0.010	1.60E-02	<0.010	<0.010	<0.010	<0.010	<0.010
Lead, Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.00381	0.00366	0.00365	0.00338	0.00322	0.00343	0.00335	0.00357	0.00377	0.00368	0.00357	0.00346
Magnesium, Total *(Dissolved, Ital.)*	9.27	9.28	9.8	9.65	10.5	9.23	9.03	9.76	9.81	9.21	8.87	9.65
Manganese, Total	0.00144	0.00087	0.00076	0.00078	0.00097	0.00086	0.00094	0.00084	0.00033	0.00091	0.00111	0.001
Mercury, Total	NA	NA	<0.000010	<0.000040	5.30E-05	<0.000040	<0.000040	<0.000040	<0.000040	NA	NA	NA
Molybdenum, Total	0.0034	0.00345	0.00358	0.00356	0.00374	0.00376	0.00355	0.00364	0.0036	0.00368	0.00362	0.00385
Nickel, Total	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	4.10E-04	2.73E-03	4.20E-04	4.40E-04	4.30E-04	8.90E-04	4.40E-04
Phosphorus	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium, Total *(Dissolved, Ital.)*	2.14	2.25	2.54	2.21	2.42	2.22	2.33	2.46	2.4	2.28	2.35	2.24
Selenium, Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon	4	4.2	3.8	3.4	4.1	3.7	3.7	3.8	3.7	4.1	4	3.8
Silver	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, Total *(Dissolved, Ital.)*	11	11	11.8	11.5	12.3	11	11.5	11.8	12.7	10.7	10.5	11.4
Strontium, Total	0.267	0.241	0.282	0.271	0.276	0.269	0.278	0.283	0.274	0.293	0.297	0.282
Sulphur	8.7	9.6	10.8	8.7	10.8	9.6	10.2	12.1	9.8	10.9	11.9	10.3
Tellurium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thorium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, Total	0.0026	0.0024	0.00261	0.00237	0.00253	0.0027	0.00252	0.00252	0.00266	0.00277	0.00261	0.00268
Vanadium	<0.0010	<0.0010	<0.0010	1.10E-03	1.10E-03	1.40E-03	<0.0010	<0.0010	1.60E-03	1.10E-03	<0.0010	<0.0010
Zinc, Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Zirconium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

***OGV** - Operational Guidance Value (Health Canada) **MAC** - Max. Acceptable Concentration **AE** - Aesthetic Objective **IHA Requirement ***USEPA recomm. **#** No. of Samples

Data is based on raw values for the most recent "full year" of data available. Obvious parameters like free and total chlorine, THM's etc… are based on treated.

5.4 WATER SUPPLY RISKS

This section listed the known risks to Summerland's water sources. The risks are to both the water quality for drinking water and water for irrigation. As Summerland's sources are either the primary domestic source, Trout Creek, or a contingent source such as the wells or Eneas Creek, the water quality should be monitored and maintained at the highest possible level. Although Summerland does not have the authority to change land-use activities, they are essentially the largest stakeholder of the watershed with the community water supply being dependent upon it.

The District of Summerland has invested a significant amount of money in the Summerland Water Treatment Plant (WTP). The plant is a critical facility in providing high quality, safe drinking water to the residents of Summerland. The plant capacity of 75 ML/day has occasionally been exceeded in the past 12 years. This resulted in Summerland having to call a Water Quality Advisory or Boil Water Notice.

With the separation of Garnett Valley into strictly an irrigation source, there is reduced water demand on the WTP as more irrigation water is fed from Garnett Reservoir. This has reduced the risk of being out of compliance with water quality regulations. The WTP does not allow Summerland to become less vigilant in protecting their raw water sources as there are contaminants and events from which the WTP will not provide protection including forest fires and toxic algae blooms.

Multi-Barrier Approach – Health Canada

Health Canada recommends that all water utilities apply a multi-barrier approach when managing risks in their water sources. Health Canada defines this approach as follows:

The key to ensuring clean, safe and reliable drinking water is to understand the drinking water supply from the source all the way to the consumer's tap. This knowledge includes understanding the general characteristics of the water and the land surrounding the water source, as well as mapping all the real and potential threats to the water quality. These threats can be natural, such as seasonal droughts or flooding, or created by human activity, such as agriculture, industrial practices, or recreational activities in the watershed. Threats can also arise in the treatment plant or distribution system thanks to operational breakdowns or aging infrastructure.

The multi-barrier approach takes all of these threats into account and makes sure there are "barriers" in place to either eliminate them or minimize their impact. It includes selecting the best available source (e.g., lake, river, and aquifer) and protecting it from contamination, using effective water treatment, and preventing water quality deterioration in the distribution system. The approach recognizes that while each individual barrier may be not be able to completely remove or prevent contamination, and therefore protect public health, together the barriers work to provide greater assurance that the water will be safe to drink over the long term.

Part of the multi-barrier approach is to carry out Source-to-Tap Assessments as set out by the Ministry of Health in their *"Comprehensive Source to Tap Assessment"* modules as defined on the previous page. Summerland completed this in 2012 for Trout Creek, Eneas Creek and their groundwater sources, as summarized in the Agua Consulting 2012 Source Water Protection plan. For the planned intake on Okanagan Lake, the water quality monitoring work by Larratt Aquatic is designed to address the requirements in the Source-to-Tap Assessments for modules 1, 2, 7 & 8.

Table 5.9 provides a list of drinking water risks that are present in the Trout Creek watershed. The rating of risks is a subjective exercise based on experience and the history of events.

Table 5.9 - District of Summerland - Risk Summary Table

No.	DW HAZARD	IDENTIFICATION METHOD(S)	REVIEW COMMENTS	RISK RATING
1	Drought / Wildfire	Visible when in watershed	Extreme weather events are increasing. Drought is the most prevalent factor prior to wildfire occurring. Alternate water sources should be available for drinking water.	High
2	Flooding	Visible, associated with wet weather events	High sediment loads in creeks, high turbidity and suspected solids in the water. Frequency of these events is increasing	Moderate to High
3	Water main Break	District is notified due to running water	Entrainment of silt & sediment directly into the water distribution system piping. Vacuum and flush out mains prior to repair and closing up water mains.	Moderate. Common to utilities
4	Agriculture / Range Activities	High E.Coli at intake	Cattle activities and leases are active in watershed. BMPs are mandated by the Province. Maintain communications with Prov. Range officer and Lessees.	Moderate to High
6	Septage	High Total coliforms / *E.Coli* at intake is primary indicator	Septic tanks/tile fields are present in the Faulder area. Failed tile fields can discharge directly to water courses	Moderate
6	Mining, extraction	Referral from the Province	Could be gravel pit, quarry or mine for mineral extraction. Processes with mine can have contaminants	Moderate
7	Forestry	Site visits of clear cut or activity too close to riparian	Forestry companies are much more aware of the riparian regulations and are changing how they log. Impacts magnify with high runoff events	Moderate
8	Algae Blooms in source (s)	Visible to the eye. Biological monitoring and testing to see if algae is Cyanobacteria	Garnett has high risk. If more water is used, risk reduces. Risk in Trout Creek watershed is much lower. Algae bloom risk exists in Okanagan Lake.	Moderate
9	Distribution system regrowth	Customer complaints. Low chlorine residual levels.	Summerland has bumped up corrosion control measures by increasing pH leaving WTP. Impacts could be more scale build-up and more regrowth. Balance in operations req'd.	Moderate to Low
10	Cross Connection	Lack of reporting by device owner	A cross connection policy in place for all new development. Premise isolation and backflow is in place.	Moderate to low
11	Pest Infestation	Visible damage to trees, forestry will find first	Mountain Pine Beetle has run through the watershed in the past decade. Existing forest canopy is growing back;	Low
12	Leachate from Landfill	Monitoring wells to determine water level in Summerland Reservoir	Protection exists if Trout Reservoir operates at higher water levels. If reservoir level is lower, testing of wells should take place	Low
13	Chemical Spill	Call-in by public or notification by road officials.	Very few trucks haul hazardous chemical on the Summerland-Princeton Road or other watershed roads	Low
14	Power Failure	Alarms to Operator of emergency condition	Emergency generators or power supply required for SCADA and alarms.	Very Low

The Risk Rating denotes the outcome of the combination of hazard creating a consequence and the likelihood of it occurring. The consequence may be low, such as high waterflow in a creek, but the likelihood of occurrence may be high resulting in a moderate risk rating. Alternately the consequences for a fuel spill may be high, but the likelihood of occurrence may be very, very low, resulting in a lower risk rating. Risk ratings are somewhat subjective, depending on who is assessing the risk.

5.5 WATER QUALITY MONITORING / FURTHER STUDY REQUIREMENTS

Sampling to fill the following chemistry and biology data gaps is recommended:

- To develop a long-term baseline for the raw water sources, it is recommended that full parameter samples be taken in the source water at the intake just prior to entering the water transmission system at least once per year. Currently samples are taken twice a year from the Garnett and Summerland water distribution systems after treatment through the WTP. By relocating one of these sampling locations to the raw water, a long-term trend of the raw water can be collected. The baseline data can then be trended. It is recommended that any changes to the sampling program be reviewed with Interior Health prior to implementation;
- When the Trout Creek Flume replacement, fish screens and fish ladder project is completed, on-line monitoring of water quality parameters, specifically on-line Turbidity, pH, conductivity, temperature and suspended solids will be connected to the Summerland SCADA system. Alarms recommended as part of that project will have the control capacity to shut down the intake gates if raw water parameters are above or below the set points;
- Although Garnett Reservoir is now no longer used for drinking water, it is a backup source in the event that the Trout Creek source is compromised;
- Water Quality data has been collected by Larratt Aquatic over the past two years at the proposed intake location on Okanagan Lake. The data is leading the District to set an intake depth in the range of 30 m below the lake low water level.
- Raw water sampling for Total Coliforms and *E.Coli* is recommended for the Trout Creek source at two locations, one at the Trout Creek intake and the second at the inlet to the Water Treatment plant before disinfection. This information will provide insight to whether or not there are issues in the watershed and there are organisms challenging the WTP process;
- With *E.Coli* sampling, the activity in the watershed can be checked. Livestock (cattle grazing) or natural wildlife, septic tanks or a number of other potential risks can be recognized earlier with if this data is collected;
- Reconsideration of the sampling of wells at the Rodeo Ground should be done. Licensing also should be considered. The wells are for emergency purposes, however there are concerns with uranium in the wells that is at half of the MAC levels for drinking water. Maintaining the wells for the longer term should be considered. If kept, then application for groundwater licenses is recommended.
- Lead and corrosion control for the water distribution system has been implemented in the past two years. Higher pH levels are set for water leaving the WTP. The higher pH and alkalinity water is less susceptible to the leaching of copper and lead from pipes and fittings;
- As part of the operations, it is recommended that at all repairs where the inside of the water distribution system is repaired, that the inside condition of the main be documented. The documentation should include: date of install, date of repair, water main age, main material type, diameter, size, inside surface description, photograph, main thickness if measurable, soil type adjacent to the main and bedding condition. This inventory will assist in determining lifespan expected for the water distribution mains.

5.6 OPERATIONAL CHALLENGES

Operational challenges with respect to water quality are set out in this section. They include the ability to operate the WTP and items that may compromise providing high quality water to the District.

Landscape Level Planning for Forestry

Historically, the progression of forestry work in a watershed has been based on accessibility, topography and economics of a cut block. The Ministry of Forests Lands and Natural Operations and Rural Development is planning out test-cases to change the long-standing forestry practices to see if there are alternate ways to manage the forests for better long-term sustainability. The fire seasons in 2017 and 2018 saw the largest acreage of burning of watersheds in the Province on record. The 2021 fire season in the Kamloops Forest District was one of the worst on-record for the BC Southern Interior.

The Forest Enhancement Society of BC (FESBC) has funded planning work in the Mission Creek, Mill Creek, Vernon Creek & Duteau Creek watershed plateau east of Kelowna to management cut blocks for fire protection. The planning exercise that will have to be carried out in conjunction with the logging companies, will see the watershed separated out into defendable cut blocks with fuel managed corridors along existing points of access. Thinned out fuel loads along the transportation routes is part of the plan. New fuel managed routes to join the fuel break corridors is also part of the plan. This approach has been lobbied to the Provincial government starting immediately after the 2003 fires in Kelowna. The recent fires in 2017 and 2018 only highlighted the need for this type of approach in our watersheds. Summerland should consider lobbying the Province for a similar approach for the Trout Creek, Eneas Creek, Deep Creek, Peachland Creek landscape.

Creek Variability

With the recent COVID-19 pandemic, there is no senior Provincial or Federal funding assistance that is expected in the short term. It is likely that this will delay the renewal work for the flume and intake on Trout Creek. With the delay comes the delay in Summerland getting controls on the intake gate and on-line monitoring equipment on Trout Creek. Consideration should be given to temporary interim pumps and instrumentation on the creek. This can be done with a small kiosk, genset, radio, instrumentation and alarm set points for water quality deviations. Even without automated controls on the gates to shut them down, the rising levels for turbidity can be seen and operators would be given more lead time of variations. The capital investment vs. improved safety for the water would have to be considered in this evaluation.

Fish Management Pressures

There is government pressure to upgrade the fish screening at the Trout Creek intake and to improve fish passage at the intake. Both of these issues will be corrected when Summerland completes the flume replacement and fish screening/fish passage project at the Trout Creek intake. The project is expensive and is one of the higher rated projects for the water utility.

On the interim, there will be pressures from First Nations groups, DFO and the Ministry of Environment to correct this as soon as possible. This pressure creates an opportunity to garner support to leverage funding for the project.

Water Treatment Plant Clearwell

Operational supply capacity is limited by the size of the clear well at the WTP. The clear well size is 6,044 m^3. To ensure there is sufficient water for the downtown core, a fire flow of 225 L/s for a duration of 2.875 hours is required. This requires that 2,329 m^3 of water must be secured for fire flow. The remaining storage of 3,715 m^3 can be withdrawn in a very short time frame. Under a MDD flow of 75 ML/day, the balancing storage can be used in 1.0 hour. As stated in Section 4.4, the cost of clear well expansion is substantial. Moving more water onto the irrigation system and off of the plant should be considered as the MDD can be reduced by 18 ML/day for the estimated $5.8 M for a 5,500 m^3 clear well. Consideration should be given by staff to how to best utilize the WTP bypass valve that allows chlorinated water to the main water system in times of emergency. Opening of the valve allows a large volume of storage water from Summerland Reservoir to be available in the event of the WTP clearwell being too low.

Sludge Handling Methods

Sludge handling and residuals management systems for the WTP is perceived to be an area of high effort. When the WTP was originally designed, the original pond system was inadequate to deal with the sludge that was generated. Subsequently, an auger system, sludge pump and force main were designed move the sludge above to the land fill. Two infiltration ponds were used to hold the sludge and to allow the water to drain away into the granular sub-soil.

The ponds were originally set up in parallel to be operated on an 8-week cycle. One pond would receive the sludge, infiltrate and thicken while the other pond would be drying during the summer months. The ponds were not operated in this manner, but rather solely as infiltration ponds. As such the bottom sand/gravel layer has tightened up with particulate matter and the infiltration rate has slowed.

In the longer term, Summerland has two options, one to refine the existing process and put more maintenance into renewing the base of the sludge ponds, and the second is to proceed with a centrifuge at the WTP. The capital cost for the centrifuge is high. The chemical cost for running the centrifuge is also high and requires continued operator monitoring and attention to run properly. The annual cost for polymer and thickening agent/chemicals for flows the size of Summerland is $75,000 plus continued time from the operators to monitor the process. Centrifuges make sense for utilities that do not have room to dry their sludge. Summerland has room at the land fill. If financial restrictions govern, the landfill option is the lower maintenance and lower cost option.

System Separation & DCC collection

The WTP capacity is designed to be 75 ML/day however maximum daily summer demands for Summerland can be as high as 95 ML/day. Fortunately, over the last 12 years, there has been substantial system separation. The trend for system separation should be continued in the future. As new residential development and densification occurs, the domestic water demands will increase. This increase can be offset by separating off an equivalent volume of water and setting it onto the irrigation water system. Development cost charges assigned to pay for system separation is a realistic and cost-effective means in which to replace domestic water system capacity. Refer to Section 7.7 for more detail costs on this subject;

Lead and Corrosion Control

The Summerland WTP operates within tight boundaries for its chemistry. The operational objective is for the chemical addition of coagulants to drop the pH of the water to optimal conditions for flocculation and sedimentation. The low pH provides for non-scaling water to pass through the filters. Adjustments with caustic soda are then done to raise the alkalinity and pH of the water. Ultimately the desired chemistry of the water is to have slightly scaling properties, and to provide a calcium carbonate coating to protect the inner lining of the water distribution pipes.

By optimizing the chemistry, the potential for corrosiveness is reduced and the leaching of lead into the water is also reduced. Although the Health department hasn't been overly proactive on this subject, with lead known to be in the plumbing fixtures, the slight scaling layer will protect the public. It will also reduce the corrosion of metal water distribution piping and prolong its lifespan. As noted by Summerland WTP staff, recently they have boosted their pH levels leaving the WTP to achieve lower corrosive potential in the water.

New Water Quality MACs for Lead and Manganese

In review of the recent MAC changes for lead and manganese, there is relatively minimal impact on Summerland. The levels in the raw and treated water for Summerland source water is low. No changes in sampling, monitoring or WTP operations is required, however there will be changes in sampling within the distribution system to verify that the water is not corrosive and that lead from within plumbing fixtures is not leaching into the drinking water.

5.7 WATER QUALITY SUMMARY

The following points summarize the major items of this section of the Water Master Plan Update:

1 **Raw Water Guidelines:** For the Trout Creek source and Well sources, the criteria utilized to review raw water quality is the BC "Source Drinking Water Quality Guidelines". For Garnett Reservoir and Eneas Creek, the raw water quality criteria used is the BC Approved Water Quality Guidelines, Aquatic Life, Wildlife & Agriculture;

2 **Treated Water Regulations:** For all domestic water, the criteria to be met are those of the Interior Health Drinking Water (4,3,2,1,0) objectives and the Health Canada Guidelines for Canadian Drinking Water Quality criterion;

3 **Stakeholder with Limited Authority:** Summerland is the largest stakeholder in the watershed with no jurisdiction as to the land use activities on private or Crown lands. Being the largest stakeholder, Summerland does have influence on the decision-makers including the Provincial ministries for Crown land activities and the Regional District of Okanagan Similkameen for activities on private lands;

4 **Existing Water Quality Baseline:** The data presented in Tables 5.2, 5.3, 5.4, 5.7 and 5.8 provide a historical summary of the full water quality parameters for each water source. Continuing on with sampling and recording the full parameters in this manner will allow Summerland to evaluate changes in the water sources;

5 **Monitoring of Raw Water Quality:** Currently full parameter water quality sampling occurs two times per year within the water distribution system. Summerland should consider monitoring one time per year at the source prior to disinfection and treatment rather than in the water distribution system. This will provide a more accurate long-term baseline for the raw water quality. Changes in sampling location should be first verified with Interior Health;

6 **Monitoring for PFAS Substances:** Although not mandated by Interior Health yet, the Per & Polyfluoroalkyl substances have been recognized as a serious contaminant in some water sources. The US EPA has hosted numerous conferences on the subject. The "Forever Chemicals" are spread through the environmental through the air and water. They do not naturally breakdown due to their very strong fluoride – carbon bonds. Telfon, fire-fighting foams and Scotchguard are all examples of this substance. They bioaccumulate in people. Summerland should consider running a set of samples from Garnett Reservoir, Trout Creek and Okanagan Lake at depth. Caro labs in Kelowna can run the tests for in the range of $500 per set. Knowing if these substances are present in the water may help Summerland understand which sources to use for their primary supply;

7 **MAC Changes in Lead and Manganese:** Recent changes have been implemented by Health Canada and adopted by Interior Health for Lead and Manganese with limits of both lowered. These were reviewed in the historical and recent sampling and it appears that the changes will have minimal effect on operations;

8 **Lead Inventory:** Currently Summerland has approximately 1350 metres of galvanized iron pipe in their water distribution system. They also have approximately 31,000 m of cast iron pipe that dates back to the 1930s still in-use in the distribution system. Testing of these materials to see if there is lead content in them would be useful information that will guide the corrosion control program and risks;

9 **Inventory of Internal Watermain Condition:** For all water main breaks and live taps, where a part of the inside of the water main is exposed, a tracking system should be implemented that collects the following information: Date of break, year of main install, pipe material, reason for break or tie-in, photographs of inside of main, and estimated condition/lifespan remaining. This will inform future renewal work scheduling and financial investment requirements;

10 **Lead Sampling:** Sampling for lead in the distribution system will require an alternate approach to current practices. Lead sampling would have to be first-user of the day at a Summerland operated facility that is deemed to be at highest risk of leaching lead. This would be due to plumbing fixtures or pipe materials The water would have to be in contact with the lead piping/fittings overnight before sampling.

11 **Groundwater Well Status:** Summerland has monitored the rodeo ground wells for many years without having to use them. For the Rodeo Well, uranium level is consistently at half the Health Canada MAC. With the flow being so low, and the well not yet being licensed, Summerland must make a decision as to whether or not to continue to invest in this well or to decommission it;

12 **Okanagan Lake Source Sampling:** Summerland has retained Larratt Aquatic Consulting to provide baseline information on Okanagan Lake to determine an optimized location for their planned intake on Okanagan Lake. The preliminary information reviewed looks favourable for an intake location at 30 m depth off of Powell Beach point. Raw water quality of this source appears very high so UV disinfection followed by chlorination should be sufficient to provide water that meets the health regulations;

13 **Water Distribution Separation vs Clearwell Expansion:** Two large phases of separation have been completed in the past 12 years, Prairie Valley and Garnett Valley. This has resulted in high quality domestic water now being provided throughout Summerland. It also has resulted in sufficient separation of the irrigation and agricultural demands so that the 75 ML/day capacity of the WTP is not exceeded. Continuation of the separation work vs. expanded clear well capacity is discussed in Section 6, Future Water System;

14 **By-Pass Valve Use:** Summerland should develop a plan and process within their Emergency Response plan for the water utility so that the large Singer by-pass valve at the WTP can be used for emergencies. This would save substantial fees by not constructing additional clearwell storage at the WTP.

6. FUTURE WATER SUPPLY

6.1 INTRODUCTION

Section 6 provides Summerland with a range of issues to consider when planning for the future. There will be changes in source water, risks to supply quantity and quality, plus, as experienced in 2020, there could be global issues impacting how water is supplied.

When trying to forecast and adapt to what is may occur in the future, one must:

1. Address what we believe is most likely to occur;
2. Understand and be aware of those exceptional events that are within the realm of possibility;
3. Develop adaptive means and measures to minimize the water supply risks.

This plan addresses normal forecasting issues, such as estimating population growth, future water demands, and the change in water demand habits and allotments. There is a stable history of recorded data upon which to base future projections.

To determine what might occur, there has been much more attention provided to this matter since the COVID outbreak. Within Section 6.2 is a listing of potential global threats and how that could impact the local level water supply.

To strengthen the water utility, building resiliency, and developing alternate water supply sources are the two most important objectives for adaptation and in moving forwards.

6.2 GLOBAL THREATS RELATED TO WATER SUPPLY

With the recent COVID-19 world pandemic, the planning and resilience of core municipal systems is being re-evaluated in greater depth. The recent pandemic has forced some of the world to reconsider what is wanted vs. what is needed in a world that is dependent on global trade for most of their products, but particularly their food supply.

For understanding what might occur, however remote, we researched out a listing of potential global risks that man could be facing in the future. Globally, there are a variety of think-tank organizations forecasting the range of global threats that society could be facing.

Through the COVID-19 pandemic, the operations and maintenance of critical municipal services is being challenged. The health and safety and importance of critical public employees is also now better realized within the water utilities. The critical role of these staff is still poorly understood and under-appreciated by the general public.

The following is a list of global threats to mankind. The list originated from the document "The Commission for the Human Future" from the Australian National University. Their general message is that since the mid 20th century, mankind has accelerated its ability to harm itself and its environment. The risks are varied, global and complex.

Global Threats and Impact on Water Supply

1. **Decline of Natural Resources:** Particularly our uncontaminated water supplies. Locally this applies to both our watersheds and to our valley lakes. Protecting the quality of water flowing into our lakes and the activities on our lakes remains largely uncontrolled. Our shorelines are eroded by recreational activities and higher water levels in recent years;
2. **Collapse of Ecosystems and loss of Biodiversity:** This real issue is possibly the most dangerous and most likely to threaten our very existence. The biodiversity and health of the local ecosystems provides balance and natural filtration of water supplies;
3. **Human Population Growth** beyond the carrying capacity of the earth is probable. With the current pandemic, the issue of food security is now being reconsidered. Local available source water is within the renewable watershed capacity can be part of the solution for maintaining food supply;
4. **Global Warming and Human Induced Climate Change:** We may be just viewing the initial climatic changes with the recent floods, drought and forest fire cycles that have gone through the region in the last five years. The water cycle is one of the big changes with global warming.
5. **Chemical Pollution of the Earth Systems** including the atmosphere and oceans. At a local level, the small personal care products, micro-plastics and wastes from street runoff find their way to our creeks and valley lakes. This highlights the need for policy improvements and the need to protect watersheds, particularly from our drainage and waste systems;
6. **Rising Food Insecurity and Failing Nutritional Quality:** The soils in which we grow bumper crops, due to nutrient and water management, is being overworked and the mineral uptake and nutrition of our food supply being reduced. Rotations and farming of more land, less intensively should be considered;
7. **Nuclear Weapons** and other weapons of mass destruction have been with us for 80 years. Disarmament is part of the solution, as is the reduction of rhetoric from our leaders.
8. **Pandemics, new and untreatable diseases:** The COVID-19 pandemic has struck world-wide and is nowhere near being in control since it was first reported.
9. **Advent of Powerful, uncontrolled new technologies:** These could include bio-engineering of foods, of humans, and the development of science in an unethical and unstainable way;
10. **Political Inaction:** National and Global Failure to understand and act proactively on any of the above risks. This has been demonstrated in those countries currently worst hit by the global pandemic where politics has been placed ahead of protecting the citizens.

Excerpt from "The Commission for Human Future" Australian National University
Adapted to water supply by Agua Consulting Inc. 2020

As demonstrated by the Corona virus, the risks may be interconnected. The short-term global political thinking has increasingly and seriously undermined our potential to decrease the risks of issues such as climate change.

6.3 WATER MANAGEMENT IN THE OKANAGAN

Being located at the top of the Okanagan River, water has only one way into the valley and two ways out. Water enters the Okanagan Valley by means of precipitation, through rainfall or snow. Water leaves the valley either through evaporation-evapotranspiration or overland and groundwater runoff southwards to the Okanogan River in the USA. The following valley-wide factors are expected to influence the direction of future water supplies in the Okanagan Valley.

1. **Biodiversity:** The interrelationship between man and the natural systems must be maintained. The wetlands, the riparian areas of the lakes and streams and the hydrological cycle all provide critical natural functions. Degradation of these components results in the costly mechanization in trying to replicate what nature does so perfectly. We are just beginning to understand why this is so important;
2. **Supply Management:** The Okanagan Valley is struggling to better understand the changing characteristics of the water resource. The supply and release of major controls are being revisited to determine how to better manage the increased flood and drought cycles experienced through our valley lakes.
3. **Knowledge of Quality and Quantity:** The *Okanagan Water Supply and Demand Study* completed studies on basin hydrology, groundwater, evaporation and evapotranspiration, plus the interconnectivity of watersheds. Raw water quality was also documented throughout the basin. Monitoring these parameters allows us to understand if the water resources are deteriorating or improving;
4. **Resiliency and Adaptation:** Alternative and/or contingent supplies will be developed by the water suppliers. For many utilities in the Okanagan, this includes groundwater. For Summerland, it includes Okanagan Lake. Having several supply sources results in more flexible and reliable water supply capacity. This should result in reduced hardship by the water users during a major drought.
5. **Basin-Wide Water Board:** The basin-wide legislative body continues to provide leadership and coordination of water resources management in the basin. The existing Okanagan Basin Water Board (OBWB) with outreach through the Okanagan Water Stewardship Council has developed a basin-wide dialogue on water issues. Currently there are 7 of the valley municipality Mayors that sit or are alternate Directors on the Board. A culture of collaboration has developed to where the Okanagan Basin Water Board is considered an excellent model for collaborative water basin management in Canada;
6. **Public Awareness:** Public awareness on water-related issues will continue to increase. Water suppliers' policies to improve water use efficiency practises will continue to increase as will the public's willingness and ability to meet these policies.

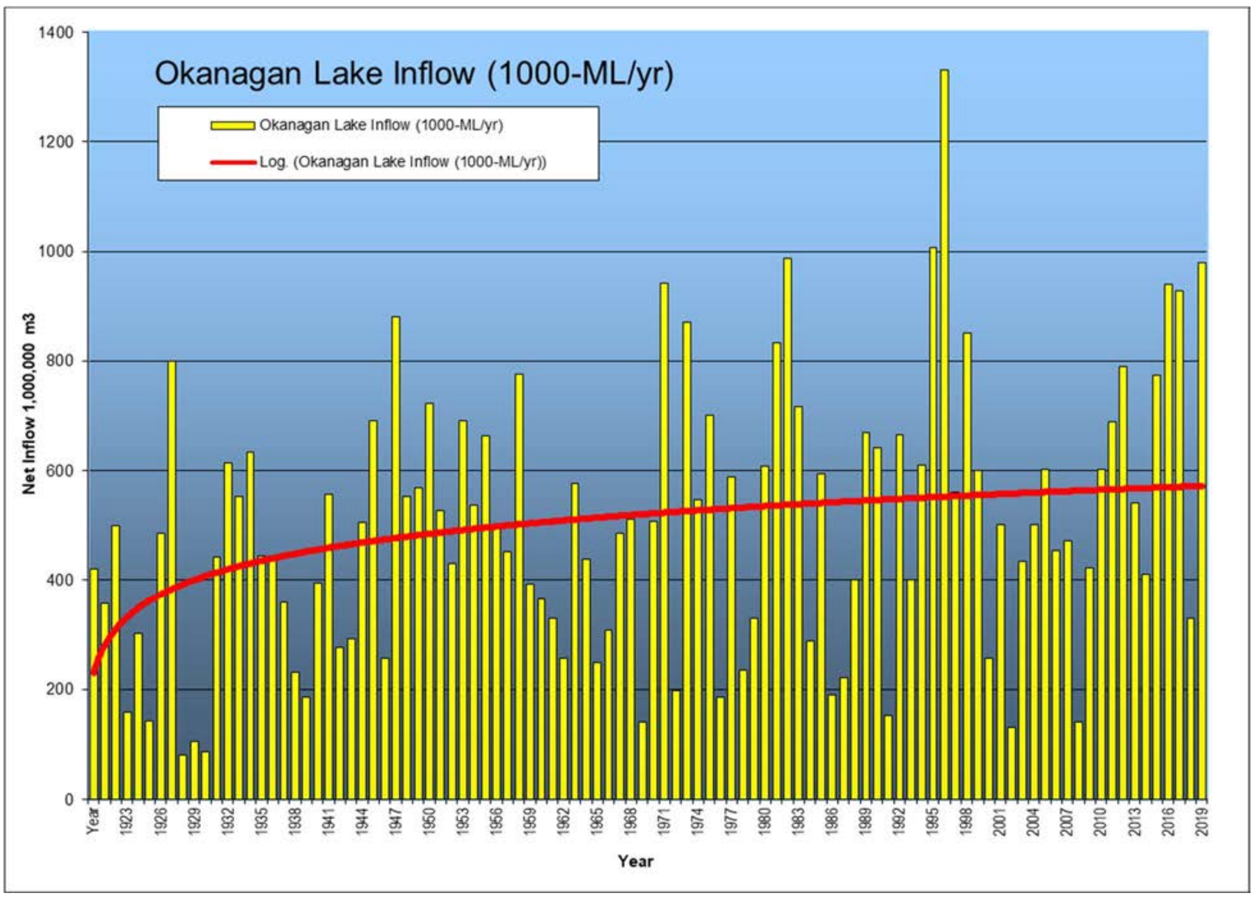
At the base of improved resiliency and adaptation is the ability to communicate well and work cooperatively with the suppliers, manufacturers, consultants and particularly the public. Partnerships with other local utilities is also very important in lending or receiving aid or support during an emergency.

6.4 CLIMATE CHANGE IMPACTS

The issue of climate change is considered one of the highest concerns in North America. Since 1890, there has been an increase in the average annual world temperature by almost 2 degrees C. This is forecasted to continue to increase well into the 21st century. The concerns of warming will result in increased greenhouse gases and carbon into the atmosphere. There are arguments as to whether what is going on is a natural condition or influenced by man. Regardless of its cause, it matters more than ever that we recognize the fact that it is occurring.

Figure 6.1 provides a summary of inflow into Okanagan Lake for a period of 98 years. The yellow bars of the graph show the annual runoff into Okanagan Lake. Dry years for the basin correspond to the low runoff into the lake and include the years of 1929, 1930, 1931, 1970, 2003 & 2009. High runoff years include the years of 1928, 1948, 1972, 1983, 1996, 1997 2017 & 2018. In an average year, there is approximately 495,000 ML of water that flows into Okanagan Lake.

Figure 6.1 - Okanagan Lake Inflow (1921-2020)



Source of Background Graph, Alan Chapman, Rivers Forecast Centre, BC

Over the last 20 years, the annual runoff into Okanagan Lake is more than 10% higher than the long term 98-year average. The red trend-line is a logarithmic trend of the annual inflow, which appears to be on a slight incline.

The annual weather cycle that has appeared recently is one of flooding in the spring, drought through the early and mid summer followed by forest fires in mid-summer and into the fall season.

In the most simplistic terms, the global warming will result in more of our ocean water evaporating and being held in the troposphere (lower atmosphere). Warmer air can hold more water than cooler air. With more water in the atmosphere, it will be held in its vapour state until the temperature changes. With the topography in British Columbia, the moisture-laden air will rise due to the convective influence of the local mountains, as it rises, the air will cool and the water will transform to precipitation onto our watersheds. The result will be increased volumes and intensity of rainfall. Rain falling on melting snow exacerbates the potential for spring flooding.

With that in mind, to manage and adapt to global warming, it is recommended that:

1. **Develop Adaptive Measures:** The water utility work towards increasing their capacity to adapt to emergencies. This means having the resources to approach any and all foreseen emergencies. It includes knowledge of the local creeks and where flooding is likely. It includes all steps within an Emergency Response Plan that includes events in the watershed. This does not necessarily increase expenditures on "what-if" scenarios, but rather having the resources, approach, and knowledge of what-to-do in the event of an emergency;
2. **Data Collection:** Monitoring and tracking of key climatic information will inform us on what is occurring over time. This key data includes flows passing the dams (spillway overflow, weir on downstream gate side of the dam, and dates of release). This data can be tracked to understand the annual and peak runoff out of each sub-basin above each of the dams. By tracking the key data, and in conjunction with other local water suppliers doing the same, a better understanding of the greater watershed and each sub-basin can be gained.
3. **Environmental Footprint:** Reducing the footprint made by the water utility is a long-term key objective. These objectives can include maximizing the supply of water by gravity and minimizing the volume of water that has to be chemically treated. Pumping from Okanagan Lake can offset WTP chemicals and operating costs plus provide a contingent supply in the event of an emergency. Reducing power consumption, investing in those components that offer the best lifecycle value can be done by a public utility as they can sustain a longer return-on-investment for their expenditures;
4. **Forest Management;** One of the most important recent developments with management of the forests in the region is the concept of creating defendable cut blocks. This means permitting selective logging in the watershed to allow for roads, logged areas and specific corridors to be thinned out to act as barriers so that fires can be more easily contained and the greater forest resource protected. A test case of this type of forest planning is being completed on the plateau east of Kelowna and it involves Mission, Mill, Vernon, Coldstream & Duteau Creek watersheds;
5. **Support Growing Food Locally:** With irrigation water available to many properties, supplying water at a lower irrigation rate for agriculturally productive land of all sizes is a program that costs very little and has a significant positive impact on the greater region. There is a positive impact on the environment if more food is grown locally.

6.5 FIRST NATIONS CONSIDERATIONS

The concerns of the First Nations have gained public and government attention in the past 10 years and are expected to continue to do so. The bands have valid concerns regarding the management and protection of the water resources. The Penticton Indian Band has lands along the south boundary of Summerland and has rights and interests in there being sufficient water for their traditional needs including improved fish management in lower Trout Creek below the falls, plus possible demands for domestic and irrigation purposes.

A key statement document addressing First Nations concerns is the UNDRIP document which is the United Nations Declaration on the Rights of Indigenous Peoples drafted in 2007. There is broad consensus among federal government policy makers that Canada's current legal and governance is insufficient to ensure water security for indigenous persons (BC DRIPA). Meaningful collaboration is one of the means in which to start improving this situation. Having the indigenous peoples involved at the start any substantial water initiative where their rights might be affected is a starting point for improved collaboration.

Another cornerstone of the First Nations is the Siwlk^w Water Declaration. In July, 2014, the Okanagan Nation Alliance endorsed the *Syilx* Water Declaration that was put forth by their Natural Resources Council It is to be a living document as the Okanagan Nation communities have held a strong connection towards siwlk^w (water). Their connection of water to their culture is spiritual.

"*The Okanagan Nation has accepted the unique responsibility bestowed upon us by the Creator to serve for all time as protectors of the lands and waters in our territories, so that all living things return to us regenerated. When we take care of the land and water, the land and water takes care of us. This is our law." Syilx Water Declaration excerpt*

Regarding access to water, the Penticton Indian Band have reserve lands within the Trout Creek watershed immediately south of the District of Summerland municipal boundary, as illustrated in Figure 6.2. The total area of these lands is significant and is the majority of property on the south District boundary. Much of the land is a natural state and not suitable for intensive agriculture. The irrigable land is limited to the areas with flatter topography which is estimated to be 2.55 km^2 (255 ha.).

Water may be required by the Penticton Indian Band for the land area identified above. An estimate for possible future water use by the Penticton Indian Band was provided within the 1997 Master Water Plan. The volume of water that would be sufficient for irrigation of these lands is provided in Section 6.7.

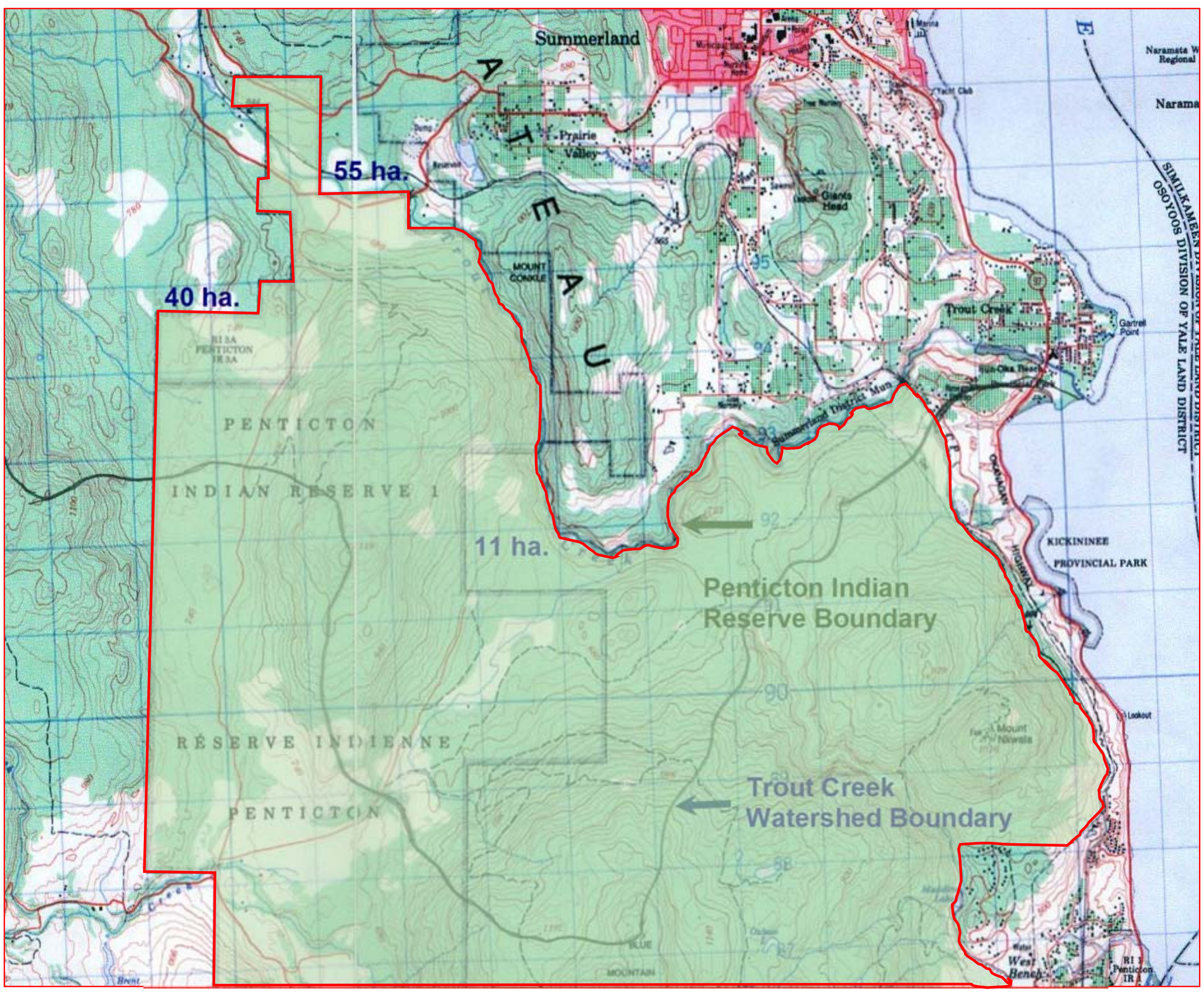
The Penticton Indian Band may eventually utilize water from Trout Creek. The development of storage on the creek would be necessary to secure a year-round reliable supply of source water. Potable water may be requested of the District in which case the required costs for water treatment would have to be identified, reviewed and a partnership formed in lobbying for water treatment upgrades at a central source.

Areas of common interest between Summerland and the Penticton Indian Band include:

- **Water for Environmental Flow Needs:** Water from Trout Creek is managed and released from storage that goes to EFNs: The Trout Creek Water Use plan set an apportionment of the total natural creek flow to maintain the environmental flow needs required in Trout Creek below Thirsk Dam. This volume of water for EFNs is being tracked to confirm the annually volume. This will help to inform all parties of the percentage of water that is going towards maintaining healthy ecosystems along Trout Creek;

- **Domestic water supply needs:** To determine this, it will require that Summerland designate a person to be the primary contact with the Penticton Indian Band. To plan what may be required for the Penticton Indian Band, the first step is to start a dialogue with them to see where partnership opportunities may exist;
- **Irrigation water to the PIB lands:** The Penticton Indian Band has lands that potentially could be used for agriculture. These lands are less steep and are not too high in elevation (> 1,000 metres) and may be viable for agriculture;
- **Fish passage and Fish screens**: It is likely that the Penticton Indian Band will respond favourably to the proposed upgrades to the Trout Creek intake which is to include fish passage and upgraded fish screens to allow local fish species to migrate up Trout Creek. It is one of the highest priority water projects for Summerland and it may be possible that support by the Penticton Indian Band may help in obtaining funding for this project.

Figure 6.2 - Penticton Indian Band Lands



6.6 FUTURE DOMESTIC WATER DEMAND

The developments proposed within the municipal boundaries of Summerland are listed in this section. The 2017 Summerland OCP and the Regional District of Okanagan Similkameen OCP are the basis for future growth projections. The development unit counts provided in this section are either based on the best available information or on reasonable allowances for development (where information does not exist).

The probable development areas for the District of Summerland are presented for the next 20 years. The actual rate at which development will proceed will be based on availability of municipal services, market absorption and external factors that Summerland is not able to control.

Population Growth and Domestic Water Demand

The historic population growth rate for Summerland as presented in Section 2 of this report is just below 2.00%. The recent Summerland OCP identified a range of growth rates that were possible. Table 6.1 provides the recent growth rates for Summerland from 2006 to 2021 and the projected growth rates for a range of percentages. The gray column is the population projection used within this report in the water calculations. It is based on the RDOS regional projected growth rate of 1.25%.

Table 6.1 - Population Projections

Grow	Years	0.25%	0.50%	0.75%	1.00%	1.25%	1.50%	2.00%
2006			10,828					
2011			11,280					
2016			11,615					
2021			12,042					
2026	5	12,200	12,300	12,500	12,700	12,800	13,000	13,300
2031	10	12,300	12,700	13,000	13,300	13,600	14,000	14,700
2036	15	12,500	13,000	13,500	14,000	14,500	15,100	16,200
2041	20	12,700	13,300	14,000	14,700	15,400	16,200	17,900
2046	25	12,800	13,600	14,500	15,400	16,400	17,500	19,800
2051	30	13,000	14,000	15,100	16,200	17,500	18,800	21,800
2056	35	13,100	14,300	15,600	17,100	18,600	20,300	24,100
2061	40	13,300	14,700	16,200	17,900	19,800	21,800	26,600

All numbers rounded to nearest 100 population
Projected growth - RDOS OCP at 1.25%

Over the next 10 years, the population could grow from 12,042 persons to somewhere in the range of 13,600 persons. This amounts to approximately 1,550 persons or 700-800 development units. As the majority of development will occur within the urban development boundary for Summerland, a significant portion of the development will be multiple-family housing. The domestic demand for these units is in the range of only 1,152 L/day/unit. It is expected that the annual water demand increase to be only 320 ML over a 10-year span.

Development areas within Summerland are illustrated in Figure 6.3. Densification and infilling are expected in the Trout Creek area, Victoria Road South, south of Cedar Avenue, and in the Downtown and Old Town areas of Summerland.

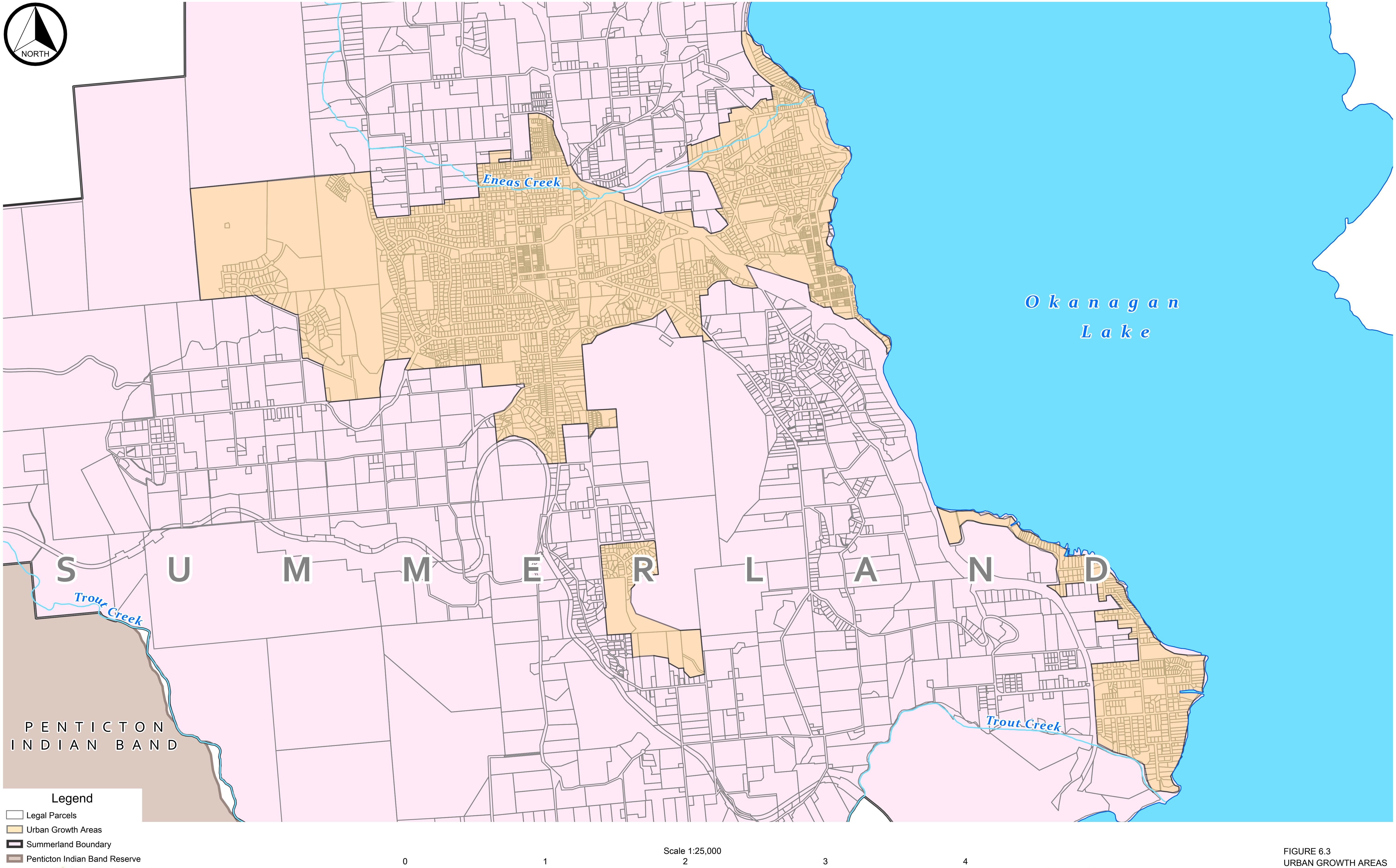


FIGURE 6.3
URBAN GROWTH AREAS

DISTRICT OF SUMMERLAND

CTQ

Agua Consulting Inc.
"Engineered Water Solutions"

6.7 FUTURE IRRIGATION WATER DEMAND

The characteristics of irrigation have changed in the past 20 years. The agricultural planting and irrigation application techniques have become much more efficient. The crops themselves have also changed with more plantings of vineyards which use less water than fruit trees. Table 6.2 provides a snapshot of the annual demand for 2011 and the most recent years from 2018 to 2021. Three of the last four years had rainy seasons within the growing period so the irrigation used is factored to an expected total water demand in an average irrigation season. The year 2021 was very dry and it was estimated that irrigation usage was approximately 11% above that of an average year.

Table 6.2 – Metered Water Use on Arable Lands

Year	(ac.)	(ha.)	Conn.	Current Year Usage (ML)	Irrigation Depth (mm)	Normalized Annual (ML)	MF to normalize demand
2011	3188.0	1290.1	478	5139.0	398		
2018	2987.2	1208.9	482	4209.6	348	4478	94%
2019	2995.4	1212.2	479	4099.8	338	4505	91%
2020	2996.2	1212.5	479	3952.9	326	4492	88%
2021	2996.2	1204.2	477	4994.7	415	4500	111%

Adjusted number column is based on the recorded demand averaged up based on the District flow records for the past 5 years.
The 2011 number is averaged for the period of time from 2005-2011.

As noted in Table 6.2, there is a notable difference from 2011 and this is primarily due to the separation of Garnett Valley, Jones Flats and the second phase of Prairie Valley that took place in 2011.

In moving forwards, there is the potential for more agriculture in the region which will have a much larger impact on water demands than population growth and densification.

Some of the larger farms have moved away from the co-operatives and are marketing their own product. This has cut out the middle handling costs and has made these producers more competitive. As a result, there are several large-scale family farms in the Okanagan that are farming more than 500 acres of high-density fruit plantings. The largest expansions in agriculture land-use are seen in the planting of cherry orchards and vineyards.

At a community-wide level, Summerland must determine to what extent it supports agriculture. To allow the extension of water supply to lands for agriculture, the cost of supply, and the lands to be serviced must be defined. A guideline for Capital Costs required for agriculture is provided in Section 7 that sets out their share of those costs that they would be expected to cover, i.e. the storage and conveyance costs but no treatment.

In the Summerland region, there are lands that could be developed for agriculture. These lands have been selected based on topography, having slopes at 15% or less, being of in a location where the extension of services is possible, and being located at an elevation that is below the 1,000 metre (3,300 ft) elevation, which is considered the upper limit for orchard development in the region. Summerland's permitting process includes environmental assessments.

Table 6.3 - Potential Agricultural Water Demand

Parcel	Area Description	Depth (m/yr) *	Total Area (ha.)	DoS (ha.)	Pent. IB (ha.)	RDOS (ha.)	TOTAL (ML/yr)	DoS (ML/yr)	PIB (ML/yr)	RDOS (ML/yr)
	Current Irrigation Demand	0.374	1204	1204				4500		
	Subtotal - Current							**4500**		
	Difference to full Allocation	0.426	1212	1212				5166		
	Infilling of Dry Lands	0.800	300	300				2400		
	Subtotal - Full Allocation							**12066**		
1	Garnett Valley - East Ridge	0.747	333	333	0	0	2488	2488	0	0
2	Prairie Valley North	0.652	185	185	0	0	1206	1206	0	0
3	Trout Creek - South	0.765	120	0	120	0	918	0	918	0
4	Bathville Road	0.668	109	0	83	26	728	0	554	174
5	Trout Creek - North	0.703	132	57	52	23	928	401	366	162
6	Trout Creek - West	0.637	188	0	0	188	1198	0	0	1198
	Subtotal - Potential		**1067**	**575**	**255**	**237**	**7465**	**4094**	**1838**	**1533**
	TOTAL		**2579**	**2087**	**255**	**237**	**7465**	**16161**	**1838**	**1533**

* Depth based on BC Agriculture water calculator or forage crop and sandy loam soil

Table 6.3 provides a summary of the existing use within the Summerland water service area. The existing recorded water use is provided. The annual differential volume to provide all properties with their full allocation of water is provided (additional 426mm depth). The current average usage is less than half of the depth of water permitted. The costs incurred by the water utility are reduced as the agricultural customers are using what they need and not their full allocation. In the longer term, an annual water demand of 16,161 ML/year has been identified. Summerland currently has 20,935 ML/year of irrigation licensing in place on Trout Creek and Eneas Creek.

The factors to consider regarding how much irrigation water each parcel should receive is listed as follows:

- Assigning an annual depth of 800mm of irrigation water to all arable land results in approximately 9,700 ML of water to be set aside for existing customers;
- Many crop types and soil types require less than 800mm water depth per year, but the water is designed to be available to service all types of agriculture and outdoor water use;
- The issue of providing water to more connections is a politically sensitive issue. The existing customer base is protective of its allocation but must understand that costs are rising and having more acreage and agricultural customers reduces the unit cost and rates;
- In review of metered demands for 2021, it is apparent that someagricultural water users were above 600mm depth of water annually for their acreage, with several above the 800mm depth allocation. There are also many parcels that pay the arable land charge that use very little water but are protecting their water rights and paying for system maintenance. **No changes are recommended for the annual allocation depth for Summerland which is consistent with calculation tools provided by the Province.**

Figure 6.5 - Available Source Capacity / Projected Water Demand

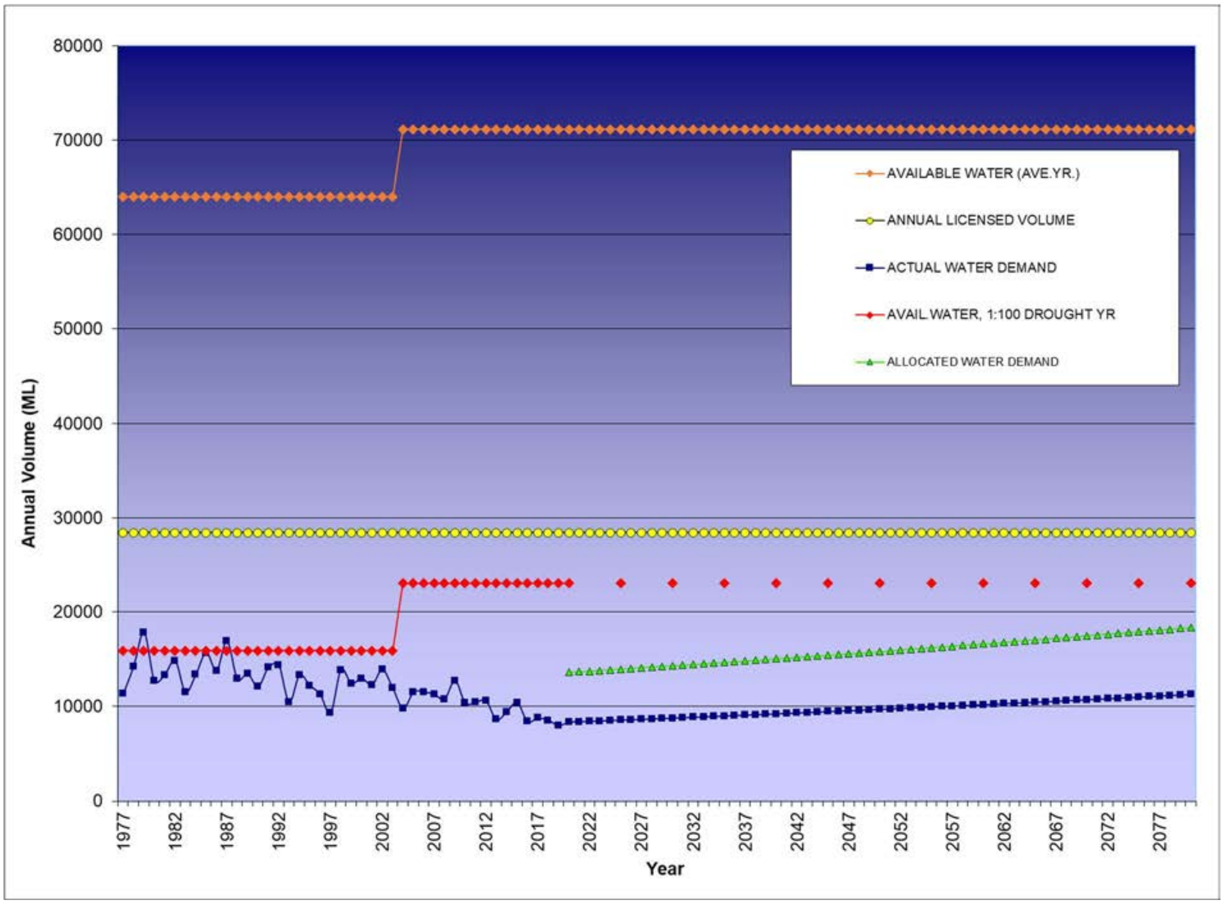


Figure 6.5 provides a long-term trend for Summerland's water supply. Trend lines within Figure 6.5 starting from the top down, are described below.

- Orange Diamonds: Source water available in an average year from all available sources. The groundwater and Okanagan Lake capacities are added in 2004. There have been forecasts of declined water supplies due to global warming however, the line is kept constant as in the future, we believe there may be more water in the high elevation watersheds;
- Yellow Circles: Annual consumptive licenses - Irrigation and WWLA licenses = 28,436 ML/yr.;
- Red Diamonds Source water available in an extreme 1:100-year event drought;
- Dark Blue Squares Historic & current water demand increasing at 0.50% rate annually.
- Green Triangles Domestic and full irrigation allocation (800mm) starting at 14,050 ML/year in 2020 and increasing demand at a 0.50% annually;

The graph shows that Summerland is in good shape in terms of raw water supply. As part of the longer-term trend to be more sustainable and reduce costs, continuing with the separation of the water distribution system is a sound approach.

6.8 Distribution System Separation

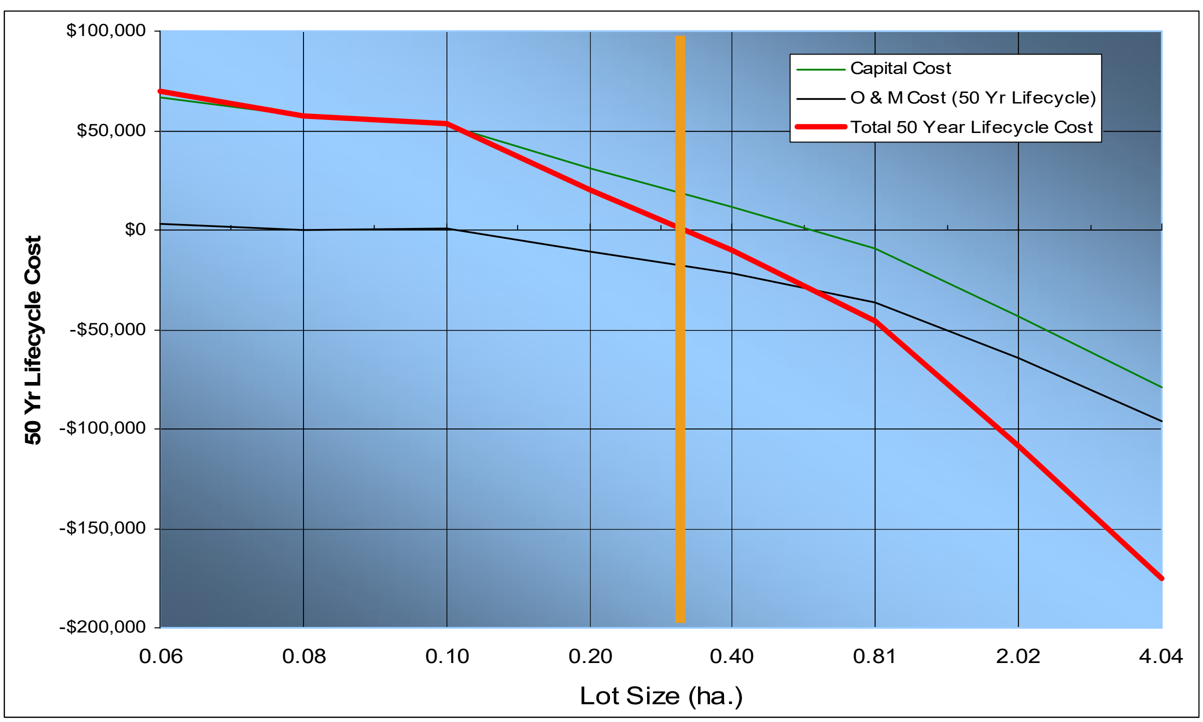
In 2008, the District of Summerland completed the Water Treatment Plant (WTP) below Summerland Reservoir. The WTP has a hydraulic capacity of 75 ML/day which was insufficient to supply the total year 2008 maximum day demands of 112 ML/day. At that time 98 ML/day was consumed within the Trout Creek water service area and 14 ML/day is used in Garnett Valley.

The plan, at the time, was to build sufficient WTP capacity so that system separation of irrigation could be carried out to reduce the demands on the WTP. There have been four phases of system separation carried out since 2008. Separation has occurred in two phases of Prairie Valley, in Garnett Valley, and in Jones Flats. The result is significantly reduced demands on the WTP which in 2020, supplied maximum daily demands in the range of only 65 ML/day. In 2021, with the extreme heat, the WTP capacity of 75 ML/day was reached and water restrictions were applied.

The 2008 Water Master Plan provides a lifecycle analysis to rationalize where system separation is economically viable. The critical conclusion is that where the average lot size for an area is larger than 0.32 ha. (0.80 acre), it is more cost effective to separate the water distribution system than to treat all of the water and have a single main service the area.

As shown in Figure 6.6 below, a 50-year lifecycle cost estimate was carried out for varying irrigation lot sizes. The Capital Cost over lot size is the green line. The 50 years of operational costs are set out in the black line. The sum of the capital costs and operational costs is the red line (lifecycle cost) Where the red line intersects zero is the break-even point. Where the red line is below zero dollars, there are cost savings to separate the water system. Separation is dependent on there being a dual system to connect to.

Figure 6.6 - System Separation Lifecycle Costs (including WTP costs)



SYSTEM SEPARATION DESIGN PRINCIPLES

The following principles are recommended for the separation of the domestic and irrigation water distribution systems. For any future separation projects, these principles should be reviewed at the start of the project with the design consultant.

- Maximize the use of gravity water throughout both the domestic and the irrigation system;
- Maximize the use of existing infrastructure;
- Staging of the separated domestic water system must originate building out from the sources of raw water irrigation, i.e. Garnett Reservoir, Summerland Reservoir and eventually Okanagan Lake;
- All rural areas with average lot sizes 0.32 ha. in size, should be considered for system separation;
- If two mains are in the street with irrigation and with domestic water, all lots 0.20 ha. should be planned to have two water services;
- Garnett Reservoir water is to be used only for irrigation so that there is one less source to have to treat and maintain over time. Keep Garnett available for use as an emergency supply source;
- In time there will be water available from Okanagan Lake that can be used to supply the lower Trout Creek area with irrigation water at a reduced cost to that of the WTP;
- Where a lot has both an irrigation and domestic distribution service, the domestic water is to be used only inside the home;
- If two mains are in the street, the fire protection is provided off of the larger capacity watermain;
- Both the irrigation and domestic water distribution systems are functional and operated year-round;
- Chlorination will remain on the irrigation system indefinitely so that biofilm growth in the irrigation distribution system is managed and there is reduced potential of illness from a person drinking the irrigation water;
- Where systems are running parallel, to reduce the potential for cross connections between the water systems, a higher operating pressure should be set for the domestic system. Where this is not possible, additional focus and attention is required to ensure that there are no cross connections between the domestic and irrigation systems;
- Care must be taken to ensure the systems are fully separated and secure, and a full cross connection control program must be maintained;
- Domestic water main to as small as 50mm diameter should be considered to reduce stagnant water potential;
- In rural areas, design new watermain installations on alignments that are off-pavement and in the shoulder of the roadways;

Drawings and cost estimates for the remaining stages of system separation are included in Appendix A. The drawings provide house locations, for where watermain installation is required and where conversions of existing mains are necessary. Eight separation areas are listed and costs for each of the areas is presented on Table 6.4.

Table 6.4 - System Separation Cost Summary

No.	PROJECT NAME	ML / day	Cost per ML	EXTENSION
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	5.35	$ 386,916	$ 2,070,000
24	AILEEN ROAD - WATER SYSTEM SEPARATION	0.25	$ 760,000	$ 190,000
25	SYSTEM SEPARATION - FRONT BENCH ROAD	2.12	$ 731,132	$ 1,550,000
26	SYSTEM SEPARATION - HAPPY VALLEY	5.56	$ 345,324	$ 1,920,000
27	SYSTEM SEPARATION - HESPLER ROAD	1.27	$ 244,094	$ 310,000
28	SYSTEM SEPARATION - LOWER JONES FLATS (EAST)	10.50	$ 443,238	$ 4,654,000
29	SYSTEM SEPARATION - SIMPSON / CANYONVIEW / HILLBORN RD.	2.71	$ 974,170	$ 2,640,000
30	SYSTEM SEPARATION - VICTORIA - SIMPSON ROAD	9.22	$ 285,249	$ 2,630,000
31	SYSTEM SEPARATION - TROUT CREEK	6.95	$ 489,209	$ 3,400,000
	TOTALS	**43.93**	**$ 440,792**	**$ 19,364,000**

Table 6.4 provides an ordered structure for system separation. A critical driving factor for separation is that there is a separated system upstream, i.e. there are pipes for both irrigation and treated domestic water supply.

Cost-benefit details are provided in the table to show how the areas compare in terms of cost and reduced demands on the WTP. A description of each column in Table 6.4, starting from the left, is described as follows:

1. Project Number - Project Number as listed in Appendix A;
2. Project Name; If implemented, the estimated reduced MDD flow on the Summerland WTP;
3. Cost effectiveness ratio of the project in Cost/ML/day;
4. Project Cost;

The projects are generally listed in the recommended order of implementation. Funding and development contributions will influence the program as will the implementation of supply from Okanagan Lake. A separation study that includes other asset conditions, such as roads, electrical and wastewater, should be considered.

Separation projects should continue over time as this will free up WTP capacity for domestic water needs. In planning of the water system, larger future irrigation expansion should come directly from the raw water sources and should not be routed through the Summerland WTP.

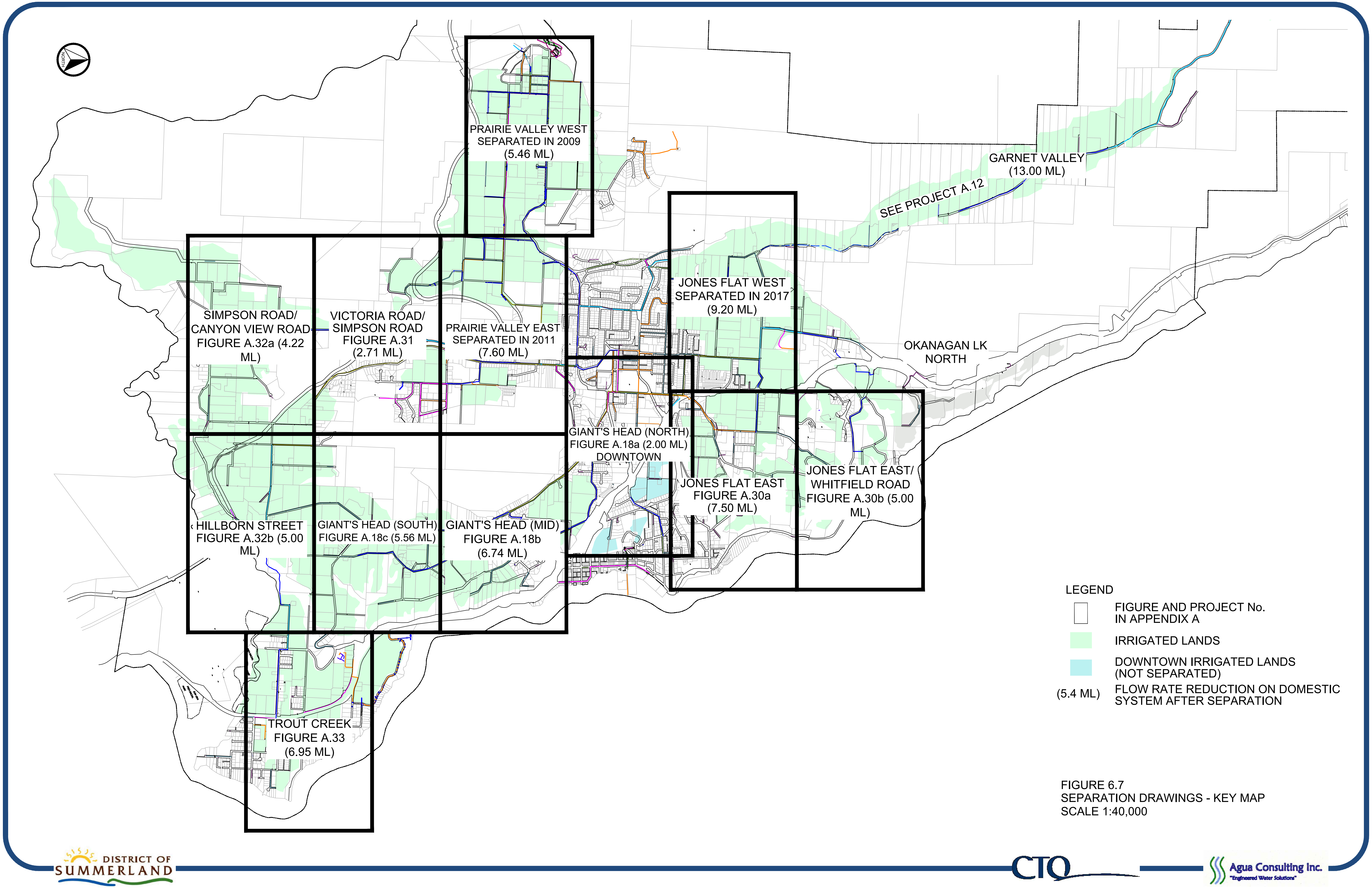


FIGURE 6.7
SEPARATION DRAWINGS - KEY MAP
SCALE 1:40,000

6.9 WATER SERVICING STRATEGY - LOT SIZES- 0.50 AC. TO 2.00 ACRES

A challenging water servicing issue for the District of Summerland is the water supply to lots 0.50 to 2.00 acres in size. Most smaller lots are serviced with a single domestic water service line. Most of the larger lots that are considered arable land have 38 mm diameter or larger irrigation service from which irrigation water is provided between April 1 and Sept 30 annually. The larger lots usually also have a domestic service connection for a residence on the parcel.

Principles for Water Servicing of Varying Sized Lots

Adopting a set of well-defined water servicing objectives for this situation is important in developing a plan that this simple, fair, cost effective and easy to implement. It is recommended that the following principles/objectives be adopted for the supply of water to properties within Summerland:

1. For irrigation supply, maximize the use of gravity from Trout Creek or Garnett Reservoir;
2. Separate the water distribution system in the rural areas. Expand the distribution system so that the water for irrigation does not run through the Summerland water treatment plant. This will reduce chemical usage at the plant and electrical costs for pumping of water. It will also reduce the generation of WTP sludge;
3. Maximize the use of existing infrastructure and service lines, particularly in areas where there is a dual distribution system. Use the newer pipes for domestic water supply purpose;
4. The water service lines to parcels should be set up considering whether or not the lines are:
   1 - In a separated area;
   2 - In an area to be separated or
   3 - In the domestic service area and will not be separated.
5. In the separated water distribution areas, work to develop and install two services per parcel with domestic water supplied only to the homes for indoor use. Irrigation service is to be installed for outdoor uses;
6. In the areas to be separated in the future, a single service can be installed, and a cost benefit analysis should be developed for the home owners so that they can determine if it is worth-their-while to install the second service line and meter.
7. For those areas where the water system is not separated, promote agriculture and outdoor irrigation through fair pricing and metering. A single 25mm diameter meter can flow up to 3.15 L/s which is sufficient for a 2.0-acre parcel. The average indoor domestic water use is well-known and in the range of 20 m3/month for a metered SF connection. An allocation for domestic and a differential for the outdoor amount could be assessed, provided there is a mechanism to prove that agricultural activities and gardens are the land-use;
8. Fire flow should be supplied through the higher capacity water supply system;
9. Water pricing is to be as fair as possible with a lower cost for the water that is not supplied through the Summerland WTP;

One challenge with servicing of the 0.50 - 2.00 ac lot sizes is that the customers do not all have the same end uses, capacity to pay, expectations, or understanding of the long-term objectives for community water supply.

6.10 FUTURE PROJECTS

A detailed listing of recommend water projects is provided in Appendix A of this report. A summary is provided in Table 6.5 on the facing page. The projects either improve capacity to service future development, or they correct or improve existing water supply conditions for the existing water customers.

The projects are assessed in recommended order of implementation, based on their viability, cost, and benefit to the District of Summerland. Details, rationale and cost estimates for the projects are included in the project sheets in Appendix A. The cost apportionment is assigned to the end-user group benefiting from the specific project. Costs are apportioned to either existing users or new development (possibly DCC Funded).

Projects in Appendix A are listed as either high, medium or low priority based on safety, value to the District, potential liability, reduction in health risk, and ability of Summerland to fund the works. It is recommended that High Priority projects be implemented as soon as financially possible. Projects of medium priority could be completed ahead of high priority projects only when there is opportunity such as underground construction or street paving occurring in the same area.

Projects of low priority are those that are typically attributable to new development. Those projects will be carried out by new development with minor contributions or latecomer's charges set up by Summerland. Many of the low priority projects will have timing well beyond the time-horizon of this plan, but are included as placeholders so that they are understood and not forgotten by future utility staff.

The ability to finance and timing to carry out the recommended projects is discussed in Section 7.

Table 6.5 - Project Summary List (All recommended projects listed)

Priority	#	PROJECT NAME	Current Users	DCC Project	TOTAL
H	1	Water Main RENEWAL (ANNUAL COST)	$ 504,862	$ -	
H	2	METERING UPGRADES, (ANNUAL COST)	$ 200,000	$ -	$ -
H	3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ 200,000	$ -	$ -
H	4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ 90,000	$ -	$ -
H	5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 1,090,000	$ -	$ 1,090,000
H	6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 50,000	$ -	$ 50,000
H	7	CRESCENT DAM SPILLWAY - UPGRADE	$ 210,000	$ -	$ 210,000
H	8	TROUT CREEK FLUME - REPLACEMENT	$ 7,090,000	$ -	$ 7,090,000
H	9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 67,551	$ -	$ 67,551
H	10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,350,000	$ -	$ 1,350,000
H	11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 70,000	$ -	$ 70,000
H	12	DAM SAFETY REVIEWS	$ 345,000	$ -	$ 345,000
M	13	ENEAS DAM - DECOMMISSIONING	$ 110,000	$ -	$ 110,000
M	14	WTP - SLUDGE HANDLING - UPGRADES	$ 6,280,000	$ -	$ 6,280,000
M	15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ 6,410,000	$ 6,410,000
M	16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ 2,750,000	$ 2,750,000
M	17	SOURCE WATER ASSESSMENT PLAN	$ 80,000	$ -	$ 80,000
M	18	TSUH DAM - DECOMMISSIONING	$ 70,000	$ -	$ 70,000
M	19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,110,000	$ -	$ 1,110,000
M	20	JAMES LAKE PUMP STATION UPGRADE	$ 210,000	$ -	$ 210,000
M	21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 3,490,000	$ -	$ 3,490,000
M	22	WTP - FLOWMETER AND PROGRAMMING	$ 40,000	$ -	$ 40,000
M	23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ 520,000	$ 1,550,000	$ 2,070,000
M	24	AILEEN ROAD - WATER SYSTEM SEPARATION	$ 190,000	$ -	$ 190,000
M	25	SYSTEM SEPARATION - FRONT BENCH ROAD	$ 390,000	$ 1,160,000	$ 1,550,000
M	26	SYSTEM SEPARATION - HAPPY VALLEY	$ 480,000	$ 1,440,000	$ 1,920,000
		TOTAL (Projects 5-26)	**$ 23,240,000**	**$13,310,000**	**$ 36,550,000**

The first four projects are operational projects that considered to be work-in-progress. Summerland is continuing to work on these issues which are considered to be part of the normal upgrades for a water utility. These projects cannot be funded through monies contributed by new development.

6.11 Future Water Supply Summary

The major conclusions from Chapter 6 are listed in this section and are as follows:

1. The COVID pandemic has highlighted how vulnerable we are health-wise and economically. There are many global threats that can impact on the water utility and the water utility also, through the development of proactive policies, can be part of the solution in solving local issues that are created by global threats;
2. The list of global threats and recent global warming impacts of floods, drought and forest fires highlight the need to invest in alternate supplies. Having the two watersheds, Okanagan Lake and groundwater all available in the event of an emergency makes the water supply more robust;
3. Water management challenges for the Okanagan, as listed in Section 6.3, include the restoration of biodiversity, and several other objectives that will serve us well into the future;
4. Climatic data for the Okanagan has shown that the last 10 years have seen 10% greater runoff that the 98-year average dating back to 1921. Global warming appears to be bringing warmer clouds with the ability to carry more precipitation to the valley;
5. Improved relations with First Nations should be high on the list of tasks for Summerland staff. There are numerous win-win projects listed in Section 6.5 that can be done in partnership with the Penticton Indian Band or Okanagan Nations Alliance regarding water and fisheries;
6. Domestic water demands are expected to be relatively low over the upcoming 10 years. It is estimated that the increase in water demand from some 500 dwelling units will increase the annual water demand by only 250 ML;
7. There is a greater potential for larger water demand increases from the agricultural community. There are potential agricultural lands within Summerland within the water-serviced areas, dry lands within Summerland District Boundaries, dry land near to Summerland in the RDOS and land in the Penticton Indian Band that could be used for agricultural purposes. The development of the lands identified would have to be addressed on a case-by-case basis. Summerland has sufficient licensing for these lands, but not sufficient infrastructure in place to convey the water;
8. Figure 6.5 shows the trends for domestic water, irrigation water, and available water over the next 50 years. There are no major shortfalls forecasted;
9. Separation of the water distribution system should continue over time only where it makes sense. Guidelines for the separation and the servicing of lots 0.50 acres to 2.00 acres in size is provided in Section 6.9;
10. The range of project for Summerland to carry out in the next 10 years is listed in Section 6.10 on the project list as High Priority. There are 11 projects listed as high priority projects and another 13 projects listed as medium priority.

7. FINANCIAL REVIEW

7.1 INTRODUCTION

This section provides a summary of the economic issues that impact the District of Summerland water utility. The current District of Summerland bylaws that relate to the supply water are listed in Section 7.2. The bylaws enable the District to collect funds to operate and maintain the utility. Present operating revenues and expenditures are provided as are the water fund levels.

This section reviews the financial aspects of the water utility and provides an indication of the future financial impacts and funding limitations. An economic model for forecasting financial position was developed and included in Appendix B. The model is an EXCEL spreadsheet tool that takes into account inflation, growth rates, varying rate increases and project implementation. Presently, Summerland has an old Development Cost Charge (DCC) bylaw in place that has limited capacity to collect revenue. The rationale for a revised water DCC bylaw is included.

7.2 BYLAWS AND REGULATORY CONSIDERATIONS

Any water charges issued to the public with regards to providing water service are authorized through the District of Summerland Council by the passing of bylaws. Water charges cannot be issued unless there is an appropriate bylaw that permits the charge. A summary of water related bylaws regulating the Summerland water utility are listed in Table 7.1.

Table 7.1 Applicable Bylaws Related to Water

Bylaw No.	Description	Comment
90-073	Summerland Research Station Agriculture Canada Fire Protection Bylaw (Nov 26, 1990)	A bylaw to provide water service line across the KVR trestle to the Research station for fire protection. Oldest water related bylaw.
98-001	Fees & Charges Bylaw	A bylaw authorizing the charges for municipal services
99-004	Subdivision & Servicing Bylaw 99-004 with additions (to Oct 10, 2017)	Subdivision servicing standards document for new development
2000-234	Summerland Water Service Parcel Tax Bylaw (Feb 27, 2006)	Parcel tax to service the debt for the Water Treatment Plant and for the upgrades to Thirsk Dam to those lots capable of being served by the water system
2000-194	Bylaw Number 2000-194, Development Cost Charges (Feb 7, 2006)	A charge for the purpose of providing funding for infrastructure so to offset the erosion of municipal service capacity.
2013-017	Building Regulations Bylaw	Bylaw related to all new structures and building construction projects within Summerland
2014-019	Water Utilities Bylaw	Water regulation and charges for water service (in the process of being revised)

Of the above bylaws, the *Water Utilities Bylaw* and the *Fees and Charges Bylaw* set out the majority of water charges for Summerland residents.

7.3 Revenues and Expenditures

The District of Summerland Reserve and Operating accounts that are used for specific purposes are described in this section. Current and recent annual revenues for the water utility are provided in Table 7.2.

Table 7.2 Water Utility Annual Revenues

2021 BUDGET plus history to 2016		2021 Budget	2020 Yr. End	2019 Yr. End	2018 Yr End	2017 Yr.End	2016 Yr.End
REVENUE							
DOMESTIC WATER RATES							
21-1-441-1000	COMMERCIAL RATES	-220,217	-209,431	-201,688	-192,095	-186,160	-169,681
21-1-441-3000	RESIDENTIAL RATES	-3,328,770	-3,050,576	-2,962,697	-2,791,106	-2,680,778	-2,441,661
21-1-441-7000	INTERNAL USE CHARGES	-10,797	-10,311	-12,923	-10,646	-10,970	-9,264
21-1-441-9000	DISCOUNTS TAKEN	382,258	201,135	180,438	176,797	174,852	151,209
Total DOMESTIC WATER RATES		**-3,177,526**	**-3,069,184**	**-2,996,870**	**-2,817,049**	**-2,703,056**	**-2,469,398**
IRRIGATION RATES							
21-1-442-1000	IRRIGATION RATES	-578,120	-459,510	-581,885	-569,087	-534,463	-506,022
21-1-442-2000	DOMESTIC SECOND SERVICE RATES	-35,361	-26,942	-34,217	-31,994	-30,796	-29,507
21-1-442-9000	DISCOUNTS TAKEN	61,348	42,684	51,822	49,460	49,333	47,786
Total IRRIGATION RATES		**-552,133**	**-443,768**	**-564,280**	**-551,621**	**-515,927**	**-487,743**
WATER TAX LEVIES							
21-1-445-1000	WATER TAX LEVY	-1,538,500	-1,538,430	-1,534,725	-1,530,165	-1,528,740	-1,509,930
Total WATER	Total WATER TAX LEVIES	**-1,538,500**	**-1,538,430**	**-1,534,725**	**-1,530,165**	**-1,528,740**	**-1,509,930**
OTHER REVENUE							
21-1-441-8000	ENVIRONMENTAL LEVY	-262,800	-261,470	-242,221	-227,531	-214,891	-213,052
21-1-449-1000	ADMINISTRATION RECOVERY	0	-7,820	-10,315	-9,630	-615	-920
21-1-449-9000	OTHER REVENUE	-500	-2,058	-2,201	-490	-3,216	-2,256
21-1-480-2000	TURN ON & OFF AND TRANSFERS	-10,000	-17,294	-19,493	-15,580	-18,024	-17,761
21-1-480-9000	CONTRIBUTIONS FROM DEVELOPERS	-25,000	0	0	0	0	0
Total	Total OTHER REVENUE	**-298,300**	**-288,642**	**-274,230**	**-253,231**	**-236,747**	**-233,989**
OTHER FISCAL SERVICES							
21-1-551-0000	MFA - CASH	-409,611	-390,439	-396,223	-356,618	-318,311	-284,281
Total OTHER	Total OTHER FISCAL SERVICES	**-409,611**	**-390,439**	**-396,223**	**-356,618**	**-318,311**	**-284,281**
TRANSFERS FROM SURPLUS AND RES.							
21-1-911-0000	TRANSFER FROM SURPLUS	-44,437	0	0	0	0	0
21-1-912-0000	TRANSFER FROM RESERVES	0	-704,592	-155,005	-256,372	-175,027	-121,053
Total TRANSFERS FROM SURPLUS		**-44,437**	**-704,592**	**-155,005**	**-256,372**	**-175,027**	**-121,053**
Total REVENUE		**-6,020,507**	**-6,435,055**	**-5,921,335**	**-5,765,056**	**-5,477,807**	**-5,106,394**

Water revenues over the past 5 years have been very stable. Approximately 50 % of the annual water utility revenue is generated from the Domestic Water Rates. Another 9 % is generated from the irrigation taxes on arable lands. The water parcel tax generates 25 % of the current revenue. The parcel tax revenue is to pay off the Water Treatment plant debt and debt for the raising of Thirsk Dam. This tax, as per bylaw 2000-234 will be reduced in 2027 and then will be retired as the debt will be paid off at that time.

Critical rates for generating revenue are as follows:

- Water parcel tax that generates 25% of the current total annual revenue;
- The 2022 SF domestic rate of $43.84/month + consumption;
- The Irrigation tax rate for 2022 is $202.53 /acre.

REVENUE STREAM

The District of Summerland has three reliable streams of revenue to fund the water utility and two intermittent revenue sources. The reliable revenue streams are user rates, irrigation taxes and the water parcel tax. The intermittent revenue streams include DCCs and grant funding from senior government.

1. **Domestic Water Rates:** Existing users pay domestic water fees for utilizing water for domestic purposes. This revenue forms the largest and most secure revenue generated for the utility. Rate increases or lack of increases in the user fees have the largest impact on the long-term financial health of the utility. The user fee for a single-family home in Summerland in 2022 will be $43.84 per month plus the consumption charge plus environmental fee.
2. **Irrigation Rates:** Irrigation rates are charged to all larger parcels of land in the District that are utilizing water. Land is defined as either arable or not arable, depending on whether or not water is being used. The 2022 rate for irrigation to arable land is $202.53 /acre. If the full depth allotment of 800 mm per year was used, the cubic metre water charge would be only $ 0.060 / m3. At the average irrigation depth of 340mm, the resulting volumetric cost is $0.140 / m^3. This is somewhat misleading as the majority of costs for infrastructure are not related to the volume of water used. This is discussed in the next section;
3. **Water Parcel Tax:** Water tax levies are assessed to each parcel in the District to cover the debt incurred the construction of the WTP and for the Thirsk Dam expansion. The parcel tax allows more lots to contribute and a lesser financial impact per lot. The charge is tied to the project debt and fixed over the specified period of time so once the debt is retired, the tax can no longer be applied.
4. **Development Charges**: Development cost charges produce a small revenue stream that is not reliable or secure in the same form as the tax and user fees. The revenue generated from development is subject to market sale conditions and the amount of development that occurs within the municipal boundaries. The revenue generated is directly dependant on the number of units developed and the DCC rate charged. The DCC rates must be sufficient so that the capacity of the system is not reduced as development connects to the water system.
5. **Grants**: Summerland is eligible to receive Federal and Provincial grants for critical water infrastructure improvements. Grant monies were received for the Thirsk Dam reconstruction, the WTP projects and the system separation projects.

If there is a revenue shortfall in funding a new project, the project would either have to be deferred or the District would have to borrow funds. If borrowing is required, it is recommended that the funds be built into the water rates so that over time, even if the debt is retired, the monies are available in the future for water system works.

Current and past annual expenditures for the water utility are provided in Table 7.3.

Table 7.3 Water Utility Annual Expenses

EXPENSES	2021 Budget	2020 Yr. End	2019 Yr. End	2018 Yr End	2017 Yr.End	2016 Yr.End
ADMINISTRATION AND OFFICE						
Total ADMINISTRATION AND OFFICE	610,587	591,177	524,659	487,011	432,310	414,388
Total TREATMENT PLANT	1,148,301	1,115,062	955,600	929,680	844,982	826,858
Total CHLORINATION	29,528	15,829	9,227	31,156	25,393	8,092
Total WATER TESTING	85,238	68,985	67,551	65,007	77,161	94,634
Total WATER SUPPLY	30,249	20,683	23,079	23,218	38,053	29,525
Total DAM MAINTENANCE	291,248	259,658	141,674	122,317	124,969	40,986
Total FLUME MAINTENANCE	6,585	4,893	2,246	2,991	3,217	1,495
Total DISTRIBUTION SYSTEM MAINTENANCE	432,032	381,900	416,971	356,606	402,443	347,871
Total IRRIGATION WATER METER MAINTENAN	90,530	82,819	36,803	96,702	24,768	50,803
Total HYDRANT MAINTENANCE	42,008	44,949	37,665	49,019	53,917	36,615
Total RESIDENTIAL WATER METERS	311,825	299,811	178,347	115,421	84,028	27,984
Total DISTRIBUTION SYSTEM OPERATIONS	234,405	216,704	233,201	199,967	170,323	173,543
Total CROSS CONNECTIONS	23,086	24,443	27,996	14,945	1,916	4,846
Total PRESSURE REDUCING VALVE STATIONS	150,934	70,937	80,689	135,000	134,801	127,307
Total DEVELOPER FUNDED WORKS	25,000	0	0	0	0	0
Total PUMP HOUSES	233,978	135,161	165,630	118,206	138,633	139,710
Total PREVENTATIVE MAINTENANCE	49,505	0	27,723	49,665	38,137	0
Total HYDRANT INSTALLATIONS	65,200	0	25,674	34,663	133	0
Total OPERATING PROJECTS	0	0	0	0	0	88,228
Total DEBT CHARGES	1,345,184	1,349,479	1,394,697	1,375,330	1,461,720	1,517,994
Total TRANSFER TO RESERVES	718,084	509,906	284,858	282,282	579,485	309,417
Total TRANSFER TO WATER CAPITAL	0	2,006,645	1,557,952	1,350,217	3,054,326	1,367,233
Total TRANSFER TO OTHER FUNDS	97,000	97,000	97,000	97,000	97,000	97,000
Total EXPENSES	**6,020,507**	**7,296,039**	**6,289,241**	**5,936,406**	**7,787,714**	**5,704,528**
Total WATER REVENUE FUND	**0**	**860,986**	**367,906**	**171,350**	**2,309,906**	**598,134**

Of the 2021 budgeted expenditures, approximately 22.3% will be required for debt servicing of Thirsk Dam and the WTP, another 19.0 % is required for the WTP operations, transfers to reserves is at 11.9%, administration is 10.1%, followed by water distribution maintenance at 7.2% and dam maintenance at 4.8%. These numbers are reasonable for a utility of this size and complexity. Of note and in-line with the parcel tax, the debt servicing will be reduced for 2026 and retired in 2027. There was a large expenditure in 2017 for the Garnett System Separation works.

The reduction in “Debt Charges” from 2016 & 2018 is due to the district staff refinancing the repayment of debt to a lower interest rate. This resulted in a $140,000/year reduction in interest payments. The extra $140,000 was allocated to the “*Water Capital Reserve Fund*”.

The annual cost to operate the water system, discounting the debt charges and transfers of surplus is $3,828,000 per year (see Table 7.4). For the 8,836,000 m^3 of water provided annually, the operating cost per cubic metre supplied works out to $0.43. This number is misleading as the majority of costs are fixed and required to be expended, regardless of water consumption. This is explained on the next page.

BALANCE BETWEEN DOMESTIC AND AGRICULTURAL CUSTOMERS

As a small community with a large agricultural component, Summerland must understand and maintain a balance in servicing their different customer groups. Each of the customer groups must pay a fair share for water. There are challenges in finding a balance so that each customer group believes that all contributors are paying a fair share of the operating costs of the utility. With Summerland, the agricultural community uses approximately half of the annual water, yet the operating costs by the utility for this customer group is minimal.

The expensive components of water supply are the cost to treat water, and the 24 hour – 365 days per year level of service expected with a domestic water supply system, including the emergency supply components and meeting the high standards of the regulator.

There are fixed and variable costs that must be considered when determining water rates. The expenditures were reviewed from the perspective of whether they were "variable costs" that increase with water consumption, or if they were "fixed costs" that are incurred regardless of water usage.

Variable Costs include power to run pumps within pump stations and the operating equipment within the water treatment plant including water treatment chemicals and chlorine.

Fixed costs include administrative fees, staff salaries & wages, building maintenance and depreciation, equipment to operate and maintain the system, and water distribution system repairs. These expenditures are relatively consistent throughout the year and do not vary seasonally. They are incurred regardless of water usage. If the debt servicing and transfers to reserves are not included in the totals, the fixed charges amount to 79.1% as summarized in Table 7.4.

Table 7.4 - Fixed and Variable Costs (based on 2021 budget)

Description	Amount	% of Total	% of Rem.
Fixed Costs	3,053,630	50.72%	79.1%
Variable Costs	806,609	13.40%	20.9%
Operation Cost Subtotal	3,860,239		100.0%
Debt Servicing	1,345,184	22.34%	
Transfers	815,084	13.54%	
Total Costs	6,020,507	100%	

If water rates are heavily weighted on metered usage, there is the risk that the water revenues may be insufficient to fund the utility during wet years. Rates should be set to encourage water conservation to defer or delay system expansion and reduce operating costs. The primary objective, though is to ensure that the rates cover the full cost to provide service.

It is recommended that, the base charge for domestic water be at least 70 - 75% of the total annual per lot revenue. Summerland's average single family water rate is estimated to be $638 per lot, with the base charge being 75% of that amount. **No revisions are recommended for the existing rate structure.**

Irrigation Rate Worksheet

The supply to agricultural land is often deferred to metering and volumetric pricing. Staff and elected officials in many communities are not aware of the fixed and variable cost components of water supply. The word “subsidized” is used often by these communities and there is often friction between the agricultural community and the urban customers.

With the majority of water utility expenditures being fixed, the water supply revenue is to fund the “Cost of Service”. In an attempt to show the components of “Cost-of-Service” the spreadsheet in Table 7.5 was developed by Agua for other Okanagan communities. It has been adjusted to show the position of agricultural water supply costs in Summerland.

Table 7.5 has inputs for annual usage, irrigated annual usage, annual renewal contribution and an estimate of the Single-family Equivalent value to 1.0 acre of land. The equivalent value for various irrigation lot sizes is compared to that of an average single-family lot within the hidden lines of the spreadsheet. Each lot larger than 0.5 acres was assumed to have both a domestic and an irrigation connection.

The spreadsheet summarizes three components of water utility expenditures:

1. Variable charges that would be assessed to the agricultural component of the water supply;
2. Apportionment of labour to agriculture which is a significant component of the fixed costs;
3. Apportionment of the renewal costs based on a ratio of lot frontage.

The most sensitive input to the irrigation rate is the District’s annual investment towards water system renewal. This cost would include renewal of water mains and/or services anywhere within the District. With an annual contribution to renewal of $590,000 the irrigation rate should be $216 to $239/acre. If renewal contribution is increased to $ 1,000,000/year, the rate per acre goes to $250 - $280/acre. If increased to $ 1,500,000 / year, the rate increases to $305 - $328 per year.

To reduce costs in the long term, there are two paths available to Summerland: one is to restrict water use and increase the price of water and tighten up on allocations and the second is to promote efficient water usage and get more acres connected to the system. Having more acres connected creates an economy of scale that brings the unit costs down. The arable land irrigation rate for 2022 is $202.53 per acre.

Land Use and Water Rates

To reduce conflict in the supply of water to arable lands, it is recommended that Summerland avoid making value decisions for irrigation water based on land-use, i.e. If there is a hobby-farm with horses, without agricultural farm status, but still in the Agricultural Land Reserve (ALR) beside a working apple orchard, the water rights and irrigation rates for the two parcels should not differ. The water supply costs for either identified parcel above costs Summerland the same.

Some communities defer to BC Assessment for the land use to assess agricultural land for water rates. This may result in the non-farm status land to use less water or no water. The risk of no revenue is created and the remaining users have to fund the difference. The Summerland water utility is a “Water Provider”, not a “Water Restrictor”

Table 7.5 - Irrigation Rate Worksheet

REVENUES	**2021 Budget**		**Percentage**				**0.000**	input cell
Taxes	$ 552,133		13.708%				**$ 100**	calculated cell
Tolls	$ 3,177,526		78.887%					
Other revenue	$ 298,300		7.406%					
TOTAL	**$ 4,027,959**		**100.000%**					
EXPENDITURES	**2021 Budget**		**Fixed Costs**	**Variable Costs**			**Labour and OT**	
Administration	$ 610,587		$ 610,587	$ -			$ 237,455	
WTP, Chlor, WQ testing	$ 1,263,067		$ 625,000	$ 638,067	Chemicals / Utilties		$ 390,619	
Dam Maintenance	$ 328,082		$ 307,832	$ 20,250	Dam and upstream works		$ 50,375	
Water Distribution	$ 871,236		$ 832,910	$ 38,326			$ 444,991	
Water Meters	$ 402,355		$ 397,355	$ 5,000	Irrigation and Domestic		$ 75,051	
Pump Stations / PRVs	$ 384,912		$ 279,946	$ 104,966	Elect / chlorine		$ 88,236	
	$ 3,860,239		**$ 3,053,630**	**$ 806,609**			**$ 1,286,727**	
% Fixed vs Variable	**100.00%**		**79.1%**	**20.9%**			33.33%	
VARIABLE COSTS								
Category	**Indoor %**	**ML/ yr**	**Outdoor %**	**ML/yr**	**TOTAL**			
SF Lots	9.30%	830	9.30%	830	1660	**8,927**	Input total ML/year	
MF Units	1.80%	161	0.80%	71	232	**Notes:**		
Commercial ICI	3.30%	295	0.00%	0	295	4572 ML Total supply to arable lands		
Agricultural - Grade A	0.00%	0	51.20%	4571	4571	1733 ML Prairie Valley/Garnett separated supply		
Leakage - UFW	24.30%	2169	0.00%	0	2169	2839 ML Irrigation supplied through WTP		
Totals	**24.29%**	**3455**	**61.30%**	**5472**	**8927**			
Total Variable Costs			20.90%	$ 806,609				
Irrig. ML divide by Variable costs	Input Irrigation ML		**2839.0**	$ 0.0904	variable cost / m3		Method 1	Method 2
Per m3 amount for arable graded land to cover variable costs					Variable Costs		**$ 256,521**	**$ 256,521**
LABOUR COST SPLIT BASED ON 6 MONTH IRRIGATION SERVICE								
Method 1 estimate: 33% Labour Expenditure for 6 month irrig.						Method 1 =	$ 214,240	
Method 2 Apportionment of incurred labour is assigned to irrigation					Office labour			$ 60,000
					Common Expenses			$ 50,000
					Field costs WD/Watershed			$ 175,000
					Range of Labour Cost		**$ 214,240**	**$ 285,000**
RENEWAL COST BASED ON LOT FRONTAGE			184	km of existing watermain		**$ 590,000**	Input annual renewal contribution	
Lot Size (ha.)	0.045	0.065	0.101	0.202	0.404	0.810	2.020	4.040
LOT SIZE (Acres)	0.11	0.16	0.25	0.50	1.00	2.00	5.00	10.00
TOTAL RENEWAL COST	$ 7,875.00	$ 8,250.00	$ 8,812.50	$ 9,975.00	$ 19,125.00	$ 21,450.00	$ 28,575.00	$ 38,775.00
RATIO ACRE / SFE unit	0.95	1.00	0.76	0.62	1.57	0.87	0.51	0.38
Irrigation area ratio to SFE - average parcel size between 2-5 acres					**0.667**	SFE units = average acre		
Number of SFE units within Summerland		4821		4821	70.84%	$ 417,965		
Arable lands convert acres to SFE units		2975		1984	29.16%	$ 172,035	$ 172,035	$ 172,035
Total SFE units for frontage calculation			SFEs	**6805**	**100.00%**	**$ 590,000**		
RENEWAL APPORTIONMENT FOR IRRIGATION					Renewal Costs for Irrigation		**$ 172,035**	**$ 172,035**
TOTAL = Variable costs + Labour (fixed) + Renewal (input)						Total Costs	**$ 642,796**	**$ 713,556**
Arable Land		2975	acres				Method 1	Method 2
				IRRIGATION RATE per ACRE			**$ 216.07**	**$ 239.85**
						w/o Renewal	$ 158.24	$ 182.02

7.4 EXISTING DEBT SERVICING

The District is currently repaying the debt on three loans, two for the Water Treatment Plant and one for Thirsk Dam. The debt will be partially retired in 2026 and full repaid in 2027. Amounts owing are listed in Table 7.6

Table 7.6 - Summary of Long-Term Debt

Bylaw No.	Amount	Name	Debt Retired Date	Interest Rate (%)	End of 2020	End of 2019
00-161	$ 6,000,000	WTP Oct 13, 2005	2025	1.80 %	$ 1,944,047	$ 2,294,316
00-213	$ 6,000,000	Thirsk Dam April 19, 2006	2026	1.75 %	$ 2,314,354	$ 2,649,850
00-195	$ 6,000,000	WTP Nov. 2, 2007	2027	2.25 %	$ 2,649,850	$ 2,972,443
		TOTAL			**$ 6,908,250**	**$ 7,916,609**

In 2021, the debt was paid down by $1,046,941. The water system debt repayment schedule based on the 2020 Summerland Financial Statement is as follows. The amounts listed do not include the interest payment which has been in the range of $300,000 per year.

Year	Payment	Remaining Debt
2020		$ 6,908,251
2021	$ 1,050,583	$ 5,857,668
2022	$ 1,088,945	$ 4,768,723
2023	$ 1,128,731	$ 3,639,992
2024	$ 1,169,995	$ 2,469,997
2025	$ 1,212,794	$ 1,257,203
2026 -retired	$ 1,257,203	
TOTAL	**$ 6,908,251**	

The revenue collected through parcel taxes will be terminated as the debt for the three loans is retired.

7.5 CURRENT WATER FUNDS

The District of Summerland Reserve and Operating accounts that are used for specific purposes are described in this section.

1. **Accumulated Operational Surplus**
   These funds are the operating funds that are accumulated over time. These funds can be used for operational items as well as capital items if council approves their use for specific capital works. User fees and Parcel Taxes collected are accumulated here and are utilized to pay for day-to-day operations and, when necessary, emergency works. These monies do not collect much interest. A minimum balance of $500,000 should be available at all times in the event of an emergency.

2. **Development Cost Charge Reserve Fund**
   This is a reserve account for the District for Capital funds for water system improvements paid for by new development. The monies within this fund collect a small amount of interest. This fund is to be used to offset the erosion of capacity of larger items such as dams/reservoir storage, water treatment, and/or transmission mains.

3. **Capital Works Reserve Fund**
   This fund is a holding account for monies for upcoming capital works that is funded by existing ratepayers. This is a statutory fund meaning that a disbursement bylaw is required from council to draw down on this reservoir fund.

Table 7.7 - Recent Year-End Annual Fund Balances

Water Reserve Levels at Year End	2018	2019	2020
Accumulated Operational Surplus	$ 1,113,991	$ 1,935,052	$ 2,272,235
Statutory Funds			
Development Cost Charge Fund	$ 226,733	$ 345,382	$ 383,529
Capital Works – Water	$ 1,057,188	$ 1,195,524	$ 930,241
Statutory Reserve Funds	$ 1,283,922	$ 1,540,906	$ 1,313,770
TOTAL AVAILABLE	**$ 2,397,913**	**$ 3,475.957**	**$ 3,586,005**
Equity in Physical Assets	$ 53,110,895	$ 53,368,321	$ 54,217,605
Replacement Value in Current day dollars	$ 168,125,000	* $ 171,487,500	$ 174,917,250

* Escalated 2.0% from the 2018 value obtained from the Asset Management Consultant report

The "Equity in Physical Assets" value is obtained from the District's financial statements. It is an accounting value based on additions made to the water system each year and system depreciation over time. The equity value is not escalated to current year value and is used primarily as an inventory tracking number to assess asset depreciation. The replacement value for the water utility asset is considerably larger. The replacement number is the value if all of the assets were to be replaced today.

7.6 System Renewal

The recent asset management reports recommended the need to increase investment in renewal works. The plan concluded that for the utility to be sustainable for the long-term, a recommended annual contribution of $3,000,000 / year should be made for renewal projects or for contribution to a renewal reserve. The current annual contribution to renewal is approximately $500,000 for distribution system main renewal plus another $110,000 per year to renew the PRV stations to above ground locations.

When discounting debt servicing and reserve transfers, the current annual revenue generated by Summerland to operate and maintain the system is $3,100,000. The asset report also identified that the remaining average lifespan remaining for the utility to be 36%. The analysis was conducted looking forward to a 30-year horizon.

The current replacement value of water system assets was estimated by Asset Management Consultants to be as listed in Table 7.8.

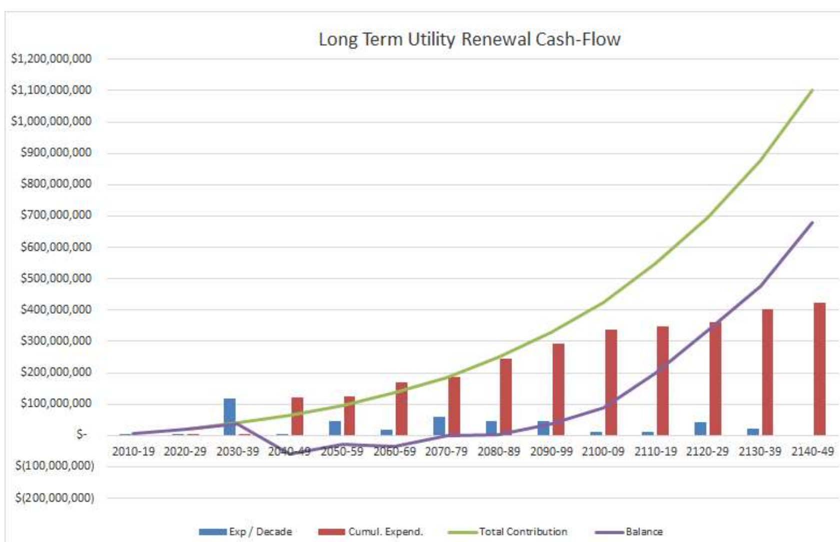
Table 7.8 - Water System Replacement Value (source Summerland Asset Management Plan Dec. 2018)

Asset Item	Number	Replacement Value
Raw Water Dams & Reservoirs	11	$ 45,400,000
Water Treatment Plant	Class IV Plant, 75 ML/day	$ 20,568,000
Water Mains	199.5 km	$ 77,010,000
Service Connections	6,123	$ 14,697,000
Hydrants	443	$ 4,496,000
Pressure Reducing Stations	9	$ 3,626,000
Pump Stations	3	$ 3,626,000
Concrete Water Reservoirs	3	$ 800,000
TOTAL		**$ 168,125,000**

If the recommended increase was implemented, it would result in a substantial increase in water rates. Prior to making substantial changes to the water rates, it is recommended that the following steps be taken to better understand the real condition of the water system.

- **Confirmation of Pipe Lengths:** A summary of lengths of watermain in Summerland and the date of installation of that watermain is provided in Table 4.8 of this report. The data from the computer model was checked against the GIS and recent asset management work. There were discrepancies found in total length of main and service line. The Agua data showed 185 km of water main with 8.0 km smaller than 100mm diameter size. The recent asset management work showed 199 km of main with 12.5 km smaller than 100mm diameter. There are also discrepancies in the amount of 150, 200 & 250mm AC main in the ground.
- **System Separation Data:** There have been watermain renewal works in Prairie Valley, Garnett Valley and Jones Flats to separate the irrigation and domestic water systems. Parts of these areas have been renewed, and although there is some older pipe still remaining, much of the older cast iron pipe has been either abandoned or replaced with PVC mains. Additional investigative work would be required to verify the accuracy of water system lengths that are renewed;

- **AC Pipe Condition:** AC pipe is considered to have a lifespan of between 50 and 75 years. The lifespan is longer in areas of granular soils and no groundwater. This is the ground condition through much of Summerland. Tests can be run on the domestic water to determine if there are Asbestos Concrete fibres in the water mains. The fiber count is one method to assess the internal integrity of the AC mains. Also with any excavations or renewal work, the pipe should be uncovered and reviewed for strength and hardness. Works staff with excavations near the pipe should, where practical, visually inspect and document the condition of the outer pipe where possible. In the right conditions, this pipe should function well beyond a 75-year lifespan;
- **Average Cost Per Water Main:** the cost per watermain works out to $385.00 per metre. Although some of the larger diameter mains will cost more than this, the majority of water mains should be under $200/m in current year dollars. The cost for road reconstruction should be part of the road asset inventory and water main renewal should take place concurrently with the road renewal. It should be confirmed that there is no double counting of renewal works.
- **Cast Iron Pipe Renewal:** There is 27 km of cast iron pipe in the ground with 24.0 km of it installed in the 1930s. Much of the small diameter pipe is located in the urban areas of Summerland where there already exists a second water main in the same road right-of-way. Much of this cast Iron pipe may not have to be renewed. It is possible that it was included in the renewal calculations. This pipe represents 15% of the total District mains 90% of the mains older than 1960;
- **Dam Stability and Maintenance:** The renewal cycle for the dams should not require a full rebuild. The recent renewal at Thirsk dam is an example of the ability to concrete structure originally built in 1940 for much less than the cost of a full rebuild. The majority of Summerland's dams are earth-berms and have minor maintenance and a long but undetermined lifespan;
- **Review Asset Lifespan:** The lifespan estimates for the water assets are conservative. The asset management consultants must follow recommended guidelines when assessing infrastructure. With limited time in understanding the utility, the numbers used for system lifespan should be conservative. Summerland should review the lifespan estimates for the various system components. The dams are an especially difficult asset to estimate due to them being stationary structures;
- **Period of Analysis:** The period analyzed was limited to the next 30 years. With some of the infrastructure expected to last more than 100 years, a longer lifecycle is useful in determining the full pattern of renewal that Summerland is facing.



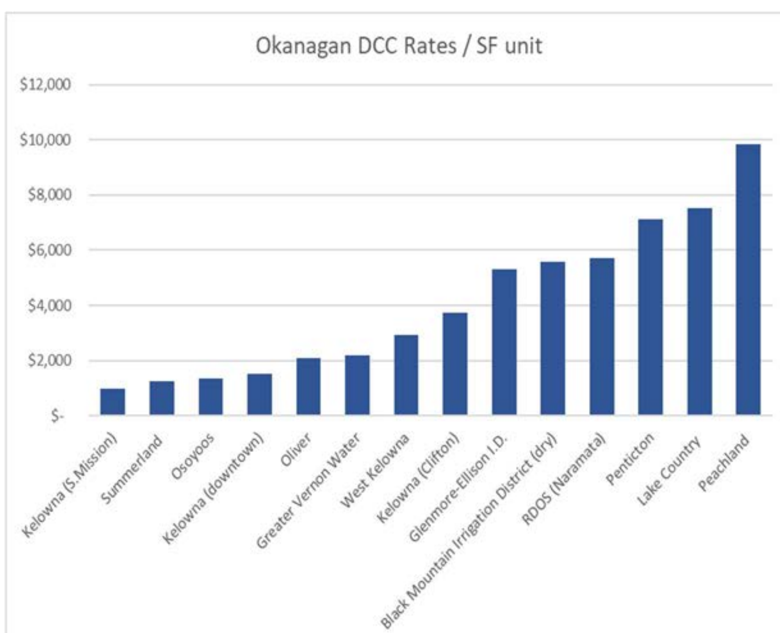
7.7 Development Cost Charges (Water)

Development cost charges have not been renewed for many years. The current bylaw is based on reservoir storage projects provided in an older UMA engineering report that is now outdated. A listing of local DCC / Capital Expenditure Charge rates in the Okanagan Valley is provided in Table 7.9.

Table 7.9 - Current Development Cost Charge Rates

Water Supplier	Bylaw Date	SF (per lot)	MF (per unit)	Irrigation (per acre)
Kelowna (S.Mission)	2020	$ 995	$ 666	n/a
Summerland	2021	$ 1,257	$ 880	$ 4,047
Osoyoos	2016	$ 1,355	$ 542	n/a
Kelowna (downtown)	2020	$ 1,503	$ 1,007	n/a
Oliver	2017	$ 2,097	$ 874	n/a
Greater Vernon Water	2017	$ 2,180	$ 1,857	n/a
West Kelowna	2015	$ 2,938	$ 2,203	$ 6,540
Kelowna (Clifton)	2020	$ 3,729	$ 2,498	n/a
Glenmore-Ellison I.D.	2015	$ 5,300	$ 3,535	n/a
Black Mountain Irrigation District (dry)	2017	$ 5,580	$ 4,460	$ 4,516
RDOS (Naramata)	2017	$ 5,700	$ 5,700	n/a
Penticton	2008	$ 7,119	$ 368	n/a
Lake Country	2016	$ 7,533	$ 4,897	n/a
Peachland	2017	$ 9,849	$ 3,628	n/a
				n/a Not Available

Most of the communities revisit their DCC list every 5 to 10 years as the eligible projects and costs are updated. Summerland should be able to proceed with an independent bylaw without being delayed due to timing not being aligned with other utilities. As their characteristics and demands on the Summerland water system vary, we have provided comments on the development of residential DCC rates and Irrigation buy-in rates. To develop fair water development charges for Summerland, the issues on the following pages should be considered. Comments are provided for both domestic and irrigation customer groups.



RESIDENTIAL DEVELOPMENT DCCS

Residential DCCs will form the majority of revenue from development in the upcoming years. The rationalization of costs for DCC rates is based on the sum of the four water supply components.

1. **Source Capacity Replacement:** Source capacity is measured in terms of annual water demand. The average single-family equivalent (SFE) lot is estimated to use 400 m^3 per year or a volume of 0.40 ML. The cost to construct reservoir storage in the upper watershed to maintain the current reservoir storage volumes is estimated to be $2,500 / ML. For a SFE equivalent lot, the cost for source capacity replacement is estimated to be **$1,000.**

2. **Water Treatment Plant Capacity Replacement:** WTP capacity is measured in terms of daily treatment capacity as the plant must be sized to handle the maximum daily demand. In Summerland, the peak usage for a single family equivalent (SFE) lot is estimated to use 4,800 L/connection per day or 0.0048 ML/day. The present-day cost of the WTP is approximately $20,600,000 for a capacity of 75 ML/day. The cost per ML works out to $275,000. For a SFE unit, the WTP capacity replacement cost is estimated to be $1,320. (round to **$1,350**)

3. **Distribution Reservoir Capacity Replacement:** Reservoir storage costs are to be replaced over time as every SFE connection that is added to the system requires balancing storage, fire storage and emergency storage. Concrete reservoir storage is estimated to cost $800 per every cubic metre of storage volume constructed. Reservoir fire storage is not included in this calculation as the fire storage component is already in place for a fire demand of up to 225 L/s for the main pressure zone and downtown areas. Based on the MDD flow per SFE unit of 4,800 L/SFE/day, the balancing volume of 1.20 m3 (plus emergency storage of 25%) is 1.50 m^3 per unit. This works out to a SFE rate of (rounded to **$1,200**).

4. **Conveyance Capacity Replacement:** There are few conveyance capacity projects listed in the Capital Plan as they are built into larger projects such as the flume replacement or the development of the Okanagan Lake source. The conveyance capacity is to replace larger transmission mains in the streets. The conveyance works are rolled into other larger projects such as the system separation works or the Okanagan Lake pump station so they are covered off in the other line items. A nominal allowance is included for water distribution projects of **$450** /SFE lot.

The total rate works out to be $4,000 per SFE unit.

For simplicity, it is recommended that the rates for various land-use classifications be based on a ratio of the rate for one SFE housing unit. An example rate sheet is set out at the end of the projects in Appendix A.

Agriculture / Irrigation DCC

Presently Summerland has a buy-in for the purchase of water supply rights for agriculture lands. Through some of the Okanagan, water supply for agriculture is facilitated through a rate structure that presumes that only raw water is required. During the past 30 years, there has been minimal expansion of agricultural lands and water for agriculture. This is starting to change with recent significant expansions of vineyards and cherry orchards throughout the Okanagan.

Irrigation development charges in the Okanagan Valley ranges between $4,000 and $15,000 per hectare, depending on the water utility and their specific costs. In review of the requirements, the irrigation supply should contribute to source replacement and water conveyance. Distribution system storage and water treatment are not required. A tabular summary of costs for agriculture and the buy-in to develop irrigated lands (upgrade to domestic) is provided below. This is based on a land area of a single-family lot.

DCC Component	Domestic	Agricultural	Upgrade to Domestic
Source Replacement	$ 1,000	$ 800	$ 200
WTP Capacity	$ 1,350	-	$ 1,350
Distribution Storage	$ 1,200		$ 1,200
Conveyance	$ 450	$ 200	$ 250
TOTAL	**$ 4,000**	**$ 1,000**	**$ 3,000**

For determining single family lot development costs, it is assumed that 10 SF lots per hectare can be developed on reasonably sloping land. At $4,000 per SF lot, a developed site would generate $40,000 of DCC revenue. If the lands are irrigated before development takes place, there is some value in the fact that the past-owner bought-in water rights and paid maintenance and user charges (Water tax) to receive irrigation water. It is recommended that if the development land is dry-land that the full rate applies and if the land has irrigation rights (classified as arable land), then a reduced DCC would apply.

Regarding varying land-use categories such as MF, industrial, institutional and commercial lots, to account for the buy-in of water for those purposes, it is recommended that the tables DCC rates be based on a percentage of the SF rate. Single-family equivalencies should be developed for all land use categories.

Specified Area or District Wide Charges

Consideration was given as to whether the water system DCCs should be District-wide charges or-specified areas. Area wide charges are recommended as they provide flexibility for Summerland to use the DCC funds on projects where it is needed, regardless of location in the community. Having district-wide application is also simpler to administer.

7.8 WATER UTILITY – ECONOMIC MODEL

An EXCEL computer spreadsheet model was developed for use by District of Summerland staff. The model is a tool for projecting revenues and expenditures, future water rates, project costs, DCC contributions, and the impact of variables such as population growth rate, inflation and financing rates.

The model is linked to the project cost estimates. If the cost estimate for the projects is updated, the data carries through the Economic model as the worksheets are linked.

Outputs include annual projected revenues and expenditures, fund level surplus or deficits, DCC revenue and balances.

Economic Model Layout

- The economic spreadsheet model is included in Appendix B;
- The spreadsheet model is set out on three pages. The first page includes input variables and the year-end fund balances over time. The second and third pages include the project cost escalation tables over time and the proposed project expenditures;
- The model extends forwards to a 20-year time period;
- The ability to change input variables is a useful feature of the model so that factors such as growth rate, interest rates, financing costs, and inflation rate can be adjusted to determine the sensitivity of the factors. These input factors are located at the top of the first page;
- The majority of growth will be either single-family, multi-family, or agricultural development. For simplicity, the DCCs from industrial, commercial and institutional development are set as a ratio equivalent to single-family equivalent units;

Conclusions from setting up the model are listed below:

- Population growth is expected to be relatively low. The resulting DCC revenue will also as a result be low. The largest revenue potential is the MF development and densification of the Downtown and Old Town areas. Although relatively small, it is worthwhile to update the DCC bylaw as approximately $2,400,000 could be generated over a 10-year span and there are many projects that would be DCC eligible.
- Renewal is included in the spreadsheet for one PRV per year for a period of 12 years and investment in water main renewal in the amount of $500,000 escalating upwards each year;
- The model shows that the expenditures must not escalate at a rate greater than the system revenues are generated. If so, there is no possibility of carrying out future works unless there is borrowing or grant funding available.
- The two largest immediate projects included in the Economic Model are the pipe repair works for Isintok Dam, which could be considered renewal works, and the flume replacement which also could be considered renewal works.
- If these two large projects are carried out, the $500,000 to distribution system renewal may have to be deferred to the more critical renewal project.

7.9 Water Utility - Twelve-Year Comparison

This section provides growth rates and changes in rates, revenues and expenditures since the 2008 Water Master Plan. The parameters and changes over the past 12 years provide insight into what to watch out for when operating and setting water rates for the utility. The year 2020 was used as year-end final numbers were available. Table 7.10 presents water rates, number of connections, arable acres and revenues and expenditures.

Table 7.10 - Water Utility Parameters

Parameter	2008	2020	% change per Year
Annual Water Demand	12,225 ML	8,836 ML	(- 2.67%)
SF Connections	3,717	3,850	0.29 %
SFE Connections	4,640	4,821	0.32 %
SF Water Rate	$ 392.00	$ 638.89	4.15 %
Domestic Revenue	$ 1,900,939	$ 3,079,492	4.10 %
Arable Lands (acres)	3,505	2,975	**(- 1.36 %)**
Irrigation Rate	$ 117.00 /ac	$ 192.89 /ac	4.25 %
Irrigation Revenue	$ 410,109	$ 566,738	2.73 %
Total Revenues	$ 2,480,000	$ 3,940,000	3.93 %
Total Expenditures	$ 1,906,000	$ 3,571,898	**5.37 %**
Surplus (Revenues – expenditures)	$ 574,000	$ 571,000	(- 0.04 %)
Consumer Price Index	114.1	137.0	1.53 %

One item of concern is the drop in number of arable acres of land serviced. This has been reduced by over 500 acres. The revenue loss is $110,000 annually. This loss in arable land would explain why revenue from arable land has not kept up to the Irrigation rate increase.

An item of concern is the increase in expenditures. Of the programs in 2008, the metering program did not yet exist. In 2020, the program costs $380,000 and $210,000 in 2019 to operate and maintain and it does not create or gain revenue. It provides equity for users and a means for monitoring water usage. The overall district revenues are tracking at 3.93% increase over 12 years while the expenditures are tracking higher at a 5.37% increase per year. The Provincial government requires a metering program for utilities before they are eligible to receive grant monies for infrastructure, so finding meters that last longer and are less costly to maintain is an objective for the utility.

Reducing water consumption will not increase revenue, but is may reduce operating costs. The main differences between 2008 and 2020 are the reduced area of arable lands irrigated and the metering program that has added to the operating cost of the utility.

7.10 FINANCIAL REVIEW SUMMARY

A listing of the main items found in the financial review are summarized as follows:

- UFW / Leakage: In review of revenue, there is a significant component of water usage that is either leakage or unaccounted for water (not-metered). If the majority of this water is UFW (not metered), it could represent additional potential revenue for the water utility. If found to be leakage, if repaired it would reduce the operating costs for the water system;
- Parcel Tax Retirement: Annual utility revenue is in the range of $6,000,000. This amount will reduce when the Water Treatment Plant debt & Thirsk Dam debt is retired in 2027. At that time the parcel taxes amounting to $1,500,000 annually will no longer be collected. When the tax ends, the minor surplus in tax funds will no longer be available;
- Rate Increases over Time: To keep the water utility in a healthy economic position, in the long term, the rate increases must be slightly higher than the inflation rate, and the rate at which utility expenditures increase. These rate adjustments take years to gain traction, but are critical so that the utility funding is sustained;
- Renewal Investment: The Asset Management Plan for the water utility highlighted the potential need to increase water rates to allow funding for $3,000,000 / year to go towards system renewal. The additional funds from present spending is an increase of $2,400,000 annually or a 65% increase in present rates. Prior to making any significant rate changes, a list of considerations is provided in Section 7.6 as to how to logically approach this challenge;
- Fixed and Variable Costs: The review of accounts found that approximately 80% of the annual operating costs for the utility are fixed and must be expended, regardless of water usage. The 20% of the costs that are variable include items such as water treatment plant chemicals, electricity for operations and pump stations, & chlorine;
- Domestic Rate Structure: The present rate structure is solid and meets the objectives of promoting water use efficiency and providing secure revenue;
- Irrigation Rate Structure: The tax structure provides for an 800mm depth of water for the irrigated acreage. The average use across all irrigated lands is much less and in the range of 340mm depth annually. In review of the metering account data, the average depth is due to the fact that may owners with arable land base do not farm the land and use significantly less water than the average amount. In review of the high production agriculture, the drought challenges in 2021 growing season showed that the 800mm is an appropriate allocation depth number.
- **To reduce overall water rates, Summerland should consider supporting development and the expansion of local agriculture as in increase in the customer base, although it would require additional water, will reduce the fixed costs assigned to each connection;**
- Economic Model: An EXCEL spreadsheet model tool was developed and included in Appendix B of this report. The model shows that the larger projects will either require grant funding, borrowing of monies, or be deferred until sufficient funds are raised;

- Financing of Projects: The amount of revenue collected through the parcel tax is substantial. The $1,500,000 per year is, at present borrowing rates of 2.00%, sufficient to fund over $20,000,000 in projects. The decision of future financing of projects is a significant decision to be made by senior staff and council;
- DCC Update: It is recommended that Summerland develop and pass a new DCC bylaw for water with agricultural rates in the range of $10,000 / ha. and Single-family lot rates in the range of $4,000/lot on dry lands and $3,000/lot on lands that are presently arable;

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8. SUMMARY

8.1 INTRODUCTION

This section summarizes the major conclusions and recommendations of the first seven sections of this report. Each point references the location within the 2021 Water Master Plan where additional information is provided.

8.2 CONCLUSIONS

Major conclusions generated during the development of this plan are as follows:

C-1 Water has been a central component to the formation and development of the community of Summerland. The historical ties of water to the community are substantial and must continue to be respected. The water supply is an essential service and it is necessary for the protection of public health, for fire protection and other emergencies, and for the production of food through the irrigation of arable land (Appendix D – Water Supply History);

C-2 For effective management of the water resources, there are seven guiding principles set out in this report. These principles provide the foundation for responsible approach to water management (Section 1.2);

C-3 Over-riding strategic objectives for the utility includes improving the adaptive capacity of the utility. Means in which to do this include providing system redundancy, identifying and managing the various risks to water quality and quantity, and using and leveraging new technologies where applicable (Section 1.3);

C-4 Criteria used within the plan are set out in Section 2.4, Table 2.2. The criteria are consistent with good engineering practices in the Okanagan Valley (Section 2.4);

C-5 Annual population growth has been historically stable at around 2.00%. The corresponding water demand has not increased at the same rate, but rather decreased significantly due to other factors (Section 2.5);

C-6 Summerland holds 25 water licenses. The licenses are listed in Table 3.1. They are for storage, waterworks (domestic), and irrigation. There have been minor adjustments in the licensing since 2008, but no major changes. The total annual licenses amount to 20,935 megalitres (ML) for Irrigation, 7,501 ML for WWLA (domestic use), and 18,891 ML for upper watershed reservoir storage. These licensed volumes should be adequate for the foreseeable future (Section 3.3);

C-7 In terms of water availability, there has been approximately a 10 % increase in available water in the Okanagan Valley in the past 11 years due possibly due to climate change. This is illustrated in Figure 3.2. Snow pack and storage from snow in the early spring from the lower elevations appears to be reducing, but overall precipitation and runoff has increased (Section 3.4);

C-8 Summerland has 12 upper watershed storage reservoirs, including Summerland Reservoir. The reliability of the reservoirs to fill on an annual basis, in order of highest reliability is Thirsk Reservoir, then Crescent, Isintok, Tsuh, Garnett, Headwaters, Whitehead and Eneas Reservoirs (Section 3.4);

C-9 The drawdown rules for upper watershed reservoirs were developed based on historical operations and probability data for watershed production. The order of reservoir drawdown is provided in Table 3.7 (Section 3.4);

C-10 The current average annual runoff in Trout Creek is estimated to be 82,629 ML at the Summerland intake. Of this annual average volume, under the Water Use Plan (WUP) 20,695 ML, or 25% of the total amount is to be used for releases to support fish habitat in lower Trout Creek. The remainder can be use by Summerland up to the amount stated in the water licenses (Section 3.4);

C-11 A 1:100-year drought frequency analysis was conducted and is summarized in Table 3.6. The analysis shows that in the event of a 1:100-year drought, that 10,228 ML of water would be available to Summerland. As per the Water Use Plan, there would be 8,618 ML of water supplied for fish flows and with storage being depleted by 8,105 ML. One year of this scenario is manageable, however a multi-year drought would be very challenging (Section 3.4);

C-12 The development of a water supply from Okanagan Lake is considered to be a worthwhile project for Summerland. The supply from Okanagan lake would offer two benefits, an emergency supply for domestic water and also to reduce operating costs as the water for Trout Creek area would not have to be treated by the Water Treatment Plant (Section 3.7);

C-13 The Summerland Reservoir is maintained within a very narrow band for the water level. This should continue in its current manner of operation. The 2020 Landfill Monitoring report by SNC Lavalin confirms that groundwater levels from the landfill are not impacting on Summerland Reservoir (Section 3.10);

C-14 The total normalized annual irrigation demand is estimated to be 4,500 ML with an average depth water used of 415 mm. The amount of water held for irrigation, based on an allotment of 800mm, is 9,698 ML (Section 4.2);

C-15 Summerland's total annual water demand has decreased in recent years. There is less arable land using water, metering and pricing has been implemented, there is a transition to lower demand crop types and irrigation methods, and increased public awareness and education (Section 4.2);

C-16 For analyzing the Summerland water distribution system, the existing EPANET *Water Distribution Computer Model* was updated with GIS data and current water demand data. The model should be used when reviewing the impacts of new development on the water distribution system (Section 4.3);

C-17 For projecting long term water availability and water demand, a graph was developed and is included as Figure 6.7. The reliability of the Summerland water sources, licensing and available water are projected out to the year 2080. Summerland should have sufficient source water available for the foreseeable future (refer to Section 6.7);

C-18 Water allocation per irrigated area was reviewed. The BC Agriculture Water Calculator was reviewed to assess water depth required to grow crops in Summerland. The water calculator annual required irrigation depths varied, depending on soil type, elevation, and crop type and ranged from 650mm to 750mm. In Summerland, based on historic usage, an annual average depth of 800mm is allocated to all arable acreage. Over the arable land acreage, the average current depth used is only 415 mm. (Section 6.7). In review of the metered data from the drought conditions of 2021, intensive agriculture in the District utilized their full allotment with some customers at or above the 800mm base allocation depth;

C-19 With the recent separation projects of Prairie Valley, Garnett Valley and Jones Flats, the Water Treatment Plant capacity of 75 ML/day is now sufficient to treat the domestic maximum day demand of 65 ML/day. Separation of irrigation flows should continue to be developed for those areas where the average lot size is large and irrigation demands are high (Section 6.8);

C-20 A total of forty-five (45) projects are listed within the 2021 Water Master Plan:
Projects 1-5 Projects that are carried out each year;
Projects 6-15 High priority projects that will inevitably be required as soon as possible;
Projects 16-28 Medium priority projects that could be done if funding becomes available or other factors influence the need to complete these works sooner:
Projects 29-44 Low priority are included for future reference and to document them so they are available for the District at some time further into the future (Section 6.10);

C-21 The area of arable land to which irrigation is provided has dropped since 2008 from 3505 acres to 2975 acres. There is reduced revenue as a result of the reduced acreage (Section 7.5);

C-22 Renewal reports have highlighted the need to reinvest in the water utility. A number of steps are set out to obtain better information on the costs for renewal. A number of items have been set out for Summerland staff to check out (Section 7.6);

C-23 A defendable Development Cost Charge (DCC) rate per single family lot is estimated to be worth $4,000. This amount is based on the replacement value for watershed source development, conveyance, WTP capacity and water distribution reservoir storage (refer to Section 7.7);

C-24 A manageable charge for buying in new arable lands for irrigation is recommended to be 10,000 per ha. (refer to Section 7.7)

C-25 Current debt servicing of the Thirsk Reservoir expansion and the Water Treatment Plant will end in 2026 – 2027. The parcel tax that is assigned to service that debt will also terminate. The ability of Summerland to fund the larger projects proposed and they will be deferred unless more revenue comes available through either raising rates, borrowing, or grant funding. Time will be required to move forward larger projects such as the development of the Okanagan Lake source (Section 7.8);

C-26 There is concern at the level of escalation of expenditures which are outstripping revenue rates over the last 12 years. The lesser amount of arable land and resulting lower irrigation revenue of approximately $100,000 and the metering costs have added more than $370,000 to the annual expenditures in some years (Section 7.9).

8.3 RECOMMENDATIONS

The major recommendations of the 2021 Water Master Plan are as follows:

R-1 That when the District of Summerland council reviews the Water Master Plan, they should consider adopting the water supply principles set out in this document (Section 1.2);

R-2 It is recommended that staff monitor key data that includes total annual flow past upper watershed dams, monthly community usage, customer group meter use for the various user categories and the annual revenue and expenditures as these are key benchmarking indicators for utility performance;

R-3 For the next revisions to the Subdivision Servicing Bylaw, Summerland should reduce the maximum day water demand (MDD) criteria 2,400 to 1,800 L/ca/day (Section 2.4);

R-4 Adjustments are required for Thirsk Reservoir and Headwaters Reservoir water licenses to match actual constructed storage volumes (Section 3.2);

R-5 There is sufficient water licensing in place for storage and irrigation purposes. Although the total domestic licensing for Summerland is sufficient, the point of where it can be obtained is Okanagan Lake where no infrastructure yet exists. Trout Creek intake currently has insufficient domestic licensing for Summerland. The domestic water can come from either applying for an alternate point-of-diversion (POD) of the Okanagan Lake domestic licensing, reallocation of irrigation licensing, or application for additional domestic licensing (Section 3.3);

R-6 The recommended reservoir site to expand is considered to be Isintok Reservoir as Thirsk was recently raised, Eneas is remote and too small, and excess water from Crescent Reservoir watershed is diverted to fill Headwaters reservoirs (Section 3.5);

R-7 The water releases from Thirsk Dam supply the valley aquifers and the community of Faulder. Groundwater withdrawals from Faulder will reduce the environmental flows in lower Trout Creek. A bulk water use agreement between Summerland and Faulder is necessary to legalize the source water supplied to Faulder from Summerland Reservoirs. The amount of funds collected annually would be small, ($2,500 range), but would show good stewardship by all parties (Section 3.5);

R-8 The Water Use Plan (WUP) was last reviewed in 2008. It is suggested that Summerland consider reviewing the WUP after they obtain flow monitoring capabilities at their Trout Creek Intake. Flow monitoring at the Trout Creek Intake will provide insight into the system losses between Thirsk Dam and the intake (Section 3.6);

R-9 Summerland WTP staff continue to operate Summerland Reservoir in the tight high-water range so that the landfill groundwater does not impact on the water supply (Section 3.10);

R-10 The Unaccounted for-Water (UFW) and the Leakage amounts appear to have increased; however, this data is marginal and effort should be expended to determine the leakage flows and then to determine those flows that are not metered (Section 4.2);

R-11 Now that the WTP is on-line, fire storage is now limited to a maximum fire flow of 225 L/s for a 2.875 hour duration. If development that requires a higher fire flow occurs, the developer must install additional fire storage capacity and improve the watermain size capacity to convey the higher flow for the required fire duration (Section 4.4);

R-12 Regarding water conservation, water metering and the installation of remote read technology has been implemented throughout Summerland. The cost of the program is of concern as the water meter companies have designed their equipment to have high costs for battery replacement with the entire meter register being required to be replaced at a cost of > $200 per domestic meter after only 10 years. Summerland should look to invest in metering that has a better lifecycle for initial capital and maintenance costs. Extending the meter battery life will reduce the program costs (Sections 4.7, Section 7.9);

R-13 Instrumentation and communications updates are an on-going part of the water system operations. The costs are substantial and the technologies is evolving at a rapid rate. A report by Centrix is included in Appendix C and summarized in Section 4.8;

R-14 There will be pressures by the regulator to address the potential for lead in the Summerland water supply. A water sampling program at municipal facilities with older pipework is recommended to be conducted and documented to understand the issue and risks (Section 5.2);

R-15 Water quality testing is recommended each year from each of Summerland's raw water sources. Over time, this will provide a baseline of data for Summerland so that any future changes or external influences can be measured and confirmed (Section 5.5);

R-16 There is the opportunity to develop partnership with the First Nations on water projects. There are four projects listed where Summerland and the Penticton Indian Band have the opportunity to work together towards common goals and interests. These include improving fish habitat in lower Trout Creek, domestic and agricultural supply for the Penticton Indian Band lands, and fish passage at the Summerland intake on Trout Creek. Having more connections and contributions to the water system will reduce cost increases to the Summerland rate payers (Section 6.5);

R-17 Several of the projects identified are a normal part of upgrade and renewal works including the SCADA system, PRV station upgrades, hydrant infilling and system blow-off installations. These works should be carried out with a set budget per year so that these works are a normal part of on-going operations (refer to Section 6.7) ;

R-18 The WTP has a capacity of 75 ML/day and with the three recent separation projects at Prairie Valley, Garnett Valley and Jones Flats, the system demand at the WTP is now 65 ML/day. Further funding system separation works should continue when it can be afforded, particularly to maximize the flow of water that does not flow through the WTP (Section 6.8);

R-19 There are 45 Capital Projects identified in this report of which 28 are at medium or high priority. Timing of projects will be dependant upon financial capacity. The projects are to be funded by user rates, DCCs, direct developer contributions, government grants, borrowing, or a combination of these funding sources (Section 6.10);

R-20 To maintain the social balance between water user groups, i.e. domestic and agriculture, an irrigation worksheet was developed to account for all of the services required for agriculture that vary from domestic. The spreadsheet identifies an irrigation rate in the range of $200 to $220 / acre. (Section 7.3);

R-21 The recent system renewal reports and memorandum has highlighted some very high annual contribution requirements for the water utility. Prior to raising rates significantly, Agua has recommended that a number of steps be taken to obtain better information on the actual condition of assets. There is 27 km of cast iron pipe that was installed in the 1930s that is due for renewal but may not have to be renewed. Also, the time period of analysis looks out to only 30 years. A longer period of analysis is required for assets that may have over a 100-year lifespan. The recommendations are set out in Section 7.6;

R-22 It is recommended that Summerland implement a DCC bylaw and a charge or obtaining arable land grade to receive irrigation water. The domestic rate works out to $4,000 /SF lot, and $3,000 / SF lot if the land is already graded as arable. For the arable land charge, a rate of 10,000 / ha. Is recommended. Even with a slow development rate, the DCC could provide $2,500,000 in revenue over a period of 10 years (Section 7.7);

R-23 With the limitations in financial capacity, the implementation of the larger projects will be dependent on grants and/or borrowing of monies (Section 7.8).

R-24 An Economic Model spreadsheet was developed and is presented in Appendix B. The spreadsheet model projects revenues and expenditure forwards with inputs for inflation, construction, growth rates, rate increases, etc. The largest concern is that expenditures are increasing faster than revenues and this will in-time limit the ability of the utility to operate effectively (Section 7.9);

R-25 The 800mm depth of water allocated by the District to taxed arable lands was reviewed using 2021 water metered data and the provincial Irrigation Water Calculator tool. The Irrigation Water Calculator predicts an average irrigation watering depth for Summerland of 680 mm. The review was whether to increase or decrease the allocated depth for arable lands. There are benefits in having additional arable lands and additional water ratepayers connected to improve the economy of scale and keep unit costs down for the benefit of all. At the same time, in review of the drought conditions of 2021, there were a greater number of users that were at or marginally over the 800mm depth for the year. These users were the larger agricultural producers with lands in production. There were many owners not using their allocation. The recommendation on this subject is to maintain the present value of 800mm annual allocation depth for arable land.

APPENDIX A - CAPITAL PROJECTS

A.1 INTRODUCTION

Capital project summary sheets are included in Appendix A. The sheets provide the best available information for the proposed projects and the project costs. A 10% allowance for engineering and a 15% allowance for contingency is included in the estimates unless otherwise noted.

The projects are listed in approximate order of priority. The order may be adjusted over time based on factors that may change the priority. Projects are listed as either **High, Medium** and **Low** priority. In total, 45 projects listed are identified.

The low priority projects, No. 29 to 45 are included for information only so that the references and data collected over the years is not lost for future review and consideration. They are considered to be viable projects, but are not critical to the current water supply system. Factors may change to make them viable.

An apportionment of costs is assessed to each project based on who would benefit from the project. The benefiting groups are either existing users or new development. An estimated percentage split in the project is provided based on who benefits.

It is noted that the system separation projects are complexed in terms of who benefits. They are assessed with a portion of them benefiting new development as WTP capacity is freed up for future population. Splitting of the domestic and irrigation water systems benefit existing users and provides some renewal. The system separation costs are partially assessed to new development.

A cost-benefit per ML assessment is provided for certain source capacity projects. This is listed the bottom of some of the cost estimate sheets. A lower cost per ML shows that the project is a more effective capital expenditure in that it produces more raw water per dollar spent.

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DISTRICT OF SUMMERLAND

APPENDIX A - CAPITAL PROJECTS

Dec. 2021

Priority	#	PROJECT NAME	Current Users		DCC Project		TOTAL	
H	1	Water Main RENEWAL (ANNUAL COST)	$	504,862	$	-		
H	2	METERING UPGRADES, (ANNUAL COST)	$	200,000	$	-	$	-
H	3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$	200,000	$	-	$	-
H	4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$	90,000	$	-	$	-
H	5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$	1,090,000	$	-	$	1,090,000
H	6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$	50,000	$	-	$	50,000
H	7	CRESCENT DAM SPILLWAY - UPGRADE	$	210,000	$	-	$	210,000
H	8	TROUT CREEK FLUME - REPLACEMENT	$	7,090,000	$	-	$	7,090,000
H	9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$	67,551	$	-	$	67,551
H	10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$	1,350,000	$	-	$	1,350,000
H	11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$	70,000	$	-	$	70,000
H	12	DAM SAFETY REVIEWS	$	345,000	$	-	$	345,000
M	13	ENEAS DAM - DECOMMISSIONING	$	110,000	$	-	$	110,000
M	14	WTP - SLUDGE HANDLING - UPGRADES	$	6,280,000	$	-	$	6,280,000
M	15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$	-	$	6,410,000	$	6,410,000
M	16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$	-	$	2,750,000	$	2,750,000
M	17	SOURCE WATER ASSESSMENT PLAN	$	80,000	$	-	$	80,000
M	18	TSUH DAM - DECOMMISSIONING	$	70,000	$	-	$	70,000
M	19	SUMMERLAND RESERVOIR SPILLWAY	$	1,110,000	$	-	$	1,110,000
M	20	JAMES LAKE PUMP STATION UPGRADE	$	210,000	$	-	$	210,000
M	21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$	3,490,000	$	-	$	3,490,000
M	22	WTP - FLOWMETER AND PROGRAMMING	$	40,000	$	-	$	40,000
M	23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$	520,000	$	1,550,000	$	2,070,000
M	24	AILEEN ROAD - WATER SYSTEM SEPARATION	$	190,000	$	-	$	190,000
M	25	SYSTEM SEPARATION - FRONT BENCH ROAD	$	390,000	$	1,160,000	$	1,550,000
M	26	SYSTEM SEPARATION - HAPPY VALLEY	$	480,000	$	1,440,000	$	1,920,000
L	27	SYSTEM SEPARATION - HESPLER ROAD	$	80,000	$	230,000	$	310,000
L	28	SYSTEM SEPARATION - LOWER JONES FLATS (EAST)	$	1,160,000	$	3,494,000	$	4,654,000
L	29	SYSTEM SEPARATION - SIMPSON / CANYONVIEW / HILLBORN RD.	$	660,000	$	1,980,000	$	2,640,000
L	30	SYSTEM SEPARATION - VICTORIA - SIMPSON ROAD	$	660,000	$	1,970,000	$	2,630,000
L	31	SYSTEM SEPARATION - TROUT CREEK	$	850,000	$	2,550,000	$	3,400,000
L	32	BULL CREEK HYDROMETRIC STATION	$	60,000	$	-	$	60,000
L	33	RESERVOIR TANK MIXING IMPROVEMENTS	$	140,000	$	-	$	140,000
L	34	PUMP STATION 2B - SOLENOID VALVE	$	90,000	$	-	$	86,336
L	35	SITE 13 RESERVOIR (3,700 ML)	$	-	$	8,190,000	$	8,190,000
L	36	SITE 2 RESERVOIR (7600 ML)	$	-	$	20,700,000	$	20,700,000
L	37	PITIN CREEK DIVERSION TO SITE 2	$	-	$	2,260,000	$	2,260,000
L	38	SITE 9 RESERVOIR, KATHLEEN CREEK (1600 ML)	$	-	$	5,380,000	$	5,380,000
L	39	SITE 1 RESERVOIR, UPPER TROUT CREEK (2220 ML)	$	-	$	9,080,000	$	9,080,000
L	40	ADDITIONAL GROUNDWATER CAPACITY	$	-	$	950,000	$	948,750
M	41	GARNET RESERVOIR - AERATION SYSTEM	$	140,000	$	-	$	140,000
L	42	BULK FILL WATER STATIONS	$	510,000	$	-	$	510,000
L	43	EMERGENCY INTERCONNECTION - RESEARCH STATION	$	3,300,000	$	-	$	3,300,000
		TOTAL (Projects 5-45)	**$**	**29,800,000**	**$**	**70,090,000**	**$**	**99,890,000**

NOTES H - High M - Moderate L- Low Priority

Agua Consulting Inc.
"Engineered Water Solutions"

DISTRICT OF SUMMERLAND

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No.	PROJECT NAME	ML / day	Cost per ML	EXTENSION
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	5.35	$ 386,916	$ 2,070,000
24	AILEEN ROAD - WATER SYSTEM SEPARATION	0.25	$ 760,000	$ 190,000
25	SYSTEM SEPARATION - FRONT BENCH ROAD	2.12	$ 731,132	$ 1,550,000
26	SYSTEM SEPARATION - HAPPY VALLEY	5.56	$ 345,324	$ 1,920,000
27	SYSTEM SEPARATION - HESPLER ROAD	1.27	$ 244,094	$ 310,000
28	SYSTEM SEPARATION - LOWER JONES FLATS (EAST)	10.50	$ 443,238	$ 4,654,000
29	SYSTEM SEPARATION - SIMPSON / CANYONVIEW / HILLBORN RD.	2.71	$ 974,170	$ 2,640,000
30	SYSTEM SEPARATION - VICTORIA - SIMPSON ROAD	9.22	$ 285,249	$ 2,630,000
31	SYSTEM SEPARATION - TROUT CREEK	6.95	$ 489,209	$ 3,400,000
	TOTALS	43.93	$ 440,792	$ 19,364,000

No.	SOURCE CAPACITY PROJECTS	ML Secured	Project Cost	Cost / ML
15	OKANAGAN LAKE PUMP STATION (PHASE 1)		$ 6,410,000	
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	5141	$ 2,750,000	$ 1,782
35	SITE 13 RESERVOIR (3,700 ML)	3700	$ 8,190,000	$ 2,214
36	SITE 2 RESERVOIR (7600 ML)		$ 20,700,000	
37	PITIN CREEK DIVERSION TO SITE 2	7600	$ 2,260,000	$ 3,021
38	SITE 9 RESERVOIR, KATHLEEN CREEK (1600 ML)	1600	$ 5,380,000	$ 3,363
39	SITE 1 RESERVOIR, UPPER TROUT CREEK (2220 ML)	2220	$ 9,080,000	$ 4,090
	TOTALS	20261	$ 54,770,000	$ 2,703

No.	SEPARATION PROJECTS	Local Area MDD (ML/day)	MAX DAY DEMAND EQUIVALENT ($ / ML/ DAY)	Total Treated flow directed to WTP (ML/day)	Project Cost ($)
	WTP CAPACITY	75	$ 240,000		$ 18,000,000
	EXISTING MDD - ENTIRE WATER SYSTEM			112	
	Separate Prairie Valley	13.06		98.94	
	Separate Garnett Valley	13		85.94	
	Separate Jones Flats	11.2		74.74	
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	5.35	$ 386,916	69.39	$ 2,070,000
24	AILEEN ROAD - WATER SYSTEM SEPARATION	0.25	$ 760,000	69.14	$ 190,000
25	SYSTEM SEPARATION - FRONT BENCH ROAD	2.12	$ 731,132	67.02	$ 1,550,000
26	SYSTEM SEPARATION - HAPPY VALLEY	5.56	$ 345,324	61.46	$ 1,920,000
27	SYSTEM SEPARATION - HESPLER ROAD	1.27	$ 244,094	60.19	$ 310,000
28	SYSTEM SEPARATION - LOWER JONES FLATS (EAST)	10.50	$ 443,238	49.69	$ 4,654,000
29	SYSTEM SEPARATION - SIMPSON / CANYONVIEW / HILLBORN RD.	2.71	$ 974,170	46.98	$ 2,640,000
30	SYSTEM SEPARATION - VICTORIA - SIMPSON ROAD	9.22	$ 285,249	37.76	$ 2,630,000
31	SYSTEM SEPARATION - TROUT CREEK	6.95	$ 489,209	30.81	$ 3,400,000
	TOTALS	**43.93**	**$ 440,792**		**$ 19,364,000**
	Works completed	**ML**	**$ / ML**	**WTP**	
	Current WTP MDD in 2020 was 65 ML/day				

DISTRICT OF SUMMERLAND

PROJECT NO. 01

Water Main RENEWAL (ANNUAL COST)

Dec. 2021

Project Description

This project is an annual reinvestment allowance by the District of Summerland to upgrade and improve older water mains in the system.
The replacement amount budgeted is approximately $500,000 which is sufficient to replace approximately a kilometer of watermain each yr

It is recommended that the replacement mains work be coordinated with other utility upgrades so that costs can be minimized.
This work is coordinated with the sanitary sewer, road and drainage utility works that may be underway.
It will also consider the age of water mains and work towards renewal of both the oldest and most problematic pipes in the distribution network.

Capital Cost Estimate	**No.**	**Unit**		**Unit Price**		**Extension**
PRV Chamber	0	each	$	104,000	$	-
200mm watermain	1100	LS	$	195	$	214,500
200mm watermain, steep hillside installation	0	LS	$	390	$	-
Road restoration	3300	m2	$	52	$	171,600
Connection to existing	2	each	$	6,500	$	13,000
Subtotal , Construction Cost Estimate					**$**	**399,100**
Engineering Allowance	10%				$	39,910
Base Capital Cost					$	439,010
Contingency Allowance	15%				$	65,852
TOTAL CAPITAL COST ESTIMATE					**$**	**504,862**
Cost Benefit Assessment		**Current Users**		**DCC Project**		
Percentage Apportionment - increases capacity to Trout Crk.		100%		0%		
Capital Value Apportionment	$	504,862	$	-	$	504,862

PRIORITY - HIGH

PROJECT No. 02

METERING UPGRADES, (ANNUAL COST)

Dec. 2021

Project Description

The majority of the District is metered. Agricultural meters are installed on all irrigation connections. Domestic meters are in place for the majority of users.
Unmetered water connections remain for properties smaller than 2.0 acres where the irrigation water is not recorded
The remaining metering plan would be to install meters to those remaining properties

Consideration should be given to the effectiveness of having one vs. two connections to those parcels smaller than 2.0 acres. If the area has dual mains installed, then two services and two meters is recommended and lower cost water can be provided to those parcels for irrigation

If only one main is passing by, there is no benefits to splitting the supply yet to these smaller lots and a single service and meter should be considered.

Critical domestic sizing component.
Lots 1.0 acre and smaller require a single water meter only with all outdoor lot irrigation routed through the one meter.
Lot sizes 0.20 to 0.40 ha. in size. Meter size = 19 mm
Lot sizes 0.20 ha. and smaller Meter size = 16 mm
All lots larger than 0.40 ha. to have two meters to the parcel, one for irrigation and one for domestic. For those lots where it is possible to route all irrigation through the home, this should be done. Meter size would be upgraded at that time to either a 19 mm, or 16 mm meter size.

It is recommended that this work be conducted if and when funding for meters comes available.

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Estimated number of irrigation meters 25mm dia.	300	each	$ 500	$ 150,000
(15 meters per week x 15 weeks for installation)				
Subtotal , Construction Cost Estimate				**$ 150,000**
Engineering Allowance	0%			$ -
Base Capital Cost				$ 150,000
Contingency Allowance	10%			$ 15,000
				$ 165,000
			Implement over 5 years	**$ 35,000**
TOTAL CAPITAL COST ESTIMATE				**$ 200,000**

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 200,000	$ -

PRIORITY - HIGH

DISTRICT OF SUMMERLAND

PROJECT NO. 03

ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)

Dec. 2021

Project Description

Descriptons of the projects are listed in Appendix C in the Electrical and Controls audit by Centrix (IITS)
It is recommended that initially, an annual budget of $50,000 be set for SCADA upgrades and that the District carry out the higher priority works.
Over time, it is expected that the District will have to invest more than $50,000 per year for these upgrades. A risk-based approach should be used.
A critical item in the decisions of instrumentation and monitoring is to assess labour effort in comparison with the reduction of risks.

Description	Unit		Unit Price	No.		Extension
Communications Study including Radio Path tests	LS	$	15,000	1	$	15,000
Develop Control Equipment Hardware Std and Programming Std Docs.	each	$	7,000	1	$	7,000
Pump Stn, Res, PRV Repeaters and SCADA comm. Upgrades	per site	$	7,000	18	$	126,000
Thirsk Dam - Reinstate satellite communications	LS	$	5,000	1	$	5,000
Thirsk Dam - update level monitoring equipment, communications	LS	$	2,500	1	$	2,500
Thirsk Dam - Add electric actuators, and programming to allow remote gate ops	LS	$	20,000	1	$	20,000
Pump Stn Control Equipment upgrades (PLCs, HM, Ethernet switches)	per site	$	25,000	8	$	200,000
Reservoir Control Equipment (PLC, HMI, Ethernet switch)	per site	$	15,000	3	$	45,000
SCADA Monitored PRV Control Equipment (PLC, HMI, Ethernet Switch)	per site	$	20,000	2	$	40,000
SCADA Monitored PRVs, Add flood, low temp, intrusion alarms	per site	$	2,500	2	$	5,000
SCADA Unmonitored PRVs, add dialers, with instrumentation	per site	$	25,000	13	$	325,000
Pump Stations - Add Gensets PH No. 1, 4, 5 & 6. One every two yrs	per site	$	250,000	6	$	1,500,000
Subtotal , Construction Cost Estimate					**$**	**2,290,500**
Engineering Allowance (included in estimates)	10%				$	229,050
Base Capital Cost					$	2,519,550
Contingency Allowance (included in estimates)	15%				$	377,933
TOTAL CAPITAL COST ESTIMATE	Implement over 15 yrs				**$**	**2,897,483**

Cost Benefit Assessment		Current Users		DCC Project
Percentage Apportionment		100%		0%
Capital Value Apportionment	$	200,000	$	-

PRIORITY - HIGH	*High Priority*	$	*196,708*	3.9	*yrs @$50,000/yr*
	Moderate Priority	$	*803,275*	16.1	*yrs @$50,000/yr*
	Low Priority	$	*1,897,500*	38.0	*yrs @ $50,000/yr*

PROJECT NO. 04

PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)

Dec. 2021

Project Description

This work is necessary in order to make the access to PRV stations that are below grade legal and in conformance with Worksafe BC regulations. Recent rule changes have resulted in WCB applying oil industry hazards to the water supply industry. It has created a significant problem for water utilities as entry is impossible without sign off from qualified professionals.

There are three options available to Summerland to correct the confined space regulations

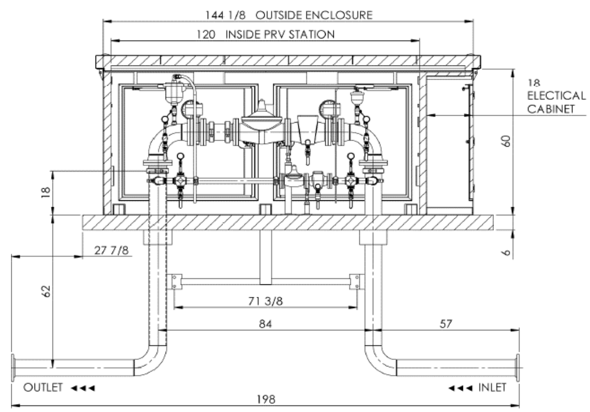
1. Add stairways to larger PRV or water pump stations that are below ground to allow man entry exit without ladders;
2. Replace existing isolation valves to higher quality valves and obtain Qualified Professional sign-off to allow single isolation
3. Move the valve chambers to above ground locations. This eliminates man-entry to those stations

For some stations such as PRV 10, option 1 is the most viable option.
For most of the stations, Summerland is utilizing higher quality Brae valves that have a higher safety rating and is obtaining professional sign-off.

For smaller size PRV stations, there are many companies now constructing PRVs for above ground service.
The sizes up to 200mm valve with 100mm bypass can fit within a 3.6m long x 1.5m H x 1.2m wide above ground kiosk

Air Release valve pose a similar issue for the operators
Systems for Air release valves without vault entry are being developed. An allowance for change over of these installations is provided for within this estimate.

It is esimated that Summerland will upgrade one buried PRV station per year



SECTION A-A

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Capital Cost Estimate	No.	Unit	Unit Price	Extension
Supply of New valve and pipeworks	*1*	*each*	*$ 30,000*	*$ 30,000*
Supply of above ground kiosk	*1*	*LS*	*$ 14,000*	*$ 14,000*
Installation - by Summerland staff	*1*	*LS*	*$ 15,000*	*$ 15,000*
Road restoration (allowance)	*75*	*m2*	*$ 55*	*$ 4,125*
Electrical service connection	*1*	*LS*	*$ 8,000*	*$ 8,000*
Subtotal , Construction Cost Estimate				**$ 71,125**
Engineering Allowance	10%			$ 7,113
Base Capital Cost				$ 78,238
Contingency Allowance	15%			$ 11,762
CAPITAL COST per YEAR				**$ 90,000**
TOTAL CAPITAL COST	One Stn / Year		12 Stns	**$ 1,079,994**

Cost Benefit Assessment		**Current Users**	**DCC Project**
Percentage Apportionment - increases capacity to Trout Crk.	10%	100%	0%
Capital Value Apportionment		**$ 90,000**	$ -

PRIORITY - HIGH

DISTRICT OF SUMMERLAND

PROJECT No. 5

WTP - CONVERSION CL_2 GAS TO SODIUM HYPOCHLORITE

Dec. 2021

Project Description

Chlorine gas disinfection systems such as the one at the WTP are very cost effective and have low maintenance requirements.
The general consensus in the industry is to limit the locations and use of gas chlorine.
Even with the monitoring devices and best practices, although the risk may be low with gas, the consequences can be very high.
Conversion of the gas systems to sodium hypochlorite is occurring with greater frequency throughout the water supply industry.

In late 2018, the District of Summerland commissioned WSP consultants to carry out an evaluation of chlorine disinfection options

The options included:

1. On-site Generated sodium hypochlorite
2. Liguid sodium Hypochlorite (deilvered in bulk)
3. Gas Chlorination (existing system)

The evaulation was to consider risks and consequences, capital costs, including costs to upgrade the safety of the existing gas system and system lifecycle costs for operations and maintenance.
The outcome of the evaluation was provided in a report.

OPTION	Capital Cost	Operations Cost	Net Present Value
On-Site Hypochlorite Generation (OSHG)	$ 1,812,000	$ 70,000	$ 2,714,000
Sodium Hypochlorite (recommended)	**$ 730,000**	**$ 86,000**	**$ 1,802,000**
Gas Chlorination	$ 1,076,000	$ 50,000	$ 1,699,000

As per the WSP recommendation, "The 12% sodium hypochlorite system offers a lower lifecycle cost when compared to OSHG system, and is the simplest to operate. It is the easiest to transition to from the existing gas chlorination system due to its small footprint. Therefore WSP recommends the use of bulk 12% sodium hypochlorite for Summerland's Water Treatment Plant.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
WTP Modifications				
Building Costs	1	LS	$ 45,000	$ 45,000
Equipment Costs	1	LS	$ 453,000	$ 453,000
Electrical	1	LS	$ 115,500	$ 115,500
Commissioning / Decomissioninç	1	LS	$ 21,000	$ 21,000
	1	LS	$ 120,000	$ 120,000
Subtotal , Construction Cost Estimate				**$ 754,500**
Engineering & Contingency 45%	(as per WSP report)			$ 339,525
				$ 1,094,025
				$ -
TOTAL CAPITAL COST ESTIMATE				**$ 1,094,025**
Cost Benefit Assessment		**Current Users**	**DCC Project**	
Percentage Apportionment		100%	0%	
Capital Value Apportionmen		$ 1,094,025	$ -	$ 1,094,025

PRIORITY - HIGH

PROJECT NO. 06

RESERVOIR SPILLWAY WEIR MONITORS (5 sites)

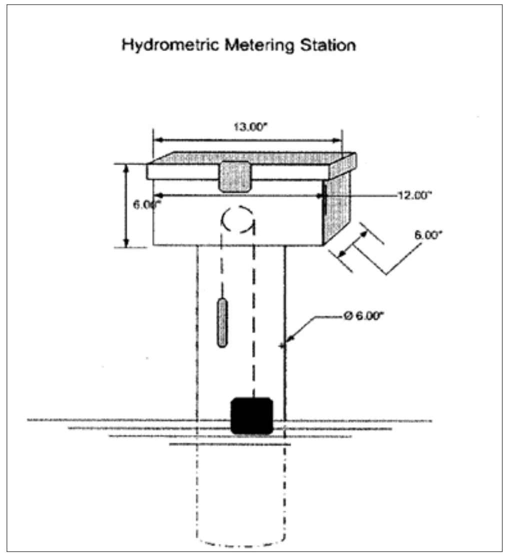
Project Description

This project is a low cost project that has high long term benefits to Summerland and the region. The devices combined with the procedures of recording releases from the dams informs Summerland of the actual capacity and reliability of their watershed areas above their water storage dams. This information helps the regional water management and would be eligible for OBWB small projects grant.

The watershed weir monitor station is of relatively low cost and allows the utility to monitor the flow of water that leaves the dam catchment area over the dam spillway. A datalogger is housed within the black box and the data only measures the depth of flow going over the weir. The depth of water flowing over the spillway can be converted to a flow rate and volume.

Correlation of this information to regional watershed runoff helps to facilitate a greater understanding of the Okanagan Basin hydrology.

There are 5 sites recommended for this installation:
1. Thirsk Dam
2. Isintok Dam
3. Headwaters Outlet (lowest dam)
4. Crescent Dam
5. Whitehead Dam



Grant monies may be available for this work from the Okanagan Basin Water Board through their small grants program.
This project would proceed contingent on grant money support.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Spillway flow measurement and recording devices (supply)	5	LS	$ 7,500	$ 37,500
Installation	5	LS	$ 3,750	$ 18,750
Subtotal , Construction Cost Estimate				**$ 56,250**
Engineering Allowance	10%			$ 5,625
Base Capital Cost				$ 61,875
Contingency Allowance	15%			$ 9,281
TOTAL CAPITAL COST ESTIMATE				**$ 71,156**
OBWB Grant				**$ (25,000)**
				$ 46,156

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 46,156	$ -

PRIORITY - HIGH

PROJECT NO. 07

CRESCENT DAM SPILLWAY - UPGRADE

Project Description

This project involves the reconstruction of the spillway and outlet channel below Crescent Dam.
The work was identified by Kerr Wood Leidal. The work includes the reconstruction of the concrete outlet channel.
It also includes revegetation and erosion protection for the channel downstream of the spillway.

A geotechnical engineer is recommended to assess the dam integrity while this work is in the planning stages
The work includes the design of corrective works and obtaining approvals.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Retain Geotechnical engineer	1	each	$ 15,000	$ 15,000
Retain engineer to design remedial structural works on spillway	1	each	$ 30,000	$ 30,000
Obtain approvals - dam safety	1	each	$ 7,500	$ 7,500
Carry out works - retain contractor	1	each	$ 113,508	$ 113,508
Subtotal , Construction Cost Estimate				**$ 166,008**
Engineering Allowance	10%			$ 16,601
Base Capital Cost				$ 182,609
Contingency Allowance	15%			$ 27,391
TOTAL CAPITAL COST ESTIMATE				**$ 210,000**
Cost Benefit Assessment		**Current Users**	**DCC Project**	
Percentage Apportionment		100%	0%	
Capital Value Apportionment		$ 210,000	$ -	$ 210,000

PRIORITY - HIGH

DISTRICT OF SUMMERLAND

PROJECT No. 08

TROUT CREEK FLUME - REPLACEMENT

Dec. 2021

Project Description

This project is nearing design completion.
Since identified in 2010, the deterioration of the flume is continuing.
Current design is to utilize the structure of the flume and place within portions of the flume a 1200 dia. HDPE pipe
Also included is a flow meter from the creek, instrumentation and remote monitoring and controls for inlet flows from Trout Creek
Fish screening to DFO/MOE standards is provided adjacent to the creek.

HDPE pipe is the most obvious choice for materials due to their resilient wearing features and flexibility during installation.

Supply Price for HDPE pipe has risen to approximately $2.20 / lb.
1200 dia HDPE DR21 (80 psi rated) is 143.32 lbs./ft = $ 1,034.46 /m for supply price
900 dia HDPE DR17 (100 psi rated) is 98.34 lbs./ft = $ 711.00 /m for supply price
900 dia HDPE DR11 (160 psi rated) is 146.47 lbs./ft = $ 1,059.98 /m for supply price

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	LS	$ 142,500	$ 142,500
Mobilization / Demobilization	1	LS	$ 52,500	$ 52,500
Intake Structure - Concrete Works	100	m3	$ 3,750	$ 375,000
In-stream works - Dewatering, water turbidity controls	1	LS	$ 112,500	$ 112,500
Rip-rap and Channel Upgrades, 1000 kg rock and placement	1	LS	$ 262,500	$ 262,500
Fish Screens (static type)	32.0	m2	$ 7,050	$ 225,600
Fish Screen Motorized Cleaning System	1.0	LS	$ 187,500	$ 187,500
Environmental Controls, (silt protection, isolation fencing, monitoring)	1	LS	$ 75,000	$ 75,000
Site Grading at Intake - to contain creek from overflow to North	1	LS	$ 45,000	$ 45,000
Concrete Building - to house Electrical - Instrumentation equipment	30	m2	$ 4,500	$ 135,000
Control Valve Chamber at Intake	1	LS	$ 75,000	$ 75,000
Meter Installation @ Intake	1	LS	$ 75,000	$ 75,000
Instrumentation to monitor raw water quality (Turb., Conduc., DOC)	1	LS	$ 52,500	$ 52,500
Electrical Power to Building at Intake (underground from Bathville Road)	700	m	$ 225	$ 157,500
SCADA Connection	1	LS	$ 37,500	$ 37,500
SCADA Programming	1	LS	$ 37,500	$ 37,500
1200 mm Diameter HDPE Main (Supply and installation)	1120	m	$ 2,325	$ 2,604,000
900 mm Diameter HDPE Main (Supply and installation)	330	m	$ 1,725	$ 569,250
Railway crossing - 900mm diameter steel pipe - open cut	1	LS	$ 75,000	$ 75,000
300mm diameter PVC overflow pipe at Stn 1+120	55	m	$ 413	$ 22,688
Overflow Vault at Stn 1+120	1	LS	$ 60,000	$ 60,000
Outlet structure into Summerland Reservoir	1	LS	$ 112,500	$ 112,500
Fibreoptic Line - Building at Intake to WTP	2300	m	$ 50	$ 113,850
Subtotal , Construction Cost Estimate				**$ 5,605,388**
Engineering Allowance	10%			$ 560,539
Base Capital Cost				$ 6,165,926
Contingency Allowance	15%			$ 924,889
TOTAL CAPITAL COST ESTIMATE				$ 7,090,815

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 7,090,815	$ -

PRIORITY - HIGH

Agua Consulting Inc.
"Engineered Water Solutions"

DISTRICT OF SUMMERLAND

PROJECT NO. 09

THIRSK DAM - ANCHOR GREASING - CONC PROTECTION

Dec. 2021

Project Description

This is maintenance work required on the downstream face of the dam.
Access is an issue as the face is quite high and access with lift equipment is limited.

Capital Cost Estimate	No.	Unit	Unit Price		Extension
				$	-
				$	-
Lump sum allowance	1	LS	$ 53,400	$	53,400
Subtotal , Construction Cost Estimate				**$**	**53,400**
Engineering Allowance	10%			$	5,340
Base Capital Cost				$	58,740
Contingency Allowance	15%			$	8,811
TOTAL CAPITAL COST ESTIMATE				**$**	**67,551**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 67,551	$ -

PRIORITY - HIGH

PROJECT No. 10

GARNETT RESERVOIR SPILLWAY - UPGRADE

Project Description

The project includes the following components:

1. Widening of the spillway to safely convey the Probable Max. Flood (PMF) of 85 m3/s
2. Bridge access to be able to access the control facilities during a flood condition
3. Rip rap along the dam face

Garnett Reservoir spillway has signficant capacity, but not enough to meet the criteria set out within the provincial Dam Safety Regulation
The concrete spillway channel will require extension upstream, it will require widening and rip rap lining downstream to contain the overflow

Bridge access is requried to get service vehicles to the dam controls area
There are presently small culverts below the dam along the road.
A concrete deck bridge 14m wide across the spillway may be the best option for vehicle access to the dam gates.

Rip rap lining of the dam face is recommended to reduce damage of the dam face caused by wind induced waves. Approx. 100 m x 5m x 1.0m thick of rip rap is required. Cost to supply, haul, deliver, and place is est. to be $150/m3.
Reuse of concrete apron concrete may be possible as part of rip rap installation

A log boom is required to be reinstated upstream of the spillway area.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Removal of south apron of spillway - prep work for widening	1	LS	$ 75,000	$ 75,000
Bridge preparation and supports	1	LS	$ 75,000	$ 75,000
Concrete apron extension, reinforced concrete slab and section	1	LS	$ 525,000	$ 525,000
Bridge across spillway - precast - two segments - 10m length each 4.0m W	2	each	$ 135,000	$ 270,000
Log Boom - supply and install	1	LS	$ 7,500	$ 7,500
Rip Rap on Dam Face 75m length x 10 m on slope x 1.00m thick = 750m3	750	m3	$ 150	$ 112,500
Subtotal , Construction Cost Estimate				**$ 1,065,000**
Engineering Allowance	10%			$ 106,500
Base Capital Cost				$ 1,171,500
Contingency Allowance	15%			$ 175,725
TOTAL CAPITAL COST ESTIMATE				**$ 1,347,225**

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	100%	0%
Capital Value Apportionment	########	$ -

PRIORITY - HIGH

DISTRICT OF SUMMERLAND

PROJECT NO. 11

THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR

Dec. 2021

Project Description

This project is to replace the three existing outlet gates that are located on the upstream face of Thirsk Dam.
The gates received a protect screen assembly in November 2011.
At that time, the gates were still functional. Since then they have had some seating issues.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Supply Gates 36" diameter including wall thimble and Vertical riser	3	each	$ 90,000	$ 270,000
Installation of Gates	3	each	$ 37,500	$ 112,500
Environmental monitoring of reservoir draw down and bypass work	1	LS	$ 37,500	$ 37,500
Subtotal , Construction Cost Estimate				**$ 420,000**
Engineering Allowance	10%			$ 42,000
Base Capital Cost				$ 462,000
Contingency Allowance	15%			$ 69,300
TOTAL CAPITAL COST ESTIMATE				**$ 531,300**

	Current Users	DCC Project
Cost Benefit Assessment		
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 531,300	$ -

PRIORITY - HIGH

DISTRICT OF SUMMERLAND

PROJECT NO. 12

Dec. 2021

DAM SAFETY REVIEWS

Project Description

Dam Safety reviews are required for the following dams.
- Headwaters 1, 2, 3 & 4
- Crescent
- Whitehead
- Isintok
- Summerland

In total 8 dams require Dam Safety Reviews. None of the dams have a Very High or Extreme Consequence level.
Reporting for this work will be to Penticton to the local Dam Safety Officer.

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Report cost estimate per dam	8	each	$ 37,500	$ 300,000
	0	each	$ 5,250	$ -
	0	LS	$ 2,250	$ -
Subtotal , Construction Cost Estimate				**$ 300,000**
Engineering Allowance				$ -
Base Capital Cost				$ 300,000
Contingency Allowance	15%			$ 45,000
TOTAL CAPITAL COST ESTIMATE				**$ 345,000**

Cost Benefit Assessment	**Current Users**	**DCC Project**	
Percentage Apportionment	100%	0%	
Capital Value Apportionment	$ 345,000	$ -	$ 345,000

PRIORITY - HIGH

PROJECT No. 13

ENEAS DAM - DECOMMISSIONING

Dec. 2021

Project Description

Eneas Lakes and Eneas Dam are situated within Eneas Provincial Park. The park is located in a remote high elevation location with poor road access. The park has a new charge rate system for having water reservoirs within their boundaries. Eneas Reservoir is very small with storage of only 148 ML (two days of storage for Summerland).
With the high requirements of maintaining a dam, the issue facing Summerland is one of high effort for minimal benefit.

There are two issues to sort out with this installation.

1. - Is the issue of reservoir storage and not losing the licensing capacity of this reservoir. That could be addressed by assigning this license to an alternate Point of Diversion downstream to where the water can be accessed.
2. - Decommissioning of the dam itself and ensuring that the berms and water naturally held will be able to safely discharge under all hydrologic conditions.

Capital Cost Estimate	No.	Unit		Unit Price		Extension
Approval agency works - Eng. Consultant support	1	m	$	7,500	$	7,500
Outlet pipe - Remove, breach dam, Site works	1	each	$	75,000	$	75,000
Finish grading, hydro-seeding	1	each	$	11,250	$	11,250
Subtotal , Construction Cost Estimate					**$**	**93,750**
Engineering Allowance	5%				$	4,688
Base Capital Cost					$	98,438
Contingency Allowance	15%				$	14,766
TOTAL CAPITAL COST ESTIMATE					**$**	**113,203**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 113,203	$ -

PRIORITY - MEDIUM

PROJECT No. 14

WTP - SLUDGE HANDLING - UPGRADES

Dec. 2021

Project Description

Since the WTP was constructed and completed in 2008, sludge handling has been challenging since the plant was first commissioned.
In 2008-09 a temporary means of dealilng with the WTP sludge was implemented with pumping of the sludge and drying/infiltration at the Landfill.

In recent years the annual volume of water to be treated has been reduced through the system separation. The amount of sludge has lessened but the land area at the landfill is limited and there are constraints in the existing process. The infiltration galleries at the landfill bind up over time and capacity to handle the sludge is reduced. There are benefits with the sludge moved up to the landfill as the decant water from the ponds is utilized by the landfill.
In 2016-2017, Opus Consultants completed a Residuals Handling Upgrade Study. The report identified short term and long term options for the handling of WTP sludge. Several options were presented. The long term Option 2 is presented here.

The options presented included:

	Capital Cost	Annual Oper. Cost
1. Interim Option 1. Pond Transfer Pump	$ 544,000	$ (16,500)
2. Interim Option 2, Maximize Current Process Performance	$ 919,000	$ (23,000)
3. Long Term Option 1 Retrofit Slow Sand Filter with High Rate Settling	$ 2,207,000	$ 9,400
4. Long Term Option 2 Mechanical Dewatering	$ 4,187,000	$ 99,400

Because of the high capital cost of the two long term options, the report wisely recommended extending the operations of the existing process until such time that it was absolutely necessary to implement the long-term solution.

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
WTP Modifications				
Polymer Makedown/Chemical Pumping Assembly *(Optional)*	1	LS	$ 187,500	$ 187,500
Recycle Controls and Instrumentation	1	LS	$ 232,500	$ 232,500
Plate Thickener			$ -	
SSF Basin 1 Modifications	1	LS	$ 471,000	$ 471,000
SSF Basin 2 Modifications	1	LS	$ 1,894,500	$ 1,894,500
Yard Piping	1	LS	$ 155,250	$ 155,250
Centrifuge Dewatering			$ -	
Centrifuge Equipment	1	LS	$ 1,957,500	$ 1,957,500
Centrate Tank and Pumping	1	LS	$ 91,500	$ 91,500
Subtotal , Construction Cost Estimate				**$ 4,331,250**
Contingency Allowance	30%			$ 1,299,375
Base Capital Cost				$ 5,630,625
Engineering Allowance	15%			$ 649,688
TOTAL CAPITAL COST ESTIMATE				**$ 6,280,313**

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 6,280,313	$ -

PRIORITY - MEDIUM 10%

PROJECT No. 15
OKANAGAN LAKE PUMP STATION (PHASE 1)

Project Description

This project is the first stage of an alternate source supply for Summerland. It consists of drawing water from Okanagan Lake and then pumping the water up to the Hydraulic grade line of the Water Treatment Plant (PZ 590). The project has three stages of pumping:

1. Lake pump station which lifts from Lake level (342m up to 380m) through UV disinfection to dedicated main to Morgan Rd pump stn.
2. Morgan Road pump station which lifts water from 380m HGL to Trout Creek zone (PZ 417) and to Hillborn Tank (Elev 470m)
3. Hillborn Tank pump station which lifts water from Hillborn Tank to Summerland WTP hydraulic grade lilne (590m)

It includes disinfection and the ability to feed all of Trout Creek.
In carrying out the Phase 1 works, the water demand from Trout Creek (6.0 ML/day) can be taken off of the Water Treatment Plant.

The system sizing is based on 20 ML/day capacity with all pumps running as this is considered an emergency condition
Pump Station Max Day Capacity is estimated to be 19.7 ML/day
Total Annual capacity is estimated to be 5141 ML/year
Available Dom WWLA Licensing in place = 6,107 ML annually

A design flow of 20 ML/day is recommended to allow the largest possible supplementary supply for the water system.
The recommended location for the Okanagan Lake pump station is the Powell Beach District park. Discussions have taken place with parks.

The intent is to feed water via the 2 AC mains to the Trout Creek tank, then feed water further up into the Canyonview/Victoria Road areas.
Techically the concept is sound as the lake water at depth meets the GCDWQ and there is typically low risk of microbial contamination.
A filtration deferral application will have to be submitted for this source to verify that filtration is not required for this water.
There are issues to resolve with the regulator who have stated that they will not approve new intakes on Okanagan Lake without filtration.
The expert panel Techncial Advisory report prepared by the Province has documented that for clear source waters, the same health outcomes can be achieved with UV disinfection and/or advanced oxidation technologies.

Viruses and bacteria can be effectively inactivated by chlorination and UV disinfection. Protozoa can effectively be inactivated by UV disinfection

A key benefit of this project in conjunction with the Phase 2 work, that it provides basic drinking water to Summerland if there is a catastrophic ever in Trout Creek such as a wildfire or major flood or landslide

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
OKANAGAN LAKE PUMP STATION				
General Requirements	1	LS	$ 75,000	$ 75,000
Wet Well at Lake Pump Station, 3.66m dia. steel caisson, 6.0m deep	1	LS	$ 750,000	$ 750,000
Directional drilling of intake pipe	93	m	$ 1,125	$ 104,625
Stainless Fish Screen, 2.5 mm clear opening, Supply/install	1	LS	$ 60,000	$ 60,000
600 dia. HDPE, SDR 17 Lake Intake Pipe to 35m depth, fuse/install	200	m	$ 975	$ 195,000
Pump Stn No.1 - Okanagan Lake - 2-75 hp (LIFT TO HGL of 380m)	2	ea	$ 67,500	$ 135,000
Kiosk - pump controls and sodium hypo - allows water to go to irrig.immediately	1	LS	$ 90,000	$ 90,000
Kiosk - Electrical and Instrumentation	1	LS	$ 90,000	$ 90,000
Process Piping	300	m	$ 188	$ 56,250
Electrical Extension to Park	560	m	$ 263	$ 147,000
Landscaping at Park	1	LS	$ 75,000	$ 75,000
Water Main (450 mm dia PVC)	2225	m	$ 713	$ 1,585,313
Highway 97 Crossing / casing pipe	10%	ea	$ 112,500	$ 11,250
Pavement Restoration	1200	m2	$ 90	$ 108,000
Morgan Road Pump Station			$ -	
Concrete Building 15m x 9m	135	m2	$ 2,700	$ 364,500
Disinfection - UV 3 reactors 75 L/s each	3	LS	$ 112,500	$ 337,500
Process pipeworks	1	LS	$ 187,500	$ 187,500
Pump Stn No.2 Morgan Rd - 2 - 250 hp (LIFT HGL 380m to HGL 420m)	2	ea	$ 187,500	$ 375,000
Local Pumps 1 - 75 hp pump	1	ea	$ 52,500	$ 52,500
PRV pipeworks - renewal - bring above ground - elsewhere in estimates	1	LS	$ -	$ -
Electrical Extension to PStn	1020	m	$ 263	$ 267,750
Subtotal , Construction Cost Estimate				**$ 5,067,188**
Engineering Allowance	10%			$ 506,719
Base Capital Cost				$ 5,573,906
Contingency Allowance	15%			$ 836,086
TOTAL CAPITAL COST ESTIMATE				**$ 6,409,992**

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment - Project frees up Source and WTP Capacity	0%	100%
Capital Value Apportionment	$ -	$ 6,409,992

PRIORITY - MEDIUM	**ML/yr**	**Cost**	**Cost per ML**
COST / ML OF ANNUAL SOURCE WATER (includes Project 10)	**5141**	**$ 9,163,322**	**$ 1,782**

DISTRICT OF SUMMERLAND

PROJECT No. 16
OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)

Project Description

The design flow for the Okanagan Lake water intake is set in Project No. 15 at 20 ML/day.
Project 15 lifts the water from the lake to the Hillborn Tank.
The MDD flow of water into the Trout Creek area is estimated to be 7 ML/day for the irrigation and another 3.0 ML/day for the residential.
There are two existing watermains along the steep ridge north of Trout Creek that presently supply water down to Trout Creek.
The design flow is limited by these two water mains a 350mm diameter AC Class 150 pipe (1976) and a 250mm dia AC Class 150 (1962)

Pump Station No. 3 - Pump from PZ 471 (Trout Creek tank) to PZ 590 (WTP Clearwell) Q = 13 ML/day or 150 L/s 3 - 150 hp pumps
A dedicated water main from Hillborn Tank to above PRV 15 on Hillborn Avenue will be required to convey the required flow.

Transmission Main Route - Hillborn Tank to Morgan Road

Capital Cost Estimate	No.	Unit	Unit Price	Extension
			$ -	
PUMP STATION NO. 3			$ -	
Electrical extension to Pump Station No. 3	280	m	$ 150	$ 41,895
Pump Station No. 3 2- 250hp pumps	500	hp	$ 3,990	$ 1,995,000
Watermain tie ins, bypass around upper PRV Station to PZ 590	2	LS	$ 69,825	$ 139,650
			$ -	
Subtotal , Construction Cost Estimate			$ -	**$ 2,176,545**
Engineering Allowance	10%			$ 217,655
Base Capital Cost				$ 2,394,200
Contingency Allowance	15%			$ 359,130
TOTAL CAPITAL COST ESTIMATE				**$ 2,753,329**

Cost Benefit Assessment		Current Users	DCC Project
Percentage Apportionment	- Project frees up Source and WTP capacity	0%	100%
Capital Value Apportionment		$ -	$ 2,753,329

PRIORITY - MEDIUM

DISTRICT OF SUMMERLAND

PROJECT No. 17

SOURCE WATER ASSESSMENT PLAN

Dec. 2021

Project Description

This project consists of the development of a source water assessment plan.
The plan must meet the requirements of the drinking water regulator, Interior Health.
The plan is a document that is to assess and record the condition of the existing watershed and the existing risks posed by various activities that could be a risk to drinking water.
In 2011, Summerland completed a Watershed Master Plan that addressed some of the risks that IH requires.

Capital Cost Estimate	**No.**	**Unit**		**Unit Price**		**Extension**
Project Initiation	1	LS	$	7,500	$	7,500
Investigation and meeting with stakeholders	1	LS	$	15,000	$	15,000
Assessment Report	1	LS	$	37,500	$	37,500
			$	-		
Subtotal , Construction Cost Estimate					**$**	**60,000**
Engineering Allowance	10%				$	6,000
Base Capital Cost					$	66,000
Contingency Allowance	15%				$	9,900
TOTAL CAPITAL COST ESTIMATE					**$**	**75,900**
Cost Benefit Assessment		**Current Users**		**DCC Project**		
Percentage Apportionment		100%		0%		
Capital Value Apportionment		$ 75,900	$	-	$	75,900

PRIORITY - MEDIUM

DISTRICT OF SUMMERLAND

PROJECT No. 18

TSUH DAM - DECOMMISSIONING

Dec. 2021

Project Description

Tsuh Dam is situated up Tsuh Creek approximately 30 km west above Summerlands Trout Creek intake.
Eneas Reservoir is very small with storage of only 308 ML (four days of storage for Summerland).
The dam is located in Eneas Provincial Park where land use is subject to the Parks Act and BC Parks.

With the high requirements of maintaining a dam, the issue facing Summerland is one of high effort for minimal benefit.

There are two issues to sort out with this installation.
One is the maintenance of Summerlands storage and irrigation licensing and the other is the decommissioning of the dam itself.

Objectives in this work are to maintain the available storage licensing and have the licensing from Tsuh transferred to another site that is downstream of Tsuh, either Summerland Reservoir above the WTP or to a future dam site.

Capital Cost Estimate	**No.**	**Unit**		**Unit Price**		**Extension**
Approval agency works - Eng. Consultant support	1	m	$	7,500	$	7,500
Outlet pipe - Remove, breach dam, Site works	1	each	$	37,500	$	37,500
Finish grading, hydro-seeding	1	each	$	11,250	$	11,250
Subtotal , Construction Cost Estimate					**$**	**56,250**
Engineering Allowance	10%				$	5,625
Base Capital Cost					$	61,875
Contingency Allowance	15%				$	9,281
TOTAL CAPITAL COST ESTIMATE					**$**	**71,156**

Cost Benefit Assessment		**Current Users**		**DCC Project**		
Percentage Apportionment		100%		0%		
Capital Value Apportionment	$	71,156	$	-	$	71,156

PRIORITY - MEDIUM

PROJECT NO. 19

SUMMERLAND RESERVOIR SPILLWAY

Project Description

This project is identified as there is no open safe alternate route other than through the water distribution system for water to exit this reservoir.
The reservoir has controlled inflow from Trout Creek. The water is all diverted to the Water Treatment Plant
As documented in the 2018 Landfill Monitoring report, Summerland operates the Summerland Reservoir through a very narrow band of High water level.

The concept of this project would be to have a gravity weir or large diameter pipe that would safely convey high flows to Prairie Valley Creek. (blue line below)
The maximum inlet flow from the flume/pipe from Trout Creek plus the natural watershed inflow would be used to size the overflow channel for the PMF.
It is noted that the conveyance capacity required should be relatively small being the sum of the critical storm runoff plus the maximum inflow from Trout Ck.

The image below shows contour elevations and aerial views of the lands immediately below Summerland Reservoir
The reservoir was operated in 2018 between a very narrow elevation band of 595.36m to 595.55m.

The steps for safe release would include:
1. finding safe and accessible route for discharge pipe / or spillway (pipe preferred)
2. Determination of property access between the reservoir and Prairie Valley Creek - Crossing of 10701 Aileen Avenue
3. Detailed Design and obtain approvals from Dam Safety
4. Construction and implementation

10% Image -Summerland GIS map service

The estimated leakage from Trout Creek Reservoir, based on flow measurement by District of Summerland staff is 4.0 ML/day. (1,460 ML/year)
There are several other issues related to Summerland Reservoir. These include reduction of leakage, protection from landfill leachate, gravel revenues, redundancy,and increased capacity of balancing storage that is off-line from Trout Creek.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Mobilization	1	LS	$ 37,500	$ 37,500
Clearing Grubbing and site preparation	1	LS	$ 30,000	$ 30,000
Construction of inlet pipe and structure on Dam face	1	LS	$ 37,500	$ 37,500
Construction of shallow large 1.2m diameter pipe on Dam face, through SRW to creek	260	m	$ 2,250	$ 585,000
Geotechnical Investigation and Testing	1	LS	$ 22,500	$ 22,500
Environmental Monitoring	1	LS	$ 45,000	$ 45,000
Obtain SRW 2000m 2 100m x 20m width	2000	m2	$ 18.75	$ 37,500
Site remediation, topsoil replacement, replanting	1	LS	$ 45,000	$ 45,000
Subtotal , Construction Cost Estimate				**$ 840,000**
Engineering Allowance	10%			$ 84,000
Base Capital Cost				$ 924,000
Contingency Allowance	20%			$ 184,800
TOTAL CAPITAL COST ESTIMATE				**$ 1,108,800**

Cost Benefit Assessment	Current Users	DCC Project	
Percentage Apportionment	100%	0%	
Capital Value Apportionment	$ 1,108,800	$ -	$ 1,108,800
PRIORITY - MEDIUM	**ML/yr**	**Cost**	**Cost per ML**

DISTRICT OF SUMMERLAND

PROJECT NO. 20

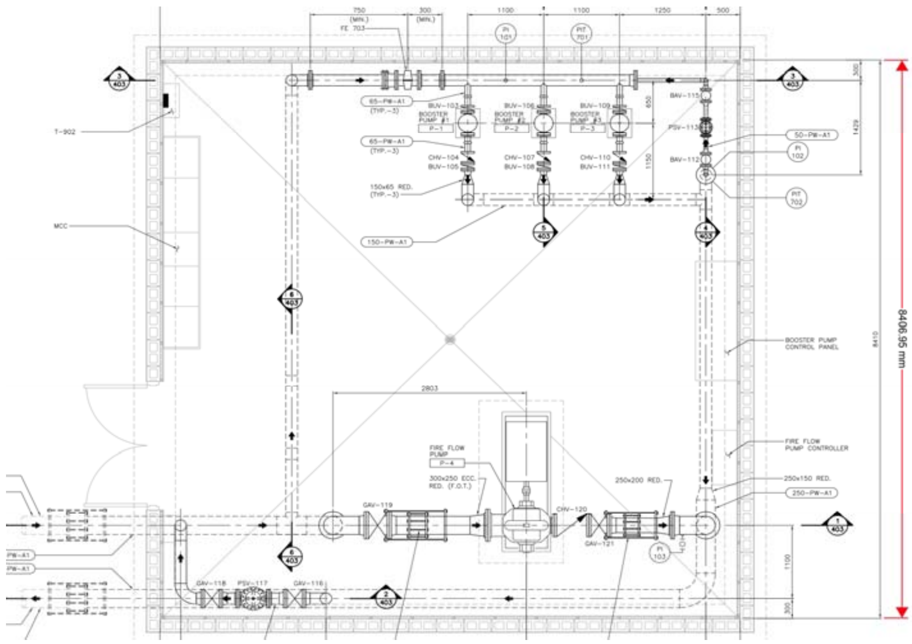
Dec. 2021

JAMES LAKE PUMP STATION UPGRADE

Project Description

This project includes additional controls on the fire pump for the James Lake Pump Station.
The fire pump is set up as a pump that meets building code requirements for private owners and not as a municipal type installation. Controls to monitor the large pump should be added.
Because of fire code standards, tampering or adjusting controls within the existing control panel cause warranty and insurance issues. Refer to electrical recommendations for how to deal with this pump.

Additional pumping capacity will be required at this station. VFDs are recommended for the duty pumps so that flows can be matched to system demands.
The project will be required as development in the area is requiring additional water in this pressure zone.
Development will be required to cover the majority of improvements at the station.



Associated Engineering - Floor Plan - James Bay Pump Station

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Adjust fire pump controls to municipal operational standards	1	allowance	$ 37,500	$ 37,500
VFDs for duty pumps	3	each	$ 18,750	$ 56,250
Replumb station with larger suction / discharge headers	1	LS	$ 75,000	$ 75,000
			$ -	
Subtotal , Construction Cost Estimate				**$ 168,750**
Engineering Allowance	10%			$ 16,875
Base Capital Cost				$ 185,625
Contingency Allowance	15%			$ 27,844
TOTAL CAPITAL COST ESTIMATE	10%			**$ 213,469**

Cost Benefit Assessment	Current Users	DCC Project	
Percentage Apportionment	100%	0%	
Capital Value Apportionment	$ 213,469	$ -	$ 213,469

PRIORITY - MEDIUM

PROJECT No. 21

ISINTOK DAM - RECONSTRUCTION AND RAISE

Dec. 2021

Project Description

This project identifies the additional cost to raise the dam by 3.0 metres to maximize the storage volume within the reservoir Isintok Reservoir is located 25 km southeast of Summerland up Canyon Creek. The reservoir is one of the oldest and it is also the closest to Summerland. The dam site is located at an elevation of 1649 metres making it one of Summerland's highest. The high elevation results in a more reliable raw water supply that the lower elevation reservoirs.

One of the greatest benefits of increasing storage at an existing dam site is that the environmental impacts are much smaller than for developing a completely new dam site. Approvals should be easier with reduced overall impacts.
The geotechnical analysis completed in 2021/22 along with the dam classification and seismic requirements indicate this project would have a very high cost. A dedicated study would be required to determine the extent of the raise that is possible and the associated costs. This project is documented to be a reminder of this potential storage.

This project would have to be considered when the spillway capacity is reviewed to see if there is benefit of doing both at the same time. The dam and reservoir information are provided within Sect 3 of this report.
Raising the dam would include the clearing of an estimated 30 metre perimeter around the reservoir. It may include the removal of tree snags by cutting them off at the base, but not pulling the stumps.
Removal of the organic material from around the reservoir perimeter to have a reservoir base of inorganic soils is an objective.

Raising of the dam by 3.0 metres would provide for a total of approximately 3600 ML of storage at this site which would match the watershed capacity. Additional work utilizing LIDAR mapping or similar is recommended prior to finalizing volumes and work.
To confirm reservoir watershed capacity, the installation of measuring devices on the spillway as per Project 5 is recommended.

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Clearing and Grubbing - forestry contractor	1	LS	$ 225,000	$ 225,000
Removal of snags, organic soils	1	LS	$ 600,000	$ 600,000
Dam raising - full upstream face to 3.0m higher	1	LS	$ 1,125,000	$ 1,125,000
Dam face liner - HDPE Material	3500	m2	$ 38	$ 131,250
Spillway raising and structure	1	LS	$ 450,000	$ 450,000
Armouring Dam Face at higher elevation	1	LS	$ 225,000	$ 225,000
			$ -	
Subtotal , Construction Cost Estimate				**$ 2,756,250**
Engineering Allowance	10%			$ 275,625
Base Capital Cost				$ 3,031,875
Contingency Allowance	15%			$ 454,781
TOTAL CAPITAL COST ESTIMATE				**$ 3,486,656**

Cost Benefit Assessment	**Current Users**	**DCC Project**	
Percentage Apportionment	100%	0%	
Capital Value Apportionment	$ 3,486,656	$ -	$ 3,486,656

PRIORITY - MEDIUM

DISTRICT OF SUMMERLAND

PROJECT NO. 22

Dec. 2021

WTP - FLOWMETER AND PROGRAMMING

Project Description

There should be a flow meter in place for water leaving the WTP.
There is merit in installation of a flow meter at the outlet to ensure that programming and recycle flows are all accounted for.
The flow meter would be useful in assessing Unaccounted for water flows and overall system leakage.

Either a strap on ultrasonic type or an insertion type meter could be utilized
The meter can be tapped into an existing pipe and provides flow
measurement over a wide range of flows. The meters are cost effective
and in the range of $ 4,000.

Programming and installation costs are provided.
The costs are based on there being a straight section of watermain
near the outlet from the plant.

Capital Cost Estimate	No.	Unit		Unit Price		Extension
Programming SCADA	1	each	$	11,250	$	11,250
Meter purchase and installation	1	each	$	15,000	$	15,000
Conduit and wiring as required	1	LS	$	2,250	$	2,250
Subtotal , Construction Cost Estimate					**$**	**28,500**
Engineering Allowance	10%				$	2,850
Base Capital Cost					$	31,350
Contingency Allowance	15%				$	4,703
TOTAL CAPITAL COST ESTIMATE					**$**	**36,053**
Cost Benefit Assessment		**Current Users**		**DCC Project**		
Percentage Apportionment		100%		0%		
Capital Value Apportionment	$	36,053	$	-	$	36,053

PRIORITY - MEDIUM

DISTRICT OF SUMMERLAND

PROJECT No. 23

SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)

Project Description

Refer to Figure A.18 through A.18c
Convert the 386m long existing 600mm trunk watermain on Victoria Ave. north of Dale Meadows Road to dedicated Irrigation main
Utilize existing 450mm AC main on Victoria Ave for all domestic use and for interim for downstream Irrigation/Domestic
Convert existing 600mm Domestic main below PRV 10 to irrigation main. Connect to 600mm below lower traffic circle on PV Road
Install Irrigation PRV station on converted 600mm main between the two traffic (PZ 586 / PZ 563)
Install a new 600mm trunk Domestic watermain for 300m length from PRV 10 to Rosedale Ave.
Convert the exisitng 600m/500mm trunk watermain on Giants Head Road to irrigation
Convert the larger diameter watermains on Gartrell Road and Giants Head Road to irrigation
Convert the existing service connections, as required to the dedicated irrigation or domestic supply mains.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Dale Meadows Road				
Install new 150mm domestic watermain	35	m	$ 293	$ 10,238
Connect to existing 500mm dia. Watermain	1	each	$ 15,600	$ 15,600
Connect to existing (200mm)	2	each	$ 9,750	$ 19,500
Long-side service connections	6	each	$ 3,510	$ 21,060
Short-side service connections	6	each	$ 1,560	$ 9,360
Road Restoration	105	m2	$ 107	$ 11,261
Prairie Valley Road / Kelly Ave / Wharton Street			$ -	
Install new 600mm irrigation watermain	310	m	$ 1,268	$ 392,925
Pressure Reducing Station large diameter	1	each	$ 412,500	$ 412,500
Long-side service connections	4	each	$ 3,510	$ 14,040
Short-side service connections	5	each	$ 1,560	$ 7,800
Road Restoration	1500	m2	$ 107	$ 160,875
Giants Head Road			$ -	
Install new 100mm domestic watermain	140	m	$ 234	$ 32,760
Long-side service connections	25	each	$ 3,510	$ 87,750
Short-side service connections	25	each	$ 1,560	$ 39,000
Road Restoration	420	m2	$ 78	$ 32,760
Connect to existing	1	each	$ 5,850	$ 5,850
Gartrell Road			$ -	
Install new 50mm domestic watermain	40	m	$ 195	$ 7,800
Long-side service connections	3	each	$ 3,510	$ 10,530
Short-side service connections	3	each	$ 1,560	$ 4,680
Road Restoration	120	m2	$ 78	$ 9,360
Connect to existing	1	each	$ 5,850	$ 5,850
Happy Valley Road			$ -	
Install new 50mm domestic watermain	150	m	$ 195	$ 29,250
Long-side service connections	5	each	$ 3,510	$ 17,550
Short-side service connections	2	each	$ 1,560	$ 3,120
Road Restoration	450	m2	$ 78	$ 35,100
Connect to existing	1	each	$ 5,850	$ 5,850
Blow-off	1	each	$ 4,875	$ 4,875
Penner St.			$ -	
Install new 50mm domestic watermain	10%	m	$ 195	$ 20
Long-side service connections	1	each	$ 3,510	$ 3,510
Short-side service connections	1	each	$ 1,560	$ 1,560
Landscape Restoration	400	m2	$ 49	$ 19,500
Connect to existing	1	each	$ 5,850	$ 5,850
Cross St.			$ -	$ -
Install new 50mm domestic watermain	130	m	$ 195	$ 25,350
Long-side service connections	1	each	$ 3,510	$ 3,510
Short-side service connections	1	each	$ 1,560	$ 1,560
Landscape Restoration	400	m2	$ 49	$ 19,500
Connect to existing	1	each	$ 5,850	$ 5,850
Swallow Back Ave.			$ -	
Install new 100mm irrigation watermain	110	m	$ 234	$ 25,740
Long-side service connections	1	each	$ 3,510	$ 3,510
Road Restoration	330	m2	$ 78	$ 25,740
Connect to existing	1	each	$ 5,850	$ 5,850
Subtotal , Construction Cost Estimate				**$ 1,589,295**
Engineering Allowance	15%			$ 238,394
Contingency Allowance	15%			$ 238,394
TOTAL CAPITAL COST ESTIMATE				**$ 2,066,084**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	25%	75%
Capital Value Apportionment	$ 516,521	$ 1,549,563

PRIORITY - MEDIUM	ML/day	Cost	Cost per ML
COST / ML OF MAX DAY CAPACITY	**5.35**	**$ 2,066,084**	**$ 386,184**

Agua Consulting Inc.
"Engineered Water Solutions"

DISTRICT OF SUMMERLAND

PROJECT NO. 24

AILEEN ROAD - WATER SYSTEM SEPARATION

Project Description

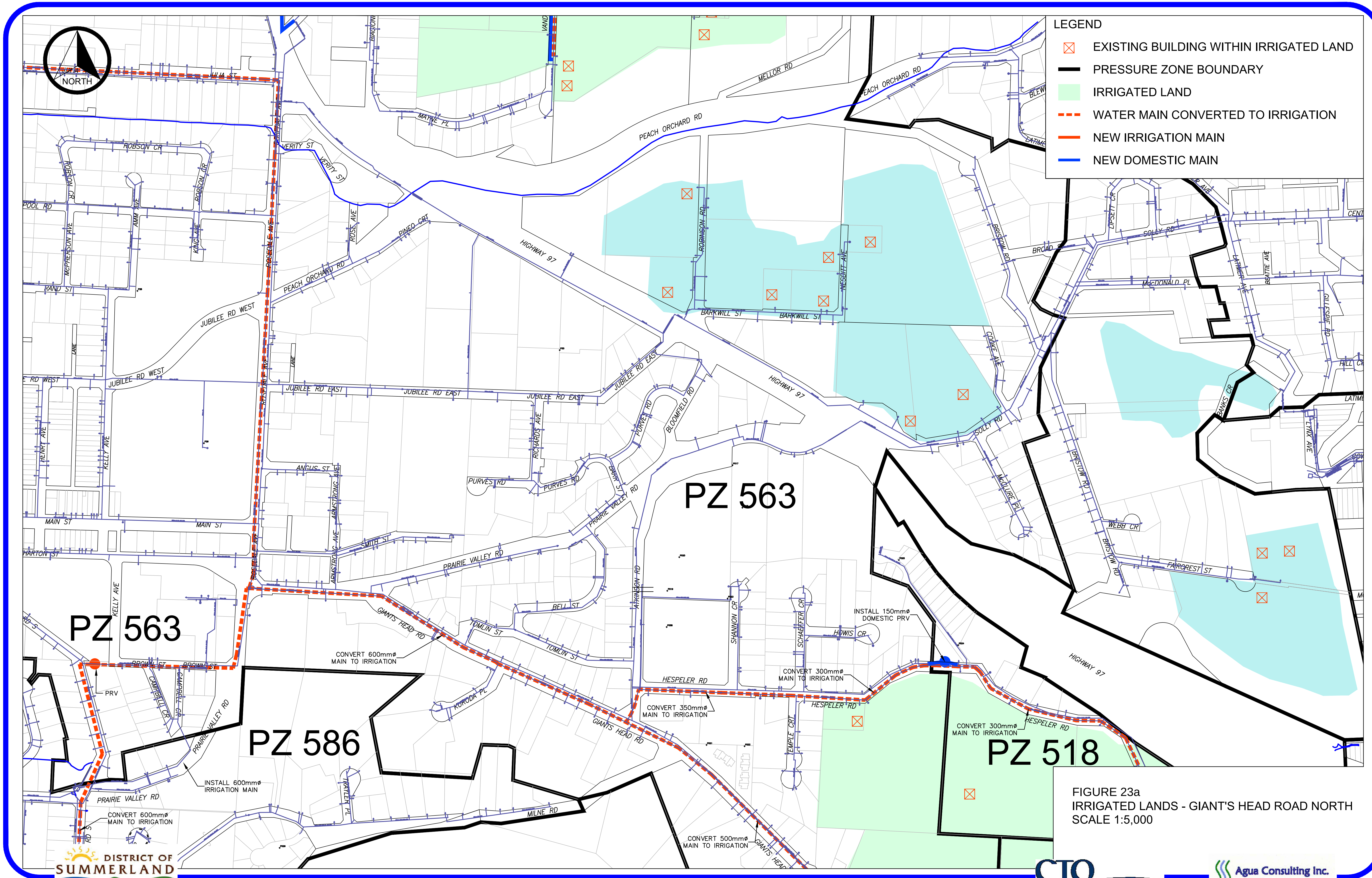
This project involves the connection of treated water to the houses above the Summerland WTP. There are approximately 5 single family homes located on Aileen Road that require water and fire protection. The work will involve approximately 275m of 150mm diameter main, fire hydrant and individual service connections. The water mains would connect to the high pressure system in Prairie Valley. The work could be considered renewal work. The mains in the area are older dating back to when the homes were first built.

The work would involve extension of a water main from the WTP treated water line to the south along Aileen Road to the five existing lots.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
150mm watermain	275	M	$ 255	$ 70,125
Road restoration	275	m2	$ 83	$ 22,688
Connection to existing	1	each	$ 7,500	$ 7,500
New Service installations	5	each	$ 6,000	$ 30,000
Hydrant - Supply and Install	1	each	$ 11,250	$ 11,250
Abandon existing service connections	5	each	$ 1,125	$ 5,625
			$ -	
Subtotal , Construction Cost Estimate				**$ 147,188**
Engineering Allowance	10%			$ 14,719
Base Capital Cost				$ 161,906
Contingency Allowance	15%			$ 24,286
TOTAL CAPITAL COST ESTIMATE				**$ 186,192**

Cost Benefit Assessment	10%	Current Users	DCC Project
Percentage Apportionment - Renewal		100%	0%
Capital Value Apportionment		$ 186,192	$ -

PRIORITY - MEDIUM



NORTH
LEGEND
EXISTING BUILDING WITHIN IRRIGATED LAND
PRESSURE ZONE BOUNDARY
IRRIGATED LAND
WATER MAIN CONVERTED TO IRRIGATION
NEW IRRIGATION MAIN
NEW DOMESTIC MAIN
PZ 563
PZ 563
PZ 586
PZ 518
PRV
INSTALL 150mmø DOMESTIC PRV
CONVERT 600mmø MAIN TO IRRIGATION
CONVERT 300mmø MAIN TO IRRIGATION
CONVERT 350mmø MAIN TO IRRIGATION
CONVERT 300mmø MAIN TO IRRIGATION
INSTALL 600mmø IRRIGATION MAIN
CONVERT 600mmø MAIN TO IRRIGATION
CONVERT 500mmø MAIN TO IRRIGATION
PEACH ORCHARD RD
HIGHWAY 97
JUBILEE RD WEST
JUBILEE RD EAST
PRAIRIE VALLEY RD
GIANTS HEAD RD
HESPELER RD
MAIN ST
ROBSON CR
MELLOR RD
ROBINSON RD
BARKWILL ST
BRISTOW RD
SOLLY RD
FAIRCREST ST
MCDONALD PL
ATKINSON RD
SHANNON CR
SCHAEFFER CR
HOWIS CR
TOMLIN ST
BELL ST
KURODA PL
MILNE RD
BROWN ST
CAMPBELL CR
ANGUS ST
ARMSTRONG AVE
SMITH ST
PURVES RD
RICHARDS AVE
BLOOMFIELD RD
KELLY AVE
HENRY AVE
RAND ST
MCPHERSON AVE
KING AVE
VERITY ST
ROSE AVE
PINEO CRT
COOKE AVE
MCCLURE PL
WEBB CR
BANKS CR
FIGURE 23a
IRRIGATED LANDS - GIANT'S HEAD ROAD NORTH
SCALE 1:5,000
DISTRICT OF SUMMERLAND
CTQ
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"Engineered Water Solutions"

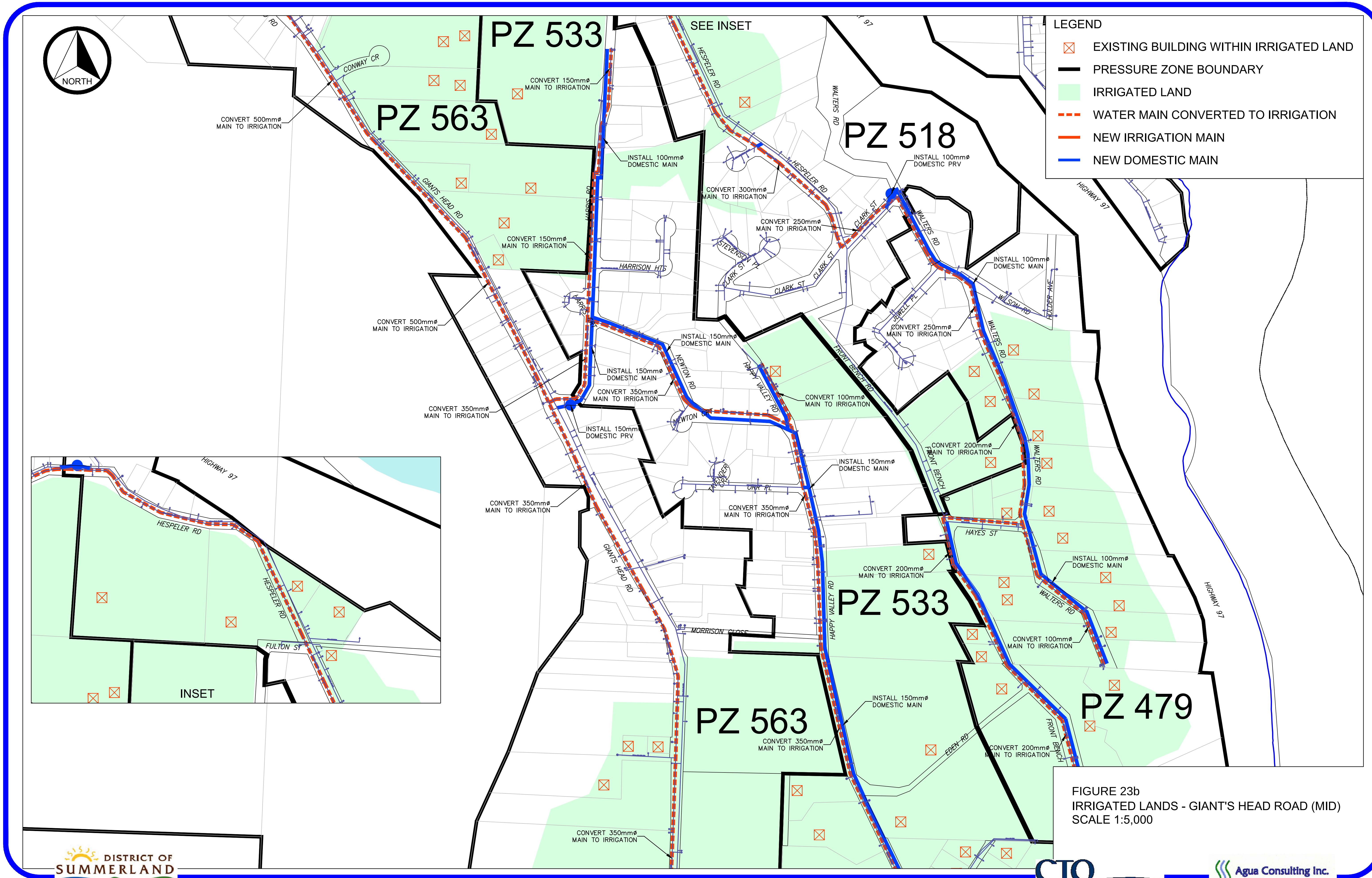


FIGURE 23b
IRRIGATED LANDS - GIANT'S HEAD ROAD (MID)
SCALE 1:5,000

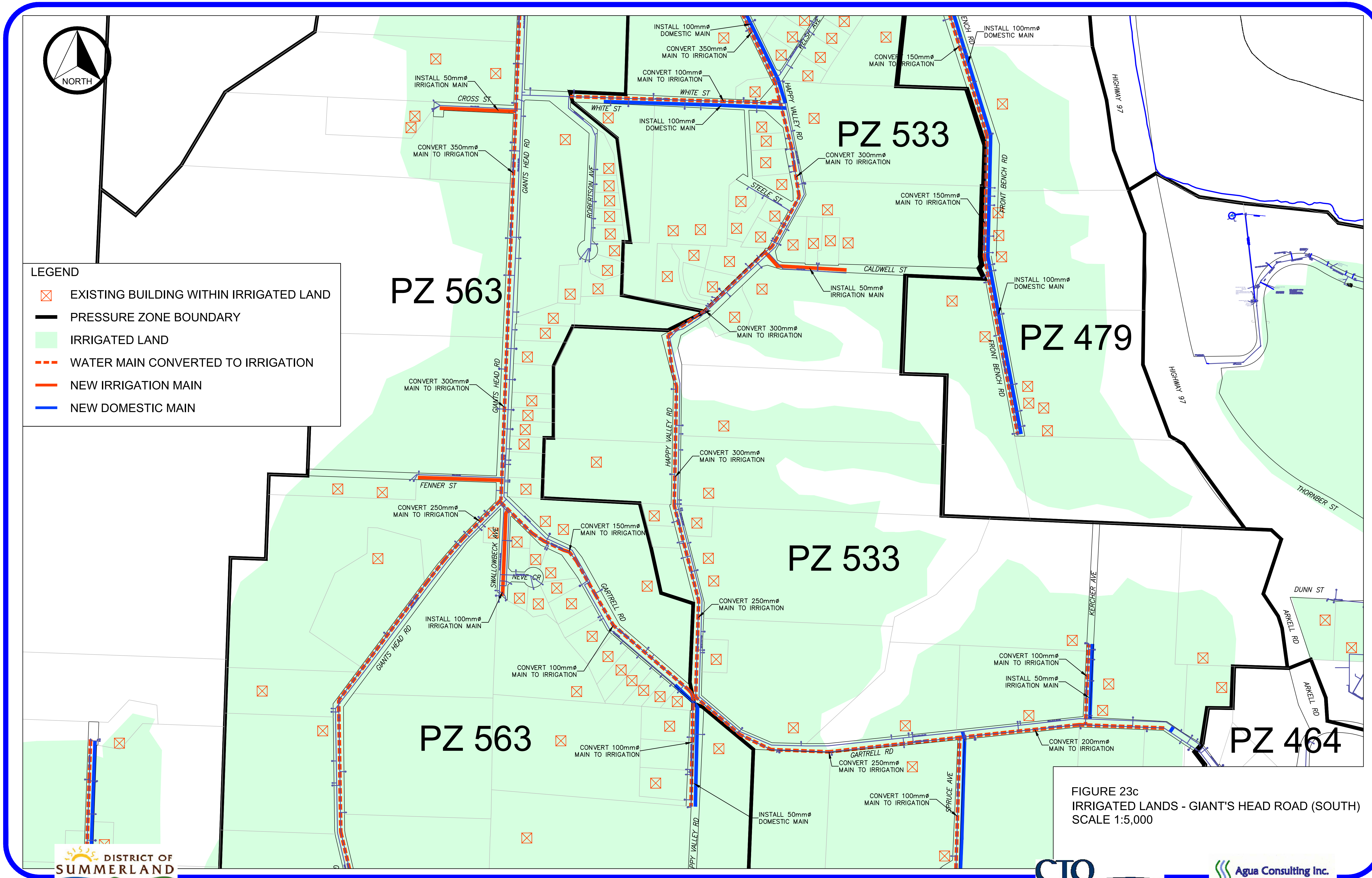


FIGURE 23c
IRRIGATED LANDS - GIANT'S HEAD ROAD (SOUTH)
SCALE 1:5,000

DISTRICT OF SUMMERLAND

PROJECT NO. 25
SYSTEM SEPARATION - FRONT BENCH ROAD

Project Description
Refer to Figure A.18b & A.18c
Connect to the dedicated irrigation watermain on Hespler Roa
Convert the existing watermain on Walters Road, Hayes St and Front Bench Road to irrigati
Install a small diameter PRV station on at Walters Rd (PZ 518/479
Install a small diameter domestic watermain on Walters Road and Front Bench Ro
Convert the existing service connections, as required to the dedicated irrigation or domestic supply ma

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Walters Road				
Install new 100mm domestic watermain	820	m	$ 234	$ 191,880
Pressure Reducing Station	1	each	$ 135,000	$ 135,000
Connect to existing	4	each	$ 5,850	$ 23,400
Long-side service connections	14	each	$ 3,510	$ 49,140
Short-side service connections	11	each	$ 1,560	$ 17,160
Road Restoration	2460	m2	$ 78	$ 191,880
Blow-off	1	each	$ 4,875	$ 4,875
Front Bench Road				
Install new 100mm domestic watermain	1200	m	$ 234	$ 280,800
Long-side service connections	8	each	$ 3,510	$ 28,080
Short-side service connections	8	each	$ 1,560	$ 12,480
Connect to existing	1	each	$ 5,850	$ 5,850
Road Restoration	3600	m2	$ 78	$ 280,800
Blow-off	1	each	$ 4,875	$ 4,875
Subtotal , Construction Cost Estimate				**$ 1,226,220**
Engineering Allowance	10%			$ 122,622
Base Capital Cost				$ 1,348,842
Contingency Allowance	15%			$ 202,326
TOTAL CAPITAL COST ESTIMATE				**$ 1,551,168**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	25%	75%
Capital Value Apportionment	$ 387,792	$ 1,163,376

PRIORITY - MEDIUM	ML/day	Cost	Cost per ML
COST / ML OF MAX DAY CAPACITY	**2.12**	**$ 1,551,168**	**$ 731,683**

10%

PROJECT NO. 26

SYSTEM SEPARATION - HAPPY VALLEY

Project Description

Refer to Figure A.18b & A.18c
Connect to the dedicated irrigation watermain on Giants Head Road
Convert the existing watermains on Harris Road, Newton Court and Happy Valley Road to irrigation
Install new domestic watermain for potable supply
Convert the existing 300mm watermain at the south end of Happy Valley Road to irrigation supply
Convert the existing 250/200mm watermain on Garthell to irrigation
Install small diameter domestic watermain on the connected side streets
Convert the existing service connections, as required to the dedicated irrigation or domestic supply mains.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**	
Install new 150mm domestic watermair	180	m	$ 293	$ 52,650	$ 195
Install new 100mm domestic watermair	400	m	$ 234	$ 93,600	$ 156
Pressure Reducing Statior	1	each	$ 135,000	$ 135,000	$ 90,000
Connect to existing	3	each	$ 5,850	$ 17,550	$ 3,900
Long-side service connections	12	each	$ 3,510	$ 42,120	$ 2,340
Short-side service connections	10	each	$ 1,560	$ 15,600	$ 1,040
Road Restoration	1740	m2	$ 78	$ 135,720	$ 52
Blow-off	1	each	$ 4,875	$ 4,875	$ 3,250
Newton Road			$ -		
Install new 150mm domestic watermair	350	m	$ 293	$ 102,375	$ 195
Long-side service connections	5	each	$ 3,510	$ 17,550	$ 2,340
Short-side service connections	8	each	$ 1,560	$ 12,480	$ 1,040
Connect to existing	1	each	$ 5,850	$ 5,850	$ 3,900
Road Restoration	1050	m2	$ 78	$ 81,900	$ 52
Happy Valley Road			$ -		
Install new 100mm domestic watermair	810	m	$ 234	$ 189,540	$ 156
Long-side service connections	14	each	$ 3,510	$ 49,140	$ 2,340
Short-side service connections	14	each	$ 1,560	$ 21,840	$ 1,040
Road Restoration	2430	m2	$ 78	$ 189,540	$ 52
Connect to existing	4	each	$ 5,850	$ 23,400	$ 3,900
Caldwell Road			$ -		
Install new 50mm domestic watermair	140	m	$ 195	$ 27,300	$ 130
Long-side service connections	1	each	$ 3,510	$ 3,510	$ 2,340
Short-side service connections	1	each	$ 1,560	$ 1,560	$ 1,040
Road Restoration	420	m2	$ 78	$ 32,760	$ 52
Connect to existing	1	each	$ 5,850	$ 5,850	$ 3,900
Gartrell Road			$ -		
Long-side service connections	4	each	$ 3,510	$ 14,040	$ 2,340
Short-side service connections	4	each	$ 1,560	$ 6,240	$ 1,040
Spruce Ave			$ -		
Install new 50mm domestic watermair	220	m	$ 195	$ 42,900	$ 130
Long-side service connections	3	each	$ 3,510	$ 10,530	$ 2,340
Short-side service connections	1	each	$ 1,560	$ 1,560	$ 1,040
Road Restoration	10%	m2	$ 78	$ 8	$ 52
Connect to existing	1	each	$ 5,850	$ 5,850	$ 3,900
Kercher Ave.			$ -		
Install new 50mm domestic watermair	120	m	$ 195	$ 23,400	$ 130
Long-side service connections	2	each	$ 3,510	$ 7,020	$ 2,340
Short-side service connections	1	each	$ 1,560	$ 1,560	$ 1,040
Road Restoration	360	m2	$ 78	$ 28,080	$ 52
Connect to existing	1	each	$ 5,850	$ 5,850	$ 3,900
Blow-off	1	each	$ 4,875	$ 4,875	$ 3,250
White St.			$ -		
Install new 50mm domestic watermair	300	m	$ 195	$ 58,500	$ 130
Long-side service connections	2	each	$ 3,510	$ 7,020	$ 2,340
Short-side service connections	3	each	$ 1,560	$ 4,680	$ 1,040
Road Restoration	400	m2	$ 78	$ 31,200	$ 52
Connect to existing	1	each	$ 5,850	$ 5,850	$ 3,900
Subtotal , Construction Cost Estimate				**$ 1,520,873**	
Engineering Allowance	10%			$ 152,087	
Base Capital Cost				$ 1,672,960	
Contingency Allowance	15%			$ 250,944	
TOTAL CAPITAL COST ESTIMATE				**$ 1,923,904**	
Cost Benefit Assessment		**Current Users**	**DCC Project**		
Percentage Apportionment		25%	75%		
Capital Value Apportionment		$ 480,976	$ 1,442,928		
PRIORITY - MEDIUM		**ML/day**	**Cost**	**Cost per ML**	
COST / ML OF MAX DAY CAPACITY		**5.56**	**$ 1,923,904**	**$ 346,026**	

DISTRICT OF SUMMERLAND

PROJECT NO. 27

SYSTEM SEPARATION - HESPLER ROAD

Dec. 2021

Project Description

Refer to Drawings A.18 & A.18a

Connect to the dedicated irrigation watermain on Giants Head Road

Convert the 350/300mm watermain on Hespler Road to irrigation

Install a small diameter PRV station for the domestic supply (PZ 563/518)

Convert the existing PRV station to irrigation supply only (PZ 563/518)

Convert the existing service connections, as required to the dedicated irrigation or domestic supply mains.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
Hespler Road				
Install new 100mm domestic watermain	40	m	$ 234	$ 9,360
Pressure Reducing Station	1	each	$ 135,000	$ 135,000
Connect to existing	3	each	$ 5,850	$ 17,550
Long-side service connections	15	each	$ 3,510	$ 52,650
Short-side service connections	10	each	$ 1,560	$ 15,600
Road Restoration	120	m2	$ 78	$ 9,360
Subtotal , Construction Cost Estimate				**$ 239,520**
Engineering Allowance	10%			$ 23,952
Base Capital Cost				$ 263,472
Contingency Allowance	15%			$ 39,521
TOTAL CAPITAL COST ESTIMATE				**$ 302,993**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	25%	75%
Capital Value Apportionment	$ 75,748	$ 227,245

PRIORITY - LOW	ML/day	Cost	Cost per ML
COST / ML OF MAX DAY CAPACITY	**1.27**	**$ 302,993**	**$ 238,577**

10%

DISTRICT OF SUMMERLAND

PROJECT NO. 28

SYSTEM SEPARATION - LOWER JONES FLATS (EAST)

Dec. 2021

Project Description

Refer to Figures A.30a & A.30b, Project involves separation of lands east of Highway 97 and to north District limits
Convert the existing water mains on Jones Flat Rd, Switchback Rd, Fosbery Rd, Mellor R
Tada Ave, Vaderburgh Ave, Highway 97, Steuart St, Kean St, Logie Rd, Whitfield Rd, and Huddleston Rd to irrigation sup|
Install new irrigation main on Matsu Dr, Logie Rd and Fosbery R
Install new domestic main on Highway 97, Steuart St, Jones Flat Rd, Switchback Rd, Fosbery Rd, Kean St, Whitfiled I
Vanderburgh Ave, Tada Ave, Huddlestone Rd and Mellor Rd. Install new Domestic PRV on Whitfield Ro

Capital Cost Estimate			Quantity	Unit	Unit Price	Extension
Jones Flat Road	Long-side service connections		2	each	$ 3,510	$ 7,020
	Short-side service connections		3	each	$ 1,560	$ 4,680
	Highway crossing for domestic main		1	each	$ 97,500	$ 97,500
	Install 100mm domestic main		405	m	$ 234	$ 94,770
	Minor Road Restoration		1215	m2	$ 78	$ 94,770
	Connect to existing		2	each	$ 5,850	$ 11,700
Switchback Road	Install 100mm domestic main		605	m	$ 234	$ 141,570
	Minor Road Restoration		1815	m2	$ 78	$ 141,570
	Connect to existing		2	each	$ 5,850	$ 11,700
	Blow-off		1	each	$ 4,875	$ 4,875
	Long-side service connections		6	each	$ 3,510	$ 21,060
	Short-side service connections		10	each	$ 1,560	$ 15,600
	Install 50mm domestic main		250	m	$ 195	$ 48,750
	Landscape Restoration		750	m2	$ 49	$ 36,563
Mellor Road	Install 100mm domestic main		535	m	$ 234	$ 125,190
	Minor Road Restoration		1605	m2	$ 78	$ 125,190
	Connect to existing		1	each	$ 5,850	$ 5,850
	Blow-off		1	each	$ 4,875	$ 4,875
	Long-side service connections		4	each	$ 3,510	$ 14,040
	Short-side service connections		6	each	$ 1,560	$ 9,360
Tada Avenue	Install 50mm domestic main		535	m	$ 195	$ 104,325
	Minor Road Restoration		1605	m2	$ 78	$ 125,190
	Blow-off		1	each	$ 4,875	$ 4,875
	Long-side service connections		2	each	$ 3,510	$ 7,020
	Short-side service connections		5	each	$ 1,560	$ 7,800
Vanderburgh Ave.	Install 50mm domestic main		290	m	$ 195	$ 56,550
	Minor Road Restoration		870	m2	$ 78	$ 67,860
	Connect to existing		2	each	$ 5,850	$ 11,700
	Long-side service connections		2	each	$ 3,510	$ 7,020
	Short-side service connections		2	each	$ 1,560	$ 3,120
Highway 97	Install 50mm domestic main		360	m	$ 195	$ 70,200
	Install 100mm domestic main		220	m	$ 234	$ 51,480
	Landscape Restoration		1740	m2	$ 49	$ 84,825
	Connect to existing		2	each	$ 5,850	$ 11,700
	Long-side service connections		5	each	$ 3,510	$ 17,550
Stewart Street	Install 150mm domestic main		515	m	$ 293	$ 150,638
	Install 50mm domestic main		130	m	$ 195	$ 25,350
	Minor Road Restoration		1260	m2	$ 78	$ 98,280
		10%	390	m2	$ 49	$ 19,013
	Connect to existing		1	each	$ 5,850	$ 5,850
	Long-side service connections		1	each	$ 3,510	$ 3,510
	Short-side service connections		2	each	$ 1,560	$ 3,120
	Blow-off		1	each	$ 4,875	$ 4,875
Logie Road	Install 200mm irrigation main		245	m	$ 361	$ 88,384
	Minor Road Restoration		735	m2	$ 78	$ 57,330
	Connect to existing		1	each	$ 5,850	$ 5,850
	Long-side service connections		7	each	$ 3,510	$ 24,570
	Short-side service connections		3	each	$ 1,560	$ 4,680
Kean Street	Install 50mm domestic main		165	m	$ 195	$ 32,175
	Minor Road Restoration		495	m2	$ 78	$ 38,610
	Blow-off		1	each	$ 4,875	$ 4,875
	Long-side service connections		1	each	$ 3,510	$ 3,510
	Short-side service connections		1	each	$ 1,560	$ 1,560
Fosbery Road	Install 100mm irrigation main		70	m	$ 234	$ 16,380
	Install 100mm domestic main		71	m	$ 234	$ 16,614
	Install 200mm irrigation main		420	m	$ 361	$ 151,515
	Minor Road Restoration		1683	m2	$ 78	$ 131,274
	Long-side service connections		8	each	$ 3,510	$ 28,080
	Short-side service connections		1	each	$ 1,560	$ 1,560
	Connect to existing		4	each	$ 9,750	$ 39,000
Matsu Drive	Install 150mm domestic main		90	m	$ 293	$ 26,325
	Install 200mm irrigation main		570	m	$ 361	$ 205,628
	Minor Road Restoration		1710	m2	$ 78	$ 133,380
	Landscape Restoration		270	m2	$ 49	$ 13,163
	Long-side service connections		4	each	$ 3,510	$ 14,040
	Short-side service connections		3	each	$ 1,560	$ 4,680
	Connect to existing		2	each	$ 9,750	$ 19,500
Whitfield Road	Install 150mm domestic main		145	m	$ 293	$ 42,413
	Install 100mm domestic main		1010	m	$ 234	$ 236,340
	Install 100mm domestic PRV		1	each	$ 234	$ 234
	Minor Road Restoration		3465	m2	$ 78	$ 270,270
	Long-side service connections		6	each	$ 3,510	$ 21,060
	Short-side service connections		1	each	$ 1,560	$ 1,560
	Connect to existing		1	each	$ 5,850	$ 5,850
Huddleston Road	Install 50mm domestic main		150	m	$ 195	$ 29,250
	Minor Road Restoration		450	m2	$ 78	$ 35,100
	Long-side service connections		1	each	$ 3,510	$ 3,510
	Short-side service connections		4	each	$ 1,560	$ 6,240
	Blow-off		2	each	$ 4,875	$ 9,750
Subtotal , Construction Cost Estimate						***$ 3,682,741***
Engineering Allowance			*10%*			*$ 368,274*
Base Capital Cost						*$ 4,051,015*
Contingency Allowance			*15%*			*$ 607,652*
TOTAL CAPITAL COST ESTIMATE						***$ 4,658,667***

Cost Benefit Assessment	Current Users	DCC Project	
Percentage Apportionmen	25%	75%	
Capital Value Apportionmen	$ 1,164,667	$ 3,494,000	
PRIORITY - LOW	**ML/day**	**Cost**	**Cost per ML**
COST / ML OF MAX DAY CAPACITY	**10.50**	**$ 4,658,667**	**$ 443,683**

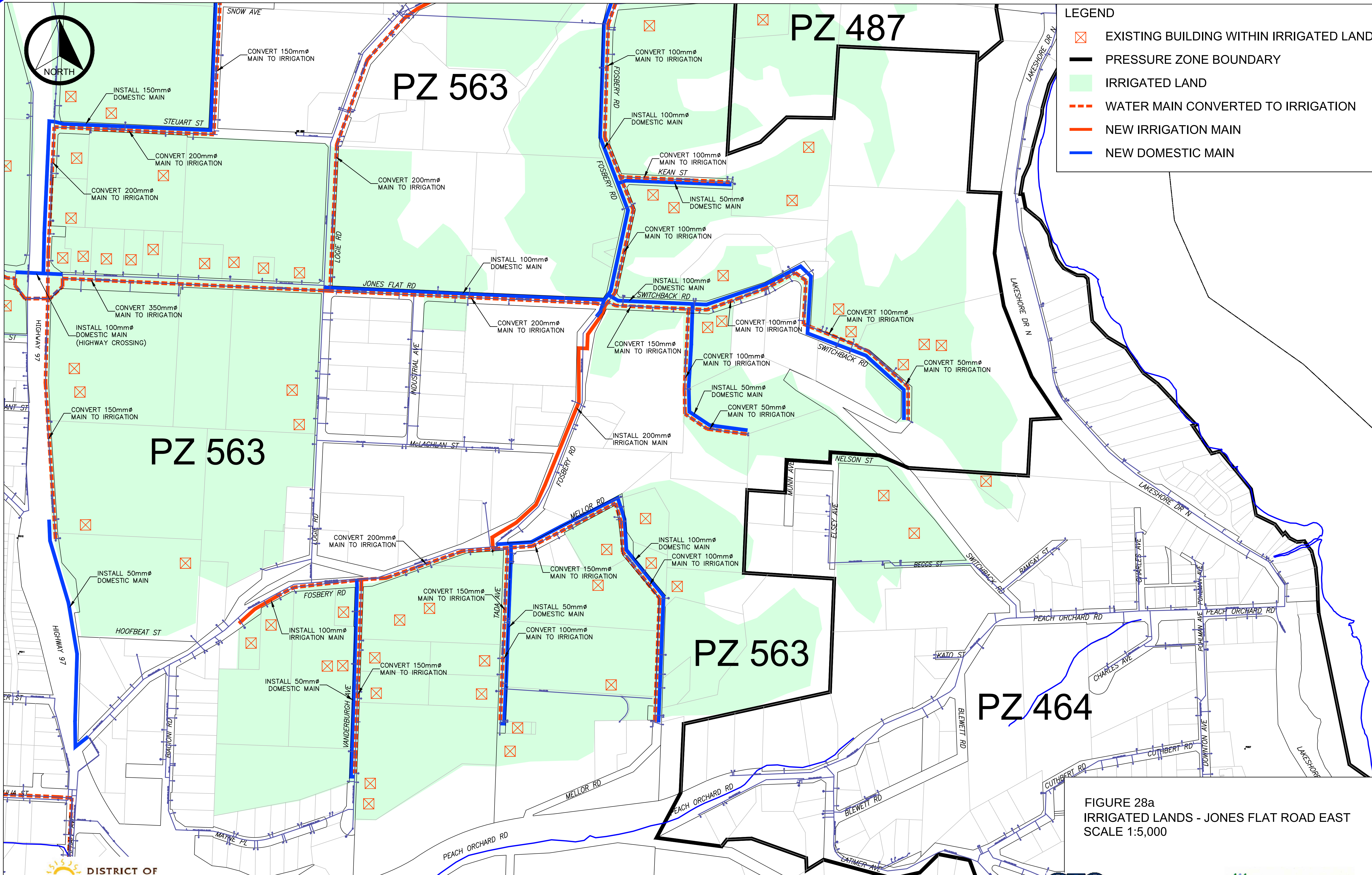


FIGURE 28a
IRRIGATED LANDS - JONES FLAT ROAD EAST
SCALE 1:5,000

DISTRICT OF SUMMERLAND

CTQ

Agua Consulting Inc. "Engineered Water Solutions"

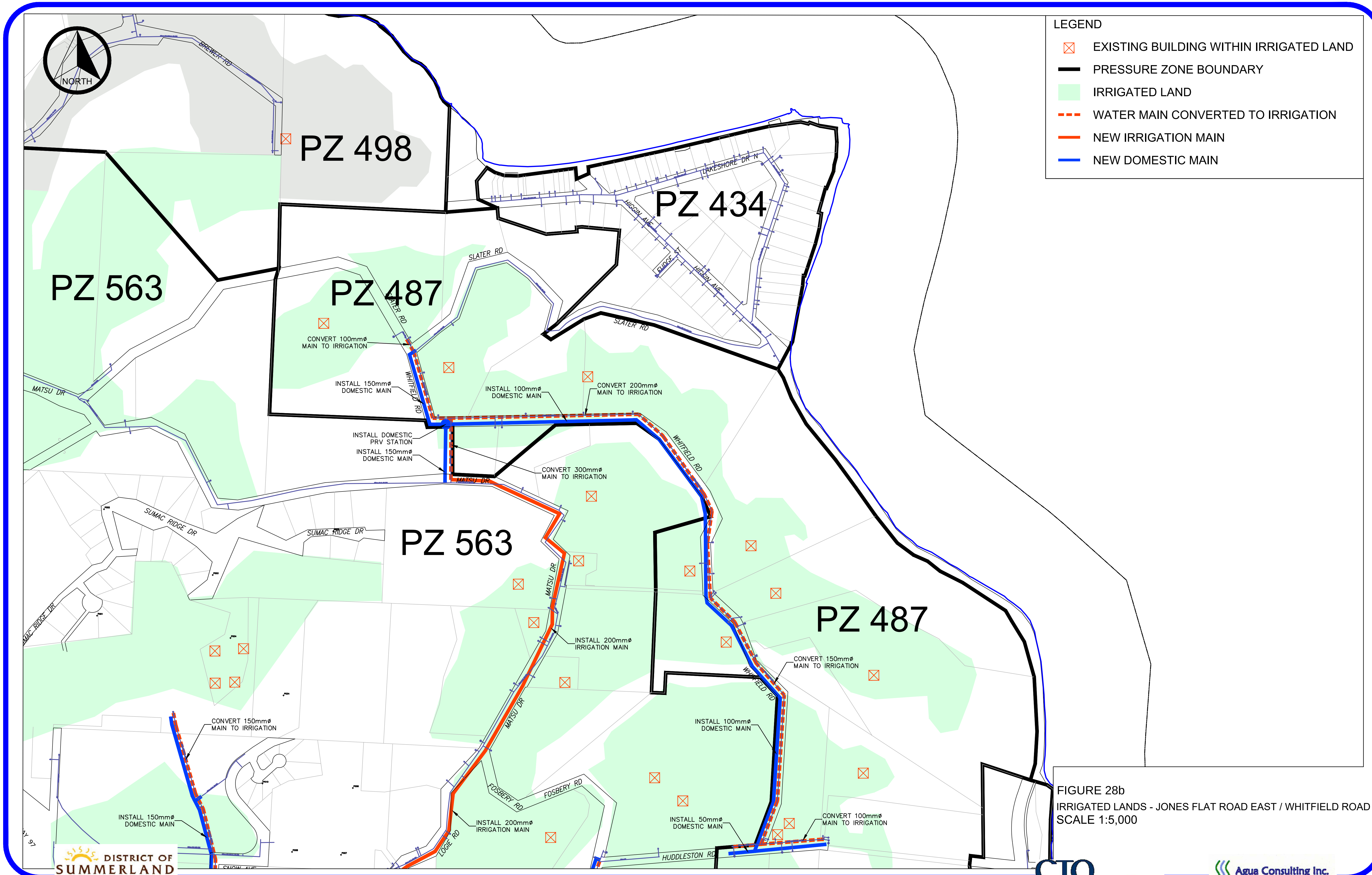


FIGURE 28b
IRRIGATED LANDS - JONES FLAT ROAD EAST / WHITFIELD ROAD
SCALE 1:5,000

DISTRICT OF SUMMERLAND

PROJECT NO. 29

SYSTEM SEPARATION - VICTORIA - SIMPSON ROAD

Dec. 2021

Project Description

Refer to Figures A.31
Convert the existing 400mm watermain on Simpson Road to irrigation supply
To receive dedicated irrigation supply this project must be preceded by the conversion of the Victoria Rd irrig. separatio
Install new smaller diameter domestic water main and domestic booster station on Simpson Roac
Convert the existing 600mm trunk main on Dale Meadows Road to irrigation supply
Convert the existing pump station (PS 5) to dedicated irrigation suppl
Convert the existing service connections, as required to the dedicated irrigation or domestic supply main

Capital Cost Estimate	Quantity	Unit		Unit Price		Extension
Simpson Road						
Install new 200mm domestic watermair	2000	m	$	361	$	721,500
New domestic pump station (PS 5-Dom)	20	Hp	$	5,850	$	60,000
Pump Station building	65	m2	$	2,925	$	97,500
Pump Station electrical	1	LS	$	58,500	$	30,000
New domestic pump station (PS-6 Dom)	15	Hp	$	5,850	$	45,000
Pump Station building	65	m2	$	780	$	26,000
Pump Station electrical	1	LS	$	58,500	$	30,000
Long-side service connections	12	each	$	3,510	$	42,120
Short-side service connections	8	each	$	1,560	$	12,480
Road Restoration	6000	m2	$	78	$	468,000
Gliman Road			$	-	$	-
Install new 100mm domestic watermair	770	m	$	234	$	180,180
Long-side service connections	3	each	$	3,510	$	10,530
Short-side service connections	4	each	$	1,560	$	6,240
Road Restoration	2310	m2	$	78	$	180,180
Bennett Road			$	-	$	-
Install new 100mm domestic watermair	320	m	$	234	$	74,880
Long-side service connections	2	each	$	3,510	$	7,020
Short-side service connections	1	each	$	1,560	$	1,560
Road Restoration	960	m2	$	78	$	74,880
Blow-off	1	each	$	4,875	$	4,875
Subtotal , Construction Cost Estimate					**$**	**2,072,945**
Engineering Allowance	10%				$	207,295
Base Capital Cost					$	2,280,240
Contingency Allowance	15%				$	342,036
TOTAL CAPITAL COST ESTIMATE					**$**	**2,622,275**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	25%	75%
Capital Value Apportionmen	$ 655,569	$ 1,966,707

PRIORITY - LOW	ML/day	Cost	Cost per ML
COST / ML OF MAX DAY CAPACITY	**2.71**	**$ 2,622,275**	**$ 967,629**

10%

PROJECT NO. 30

SYSTEM SEPARATION - SIMPSON / CANYONVIEW / HILLBORN RD.

Project Description

Refer to Figures A.32a and A.32b
Reconnect to the dedicated 500mm irrigation watermain west of Walton St.
Convert the existing 500mm trunk watermain on Dale Meadows Road to irrigation supply
Convert the 750mm and 600mm trunk watermain on Victoria Rd S to irrigation
Convert the 600mm trunk watermain on Lewes Ave to irrigation
Convert the 450mm trunk watermain on Hillburn St to irrigation
Install a new small diameter PRV station on Hillburn St. for domestic supply
Install new small diameter domestic watermain on Andrew Ave, English Ave, Fiske St and Canyonview rd.
Convert the existing service connections, as required to the dedicated irrigation or domestic supply mains.

Capital Cost Estimate		Quantity	Unit	Unit Price	Extension
Victoria Road	Long-side service connections	9	each	$ 3,510	$ 31,590
	Short-side service connections	6	each	$ 1,560	$ 9,360
	Connections to existing	2	each	$ 9,750	$ 19,500
Lewes Ave.	Long-side service connections	2	each	$ 3,510	$ 7,020
	Short-side service connections	2	each	$ 1,560	$ 3,120
	Connections to existing	2	each	$ 9,750	$ 19,500
Monro Ave	Install new 100mm domestic watermain	1300	m	$ 234	$ 304,200
	Long-side service connections	10	each	$ 3,510	$ 35,100
	Short-side service connections	8	each	$ 1,560	$ 12,480
	Road Restoration	3900	m2	$ 78	$ 304,200
	Blow-off	1	each	$ 4,875	$ 4,875
Andrew Ave.	Install new 100mm domestic watermain	600	m	$ 234	$ 140,400
	Long-side service connections	5	each	$ 3,510	$ 17,550
	Short-side service connections	8	each	$ 1,560	$ 12,480
	Road Restoration	1800	m2	$ 78	$ 140,400
	Blow-off	1	each	$ 4,875	$ 4,875
Hillborn St.	Pressure Reducing Station (100mm)	1	each	$ 135,000	$ 135,000
	Install new 100mm domestic watermain	10	m	$ 234	$ 2,340
	Long-side service connections	6	each	$ 3,510	$ 21,060
	Short-side service connections	6	each	$ 1,560	$ 9,360
English Ave.	Install new 50mm domestic watermain	120	m	$ 195	$ 23,400
	Long-side service connections	1	each	$ 3,510	$ 3,510
	Short-side service connections	1	each	$ 1,560	$ 1,560
	Road Restoration	360	m2	$ 78	$ 28,080
	Connect to existing	1	each	$ 5,850	$ 5,850
	Blow-off	1	each	$ 4,875	$ 4,875
Happy Valley Road	Install new 100mm domestic watermain	400	m	$ 234	$ 93,600
	Long-side service connections	3	each	$ 3,510	$ 10,530
	Short-side service connections	3	each	$ 1,560	$ 4,680
	Road Restoration	1200	m2	$ 78	$ 93,600
	Connect to existing	1	each	$ 5,850	$ 5,850
	Blow-off	1	each	$ 4,875	$ 4,875
Canyon View Road	Install new 100mm domestic watermain	1100	m	$ 234	$ 257,400
	10%	10	each	$ 3,510	$ 35,100
	Short-side service connections	8	each	$ 1,560	$ 12,480
	Road Restoration	3300	m2	$ 78	$ 257,400
	Connect to existing	1	each	$ 5,850	$ 5,850
	Blow-off	1	each	$ 4,875	$ 4,875

Subtotal , Construction Cost Estimate		**$ 2,087,925**
Engineering Allowance	10%	$ 208,793
Base Capital Cost		$ 2,296,718
Contingency Allowance	15%	$ 344,508
TOTAL CAPITAL COST ESTIMATE		**$ 2,641,225**

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	25%	75%
Capital Value Apportionment	$ 660,306	$ 1,980,919

PRIORITY - LOW	**ML/day**	**Cost**	**Cost per ML**
COST / ML OF MAX DAY CAPACITY	**9.22**	**$ 2,641,225**	**$ 286,467**

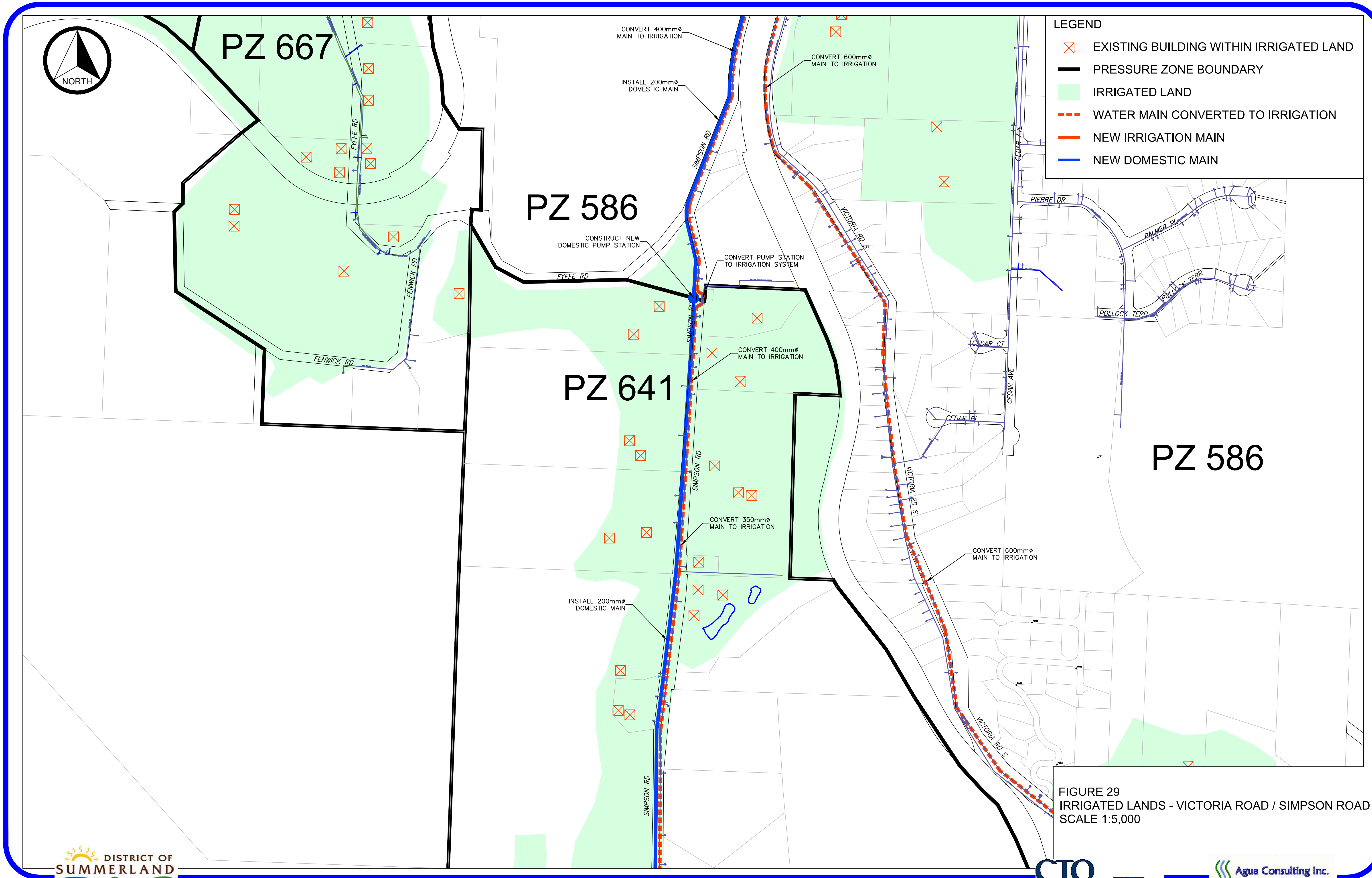


FIGURE 29
IRRIGATED LANDS - VICTORIA ROAD / SIMPSON ROAD
SCALE 1:5,000

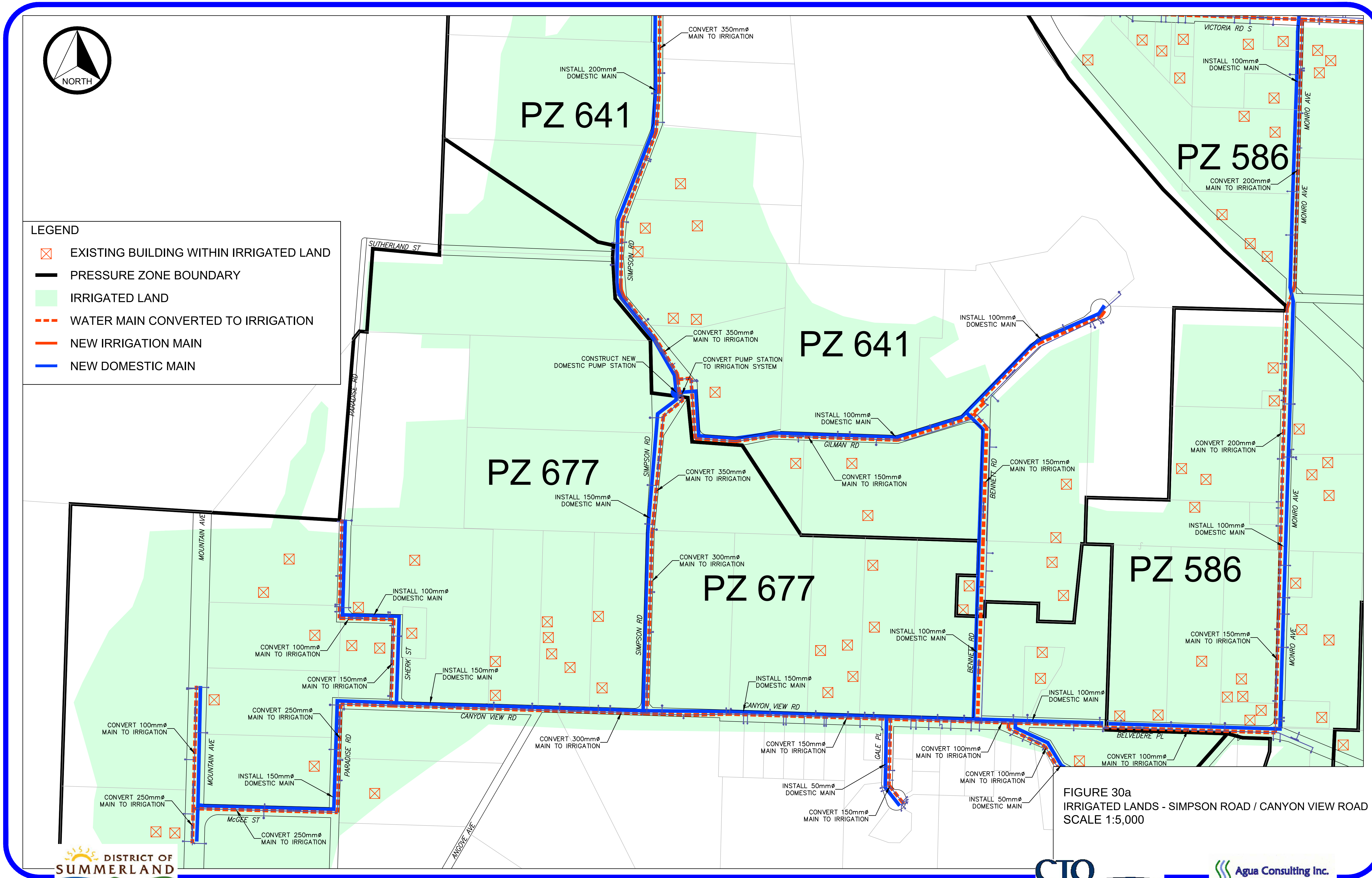


FIGURE 30a
IRRIGATED LANDS - SIMPSON ROAD / CANYON VIEW ROAD
SCALE 1:5,000

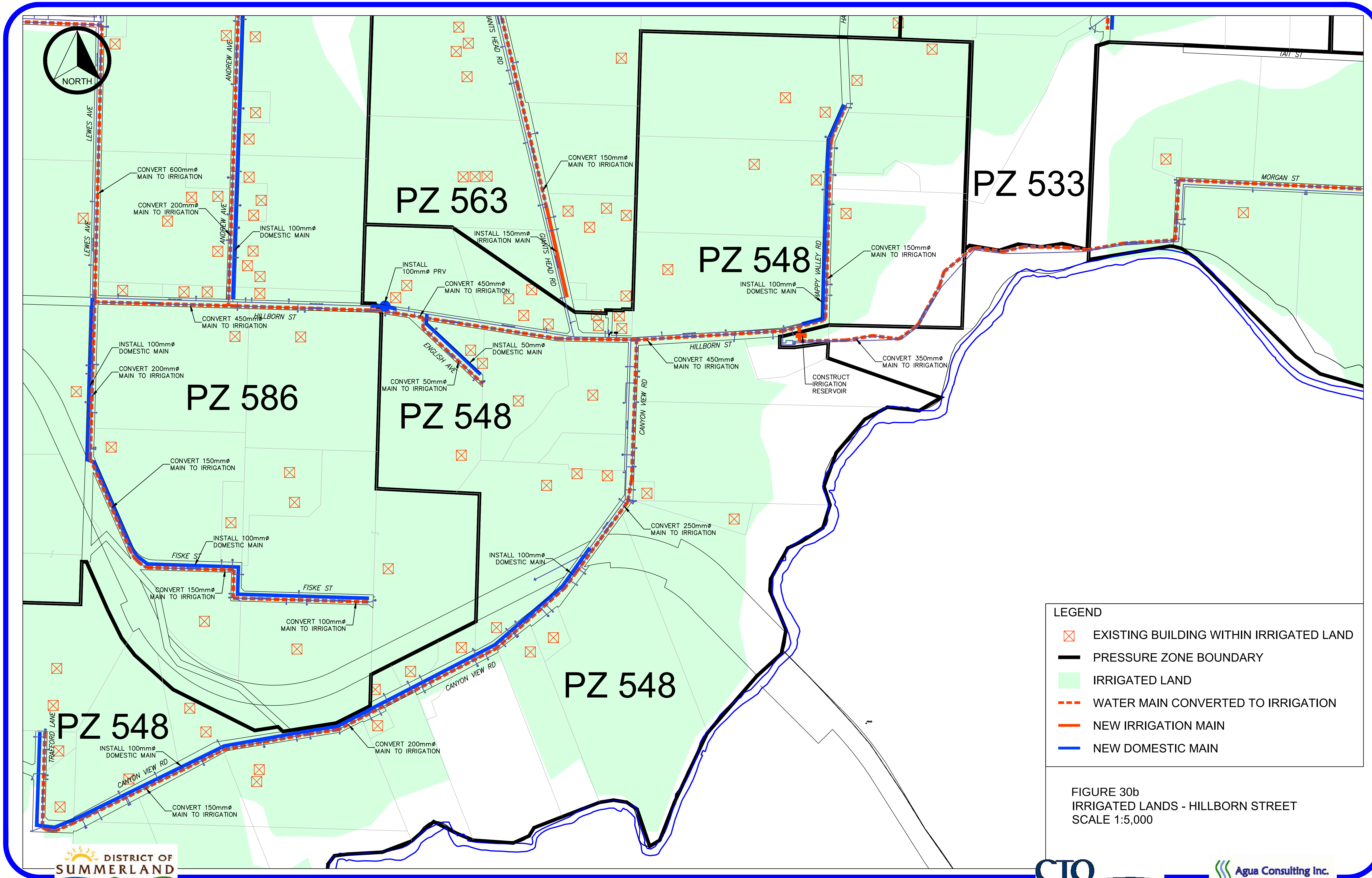


FIGURE 30b
IRRIGATED LANDS - HILLBORN STREET
SCALE 1:5,000

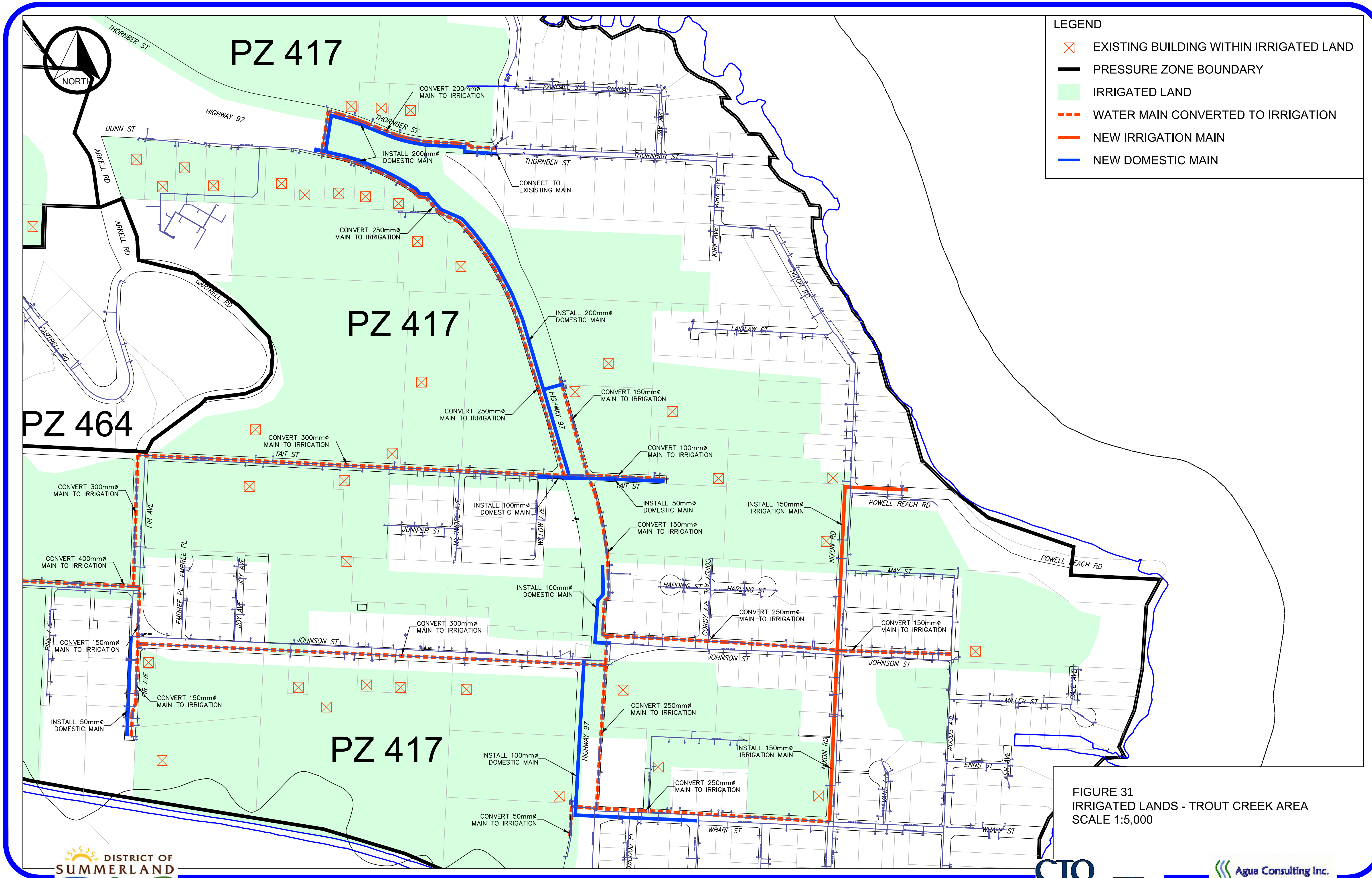


FIGURE 31
IRRIGATED LANDS - TROUT CREEK AREA
SCALE 1:5,000

DISTRICT OF SUMMERLAND

PROJECT NO. 31

SYSTEM SEPARATION - TROUT CREEK

Dec. 2021

Project Description

Refer to Figure A.33
Convert the PRV and 400mm watermain on Morgan St. to irrigation supply
Convert the smaller diameter mains to domestic water supply
Convert the existing watermain on Hwy 97 north of Tait St to irrigation
Install new domestic watermain to feed into the grid at Thornber St.
Install new domestic watermain south of Johnson St. to feed into the grid at Wharf St.
Convert the existing service connections, as required to the dedicated irrigation or domestic supply mains.

Capital Cost Estimate		Quantity	Unit		Unit Price		Extension
Morgan St.	Long-side service connections	2	each	$	3,510	$	7,020
	Short-side service connections	2	each	$	1,560	$	3,120
Fir Ave.	Install new 50mm domestic watermain	140	m	$	195	$	27,300
	Long-side service connections	5	each	$	3,510	$	17,550
	Short-side service connections	3	each	$	1,560	$	4,680
	Road Restoration	420	m2	$	78	$	32,760
	Connect to existing	1	each	$	5,850	$	5,850
	Blow-off	1	each	$	4,875	$	4,875
Tait St.	Install new 50mm domestic watermain	180	m	$	195	$	35,100
	Long-side service connections	2	each	$	3,510	$	7,020
	Short-side service connections	1	each	$	1,560	$	1,560
	Road Restoration	450	m2	$	78	$	35,100
	Blow-off	1	each	$	4,875	$	4,875
	Highway Crossing	1	each	$	97,500	$	97,500
	Connect to existing	1	each	$	5,850	$	5,850
Johnson St.	Install new 150mm domestic watermain	5	m	$	293	$	1,463
	Long-side service connections	10	each	$	3,510	$	35,100
	Short-side service connections	10	each	$	1,560	$	15,600
	Connections to existing	2	each	$	9,750	$	19,500
Highway 97	Install new 200mm domestic watermain	870	m	$	361	$	313,853
	Install new 100mm domestic watermain	370	m	$	234	$	86,580
	Highway Crossing (200mm)	1	each	$	175,500	$	175,500
	Highway Crossing (less than 150mm)	3	each	$	97,500	$	292,500
	Short-side service connections	7	each	$	1,560	$	10,920
	Road Restoration	420	m2	$	78	$	32,760
	Landscape restoration allowance	200	m2	$	49	$	9,750
	Connect to existing (200mm)	2	each	$	9,750	$	19,500
	Connect to existing (100mm)	2	each	$	5,850	$	11,700
	Blow-off	1	each	$	4,875	$	4,875
Powell Beach Road	Install new 150mm irrigation watermain	80	m	$	293	$	23,400
	Long-side service connections	1	each	$	3,510	$	3,510
	Short-side service connections	1	each	$	1,560	$	1,560
	Blow-off	1	each	$	4,875	$	4,875
Nixon Road	Install new 150mm irrigation watermain	500	m	$	293	$	146,250
	Long-side service connections	1	each	$	3,510	$	3,510
	10%	3	each	$	1,560	$	4,680
	Road Restoration	1500	m2	$	78	$	117,000
	Connection to existing	2	each	$	5,850	$	11,700
Wharf St.	Install new 100mm domestic watermain	160	m	$	234	$	37,440
	Long-side service connections	2	each	$	3,510	$	7,020
	Short-side service connections	3	each	$	1,560	$	4,680
	Road Restoration	450	m2	$	78	$	35,100
	Connection to existing	2	each	$	5,850	$	11,700
Hillborn Street	Construct New Irrigation Reservoi	1000	m3	$	858	$	858,000
	Site Piping	1	LS	$	97,500	$	97,500
Subtotal , Construction Cost Estimate						$	2,687,685
Engineering Allowance		10%				$	268,769
Base Capital Cost						$	2,956,454
Contingency Allowance		15%				$	443,468
TOTAL CAPITAL COST ESTIMATE						**$**	**3,399,922**

Cost Benefit Assessment		**Current Users**		**DCC Project**
Percentage Apportionment		25%		75%
Capital Value Apportionment	$	849,980	$	2,549,941

PRIORITY - LOW	**ML/day**		**Cost**		**Cost per ML**
COST / ML MAX DAY CAPACITY	**6.95**	**$**	**3,399,922**	**$**	**489,197**

PROJECT NO. 32

BULL CREEK HYDROMETRIC STATION

Project Description

An abandoned Water Survey of Canada station No. 08NM133 is on Bull Creek

This project involves reinstatement of a flow monitoring station on Bull Creek in the Trout Creek watershed.
Bull Creek would provide a reasonable representation of an unregulated stream in the Upper Trout Creek watershed.
Several years of data would be required to develop a correlation with other streamflow monitoring stations in the watershed.

This station would provide additional information on watershed production tc r

The cost is to reinstate the measuring station. The project is not critical to Summerland and should only be required if there are issues with the accuracy of Camp Creek and issues with the Water Use Plan. This project may be eligible for small water grants from the OBWB

Capital Cost Estimate	No.	Unit		Unit Price		Extension
Reinstate existing WSC station	1	each	$	52,500	$	52,500
Measuring device for flow levels	1	LS	$	11,250	$	11,250
Subtotal , Construction Cost Estimate					**$**	**63,750**
Engineering Allowance	10%				$	6,375
Base Capital Cost					$	70,125
Contingency Allowance	15%				$	10,519
OBWB GRANT (SMALL WATER PROJECTS GRANTS)					**$**	**(25,000)**
TOTAL CAPITAL COST ESTIMATE					**$**	**55,644**

Cost Benefit Assessment		Current Users		DCC Project
Percentage Apportionment		100%		0%
Capital Value Apportionment	$	55,644	$	-

PRIORITY - LOW

DISTRICT OF SUMMERLAND

PROJECT NO. 33

RESERVOIR TANK MIXING IMPROVEMENTS

Project Description

There are three existing small reservoirs in service in Summerland.
R-1 Deere Ridge (423 cubic metres)
R-2 Trout Creek (430 cubic metres)
R-3 Lower Town (190 cubic metres)
All of the reservoirs have room for improvement in mixing and turn-over of the water.
The system reservoirs do not have mixing configurations in their outlet piping.
Methods for reservoir mixing are to inject fresher water into the reservoir chambers by means of nozzles or flap valves as utilized by the "Tideflex" system for reservoir mixing.
The flap valve system is expensive and a cost-effective nozzle system is recommended for the Summerland reservoirs.

Allowance is provided on an individual reservoir basis.
Implementation is to retrofit one reservoir every two years by PW staff.

Requirements for process piping
- Piping PVC Schedule 80
- all penetrations through walls to be steel, cored and grouted tight
- no glued joints for pressure points
- Check valve allowing flow only one way into and one-way out of the reservoir
- Recirculation pump may be required to circulate water if poor chlorine residuals are noted. Allowance is added.
- rechlorination is not added at this time, however set up should include consideration for rechlorination

Capital Cost Estimate	No.	Unit		Unit Price		Extension
Pipeworks per reservoir	3	LS	$	15,000	$	45,000
Check valves and fitting connections to inlets/outlets (1 inlet & outlet)	3	LS	$	7,500	$	22,500
Vault and valving to control inlet/outlet flows	3	each	$	15,000	$	45,000
Recirculation pump to turn over reservoir (not included)	3	LS	$	-		
Subtotal , Construction Cost Estimate					**$**	**112,500**
Engineering Allowance	10%				$	11,250
Base Capital Cost					$	123,750
Contingency Allowance	15%				$	18,563
TOTAL CAPITAL COST ESTIMATE					**$**	**142,313**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 142,313	$ -

PRIORITY - LOW

DISTRICT OF SUMMERLAND

PROJECT NO. 34

PUMP STATION 2B - SOLENOID VALVE

Project Description

This project allows the release of water from PZ 730 (Reservoir) back down to PZ 667 for fire flow. Flow into this zone for fire flow is limited by the pump station capacity below this zone.

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Pipeworks at pump station	1	LS	$ 29,250	$ 29,250
Programming SCADA	1	each	$ 9,750	$ 9,750
SCADA Site connection (covered in Instrumentation budget)			$ -	
Solenoid valve and Emergeny power supply (for electrical)	1	LS	$ 29,250	$ 29,250
Subtotal , Construction Cost Estimate				**$ 68,250**
Engineering Allowance	10%			$ 6,825
Base Capital Cost				$ 75,075
Contingency Allowance	15%			$ 11,261
TOTAL CAPITAL COST ESTIMATE				**$ 86,336**

Cost Benefit Assessment	Current Users	DCC Project	
Percentage Apportionment	100%	0%	
Capital Value Apportionment	$ 86,336	$ -	$ 86,336

PRIORITY - LOW

DISTRICT OF SUMMERLAND

PROJECT No. 35

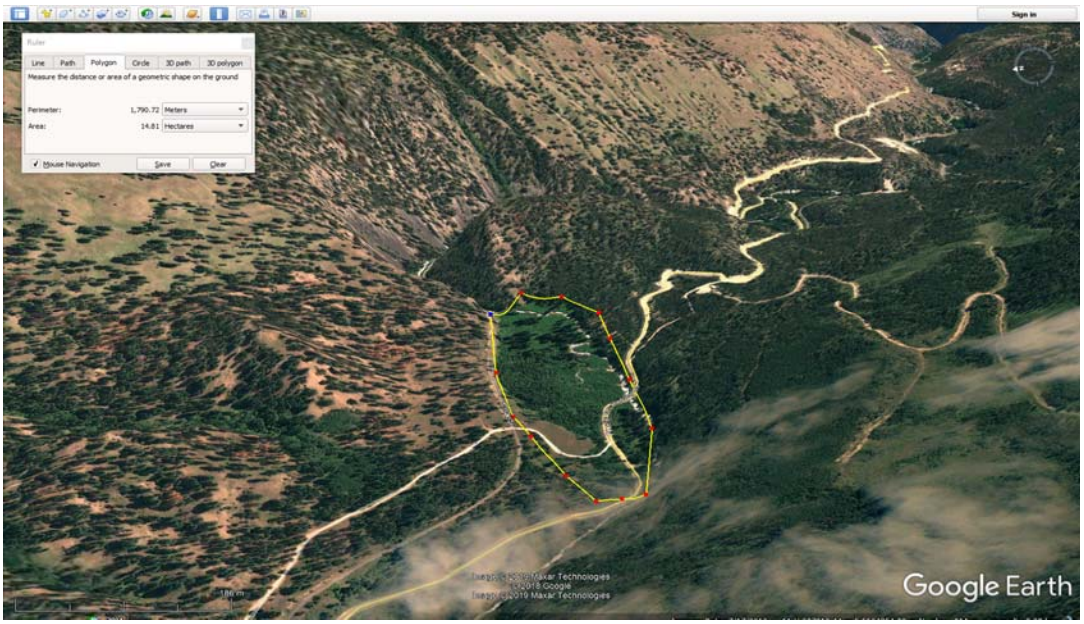
SITE 13 RESERVOIR (3,700 ML)

Dec. 2021

Project Description

This project was identified in the 1992 UMA Report on Additional Water Storage in the Trout Creek Watershed.
The first known survey of the site was by Mr. J.C. Dufresne, C.E. in 1921. The dam height was limited to 6 m so as not to flood the KVR.
Costs were updated using escalation factors for inflation since 1992. The site is at the rock outcrop approximately 19 km west of the Summerland WTP.
It is recognized the current dam construction techniques and environmental procedures are more stringent now than in 1992.

The site is located at a point where the Trout Creek valley narrows considerably 2 km downstream of the old KVR station of Kirton.
The dam site is proposed to be located at elevation 884 m on Trout Creek. The area upstream of the dam is 420 km ^{2}.
There is bedrock at this site which could form a good foundation for a future dam. There are several options for construction that are not determined in this assessment.
Two storage volumes were reviewed in the UMA Report, one of 1,850 ML that would see a maximum dam height of 19 m.
The second volume was to store 3,700 ML with a maximum dam height of 26 m. The larger volume is recommended.



Google Earth Image

Capital Cost Estimate	10%	Unit	Unit Price	Extension
Mobilization	1	LS	$ 117,000	$ 117,000
Reservoir Clearing	20	ha.	$ 31,200	$ 624,000
Clearing and Grubbing	0.3	ha.	$ 39,000	$ 11,700
Road / Bridge Relocation	1	LS	$ 468,000	$ 468,000
Stream Diversion	1	LS	$ 78,000	$ 78,000
Foundation Excavation	2000	cm	$ 39	$ 78,000
Dental Excavation	500	cm	$ 195	$ 97,500
Dental Concrete	200	cm	$ 1,950	$ 390,000
Drill Grout Holes	1200	cm	$ 195	$ 234,000
Grout Injection	120	t	$ 2,730	$ 327,600
Drill Drain Holes	600	m	$ 195	$ 117,000
Roller Compacted Concrete	5400	m	$ 468	$ 2,527,200
Spillway Walls	30	cm	$ 5,850	$ 175,500
Flip Bucket Concrete	140	cm	$ 1,950	$ 273,000
Low Level Outlet Pipes	30	m	$ 780	$ 23,400
Gates and Hoists	2	ea	$ 27,300	$ 54,600
Environmental Assessment	1	LS	$ 292,500	$ 292,500
Geotechnical Investigation and Testing	1	LS	$ 585,000	$ 585,000
Subtotal , Construction Cost Estimate				**$ 6,474,000**
Engineering Allowance	10%			$ 647,400
Base Capital Cost				$ 7,121,400
Contingency Allowance	15%			$ 1,068,210
TOTAL CAPITAL COST ESTIMATE				$ 8,189,610

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	0%	100%
Capital Value Apportionment	$ -	$ 8,189,610

PRIORITY - LOW	ML/yr	Cost	Cost per ML
COST / ML OF ANNUAL CAPACITY	**3700**	**$ 8,189,610**	**$ 2,213**

DISTRICT OF SUMMERLAND

PROJECT No. 36
SITE 2 RESERVOIR (7600 ML)

Project Description

The site was reviewed in detail by H.Fellhauer, P.Eng. in 1985. The site of the reservoir is at a location along Upper Trout Creek where the valley is relatively flat.
The project was then updated in the 1992 UMA report on *Additional Water Storage in Trout Creek Watershed*
The project was then again updated in the 1997 Associated Engineering Master Plan.

This project is located on the east fork of Trout Creek approximately 8.0 km downstream of Headwaters Dam No. 4.
The catchment area is 66.0 km2 of which 51.5 km2 is within the Crescent Reservoir and Headwaters Reservoirs catchments.

The mean annual runoff of the unregulated area of 14.5 km2 is estimated to be approximately 1,780 ML. That plus the overflow from Crescent and Headwaters Reservoirs is what would be available to fill this reservoir. Additional details are provided within the 1992 UMA report.
Costs from the report were updated to present day dollars with the inclusion of cost for a BC Environmental Assessment.

A dam 400m wide, 21 metres high is envisioned. The dam would be able to be filled only in wet years and with the assistance of a diversion from Pitin Creek which is included in the project list. It is included for future reference. There is sufficient developed storage at Headwaters and Crescent.
Re-consideration of this site should only be done if reliability of the existing water supply changes substantially.

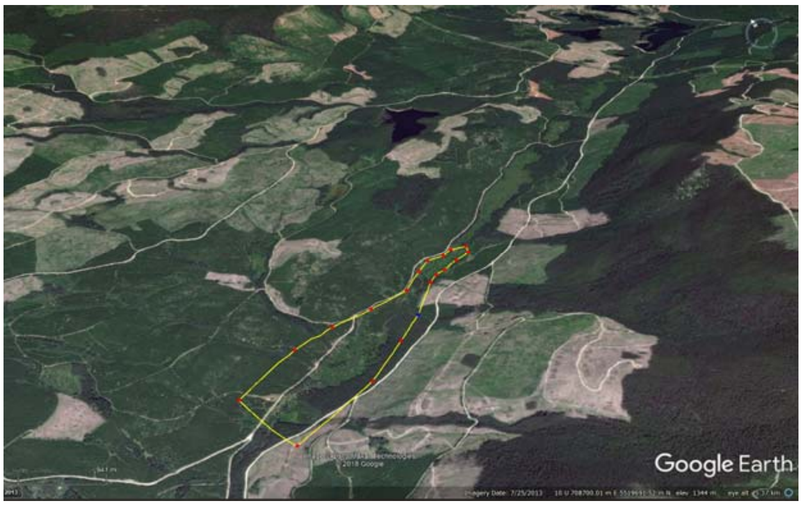


Image: Google Earth aerial photo

10%

Capital Cost Estimate	No.	Unit		Unit Price		Extension
Mobilization	1	LS	$	116,146	$	116,146
Reservoir Clearing	110	ha.	$	19,358	$	2,129,335
Clearing and Grubbing	3.5	ha.	$	77,430	$	271,006
Stream Diversion - (see Pitin Creek diversion project)	0	LS	$	77,430	$	-
Drain Materials	11500	cm	$	19	$	222,612
Core Trench Excavation	33400	cm	$	19	$	646,544
Embankment Materials	308000	cm	$	27	$	8,346,995
Drain Materials	38000	cm	$	77	$	2,942,354
Low Level Outlet Pipe	120	m	$	774	$	92,916
Outlet Gate	1	LS	$	58,073	$	58,073
Impact Stilling Basin	8	cm	$	4,646	$	37,167
Spillway Excavation	15000	cm	$	19	$	290,364
Spillway Concrete	25	cm	$	2,323	$	58,073
Spillway Rip Rap	3000	cm	$	116	$	348,437
Environmental Assessment	1	LS	$	225,000	$	225,000
Geotechnical Investigation and Testing	1	LS	$	580,728	$	580,728
Subtotal , Construction Cost Estimate					**$**	**16,365,750**
Engineering Allowance	10%				$	1,636,575
Base Capital Cost					$	18,002,325
Contingency Allowance	15%				$	2,700,349
TOTAL CAPITAL COST ESTIMATE					$	20,702,674

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	0%	100%
Capital Value Apportionment	$ -	$ 20,702,674

PRIORITY - LOW	**ML/yr**	**Cost**	**Cost per ML**
	Pitin Creek Project	$ 2,263,439	
COST / ML OF ANNUAL CAPACITY (Including Pitin Creek Diversion)	**7600**	**$ 22,966,112**	**$ 3,022**

DISTRICT OF SUMMERLAND

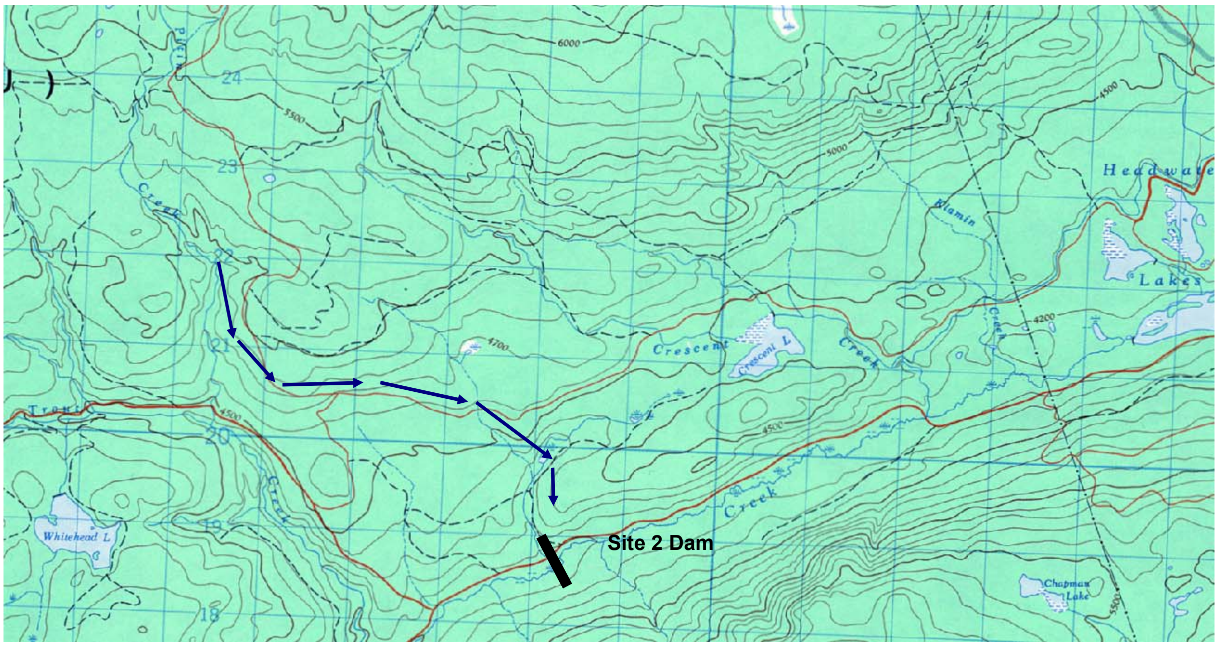
PROJECT No. 37

PITIN CREEK DIVERSION TO SITE 2

Dec. 2021

Project Description

This project was reviewed in conjunction with the Site 2 Reservoir and Dam works. Refer to Site 2 Reservoir project details.
It is noted that this site was reviewed in 1990 by the Ministry of Environment and was not approved at that time.
The estimated Mean Annual Runoff that could be generated from Pitin Creek is in the range of 4,700 ML.
Some of the diversion could run along the existing roadway. The total length of the diversion is in the range of 5.5 km.



Capital Cost Estimate	No.	Unit	Unit Price	Extension
Diversion and Dewatering	1	LS	$ 16,720	$ 16,720
Excavation	250	cm	$ 67	$ 16,720
Reinforced Concrete	25	cm	$ 5,016	$ 125,401
Backfill	100	cm	$ 67	$ 6,688
Grouted Rip Rap	100	cm	$ 334	$ 33,440
Slide Gates	2	ea	$ 13,376	$ 26,752
Corrugated Steel Pipe	50	m	$ 1,003	$ 50,160
Clearing	10%	ha	$ 26,752	$ 2,675
Grubbing and Stripping	6.5	ha	$ 66,881	$ 434,724
Excavation	19400	cm	$ 33	$ 648,742
Road Surfacing	1685	cm	$ 84	$ 140,867
Road Culverts	40	m	$ 1,003	$ 40,128
Side Channel Drains	1	LS	$ 33,440	$ 33,440
Environmental Assessment	1	LS	$ 112,500	$ 112,500
Geotechnical Investigation and Testing	1	LS	$ 100,321	$ 100,321
Subtotal , Construction Cost Estimate				**$ 1,789,280**
Engineering Allowance	10%			$ 178,928
Base Capital Cost				$ 1,968,207
Contingency Allowance	15%			$ 295,231
TOTAL CAPITAL COST ESTIMATE				$ 2,263,439

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	0%	100%
Capital Value Apportionment	$ -	$ 2,263,439

PRIORITY - LOW

PROJECT No. 38

SITE 9 RESERVOIR, KATHLEEN CREEK (1600 ML)

Project Description

This project was identified in the 1992 UMA Report on Additional Water Storage in the Trout Creek Watershed.

The site was first surveyed and considered by Mr. J.C. Dufresne, C.E. in 1921 (in the era when Crescent Lake was first being considered).

Costs were updated using escalation factors for inflation since 1992.

It is recognized the current dam construction techniques and environmental procedures are more stringent now than in 1992.

Kathleen Creek is located 13 km downstream of Headwaters Reservoir on the east side of the section where Trout Creek flows southwards

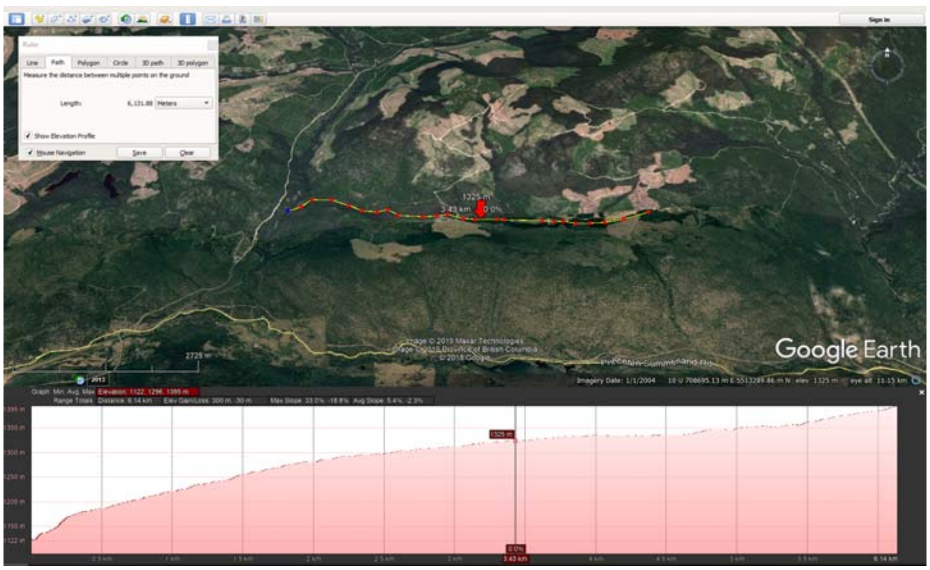
The dam site is proposed to be located at elevation 1,325 m on Kathleen Creek. The area upstream of the dam is 13 km ^{2}.

The dam site is located at the outlet of Kathleen Lake on a soil foundation.

Two storage volumes were reviewed in the UMA Report, one of 1110 ML that would see a maximum dam height of 10.7m.

The second volume was to store 1600 ML with a higher water height of 12.8m. The larger volume is recommended.

An earth filled dam was recommended at this site.



Google Earth Profile- Kathleen Creek

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Mobilization	10%	LS	$ 117,000	$ 11,700
Reservoir Clearing	25	ha.	$ 19,500	$ 487,500
Clearing and Grubbing	1.3	ha.	$ 39,000	$ 50,700
Stream Diversion	1	LS	$ 39,000	$ 39,000
Foundation Excavation	4900	m3	$ 20	$ 95,550
Core Trench Excavation	6100	m3	$ 20	$ 118,950
Embankment Material	70000	m3	$ 27	$ 1,911,000
Drain Material	7500	m3	$ 78	$ 585,000
Low Level Outlet Pipe	75	m	$ 390	$ 29,250
Outlet Gate	1	LS	$ 58,500	$ 58,500
Impact Stilling Basin	8	m3	$ 4,680	$ 37,440
Spillway Excavation	7000	m3	$ 12	$ 81,900
Spillway Concrete	20	m3	$ 2,340	$ 46,800
Spillway Rip Rap	1000	m3	$ 117	$ 117,000
Environmental Assessment	1	LS	$ 292,500	$ 292,500
Geotechnical Investigation and Testing	1	LS	$ 292,500	$ 292,500
Subtotal , Construction Cost Estimate				**$ 4,255,290**
Engineering Allowance	10%			$ 425,529
Base Capital Cost				$ 4,680,819
Contingency Allowance	15%			$ 702,123
TOTAL CAPITAL COST ESTIMATE				$ 5,382,942

Cost Benefit Assessment		**Current Users**	**DCC Project**
Percentage Apportionment		0%	100%
Capital Value Apportionment	$	-	$ 5,382,942

PRIORITY - LOW	**ML/yr**	**Cost**	**Cost per ML**
COST / ML OF ANNUAL CAPACITY	**1600**	**$ 5,382,942**	**$ 3,364**

PROJECT No. 39

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SITE 1 RESERVOIR, UPPER TROUT CREEK (2220 ML)

Dec. 2021

Project Description

This project was identified in the 1992 UMA Report on Additional Water Storage in the Trout Creek Watershed.
The site was investigated in 1970 by T. Ingledow & Associates Ltd.
Costs were updated using escalation factors for inflation since 1992.
It is recognized the current dam construction techniques and environmental procedures are more stringent now than in 1992.
Site is located 7.5 km dowstream on Trout Creek from Headwaters No. 4 dam and 2 km upstream of the confluence with North Trout Creek.
The dam site is proposed to be located at elevation 1,240 m on Upper Trout Creek. The area upstream of the dam is 85 km^2.
The regulated area is 51.5 km^2 controlled by Crescent and Headwaters Dams. The unregulated portion remaining downstream is 33.5 km^2.
Two storage volumes were reviewed in the UMA Report, one of 1480 ML that would see a maximum dam height of 12.8m.
The second volume was to store 2,220 ML with a higher water height of 15.7m. The larger volume is recommended.
An earth filled dam is recommended at this site.
If Site 2 dam is constructed, this reservoir would not be needed

Google Earth Image - Crescent Reservoir central / HW reservoirs to right

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Mobilization	1	LS	$ 117,000	$ 117,000
Reservoir Clearing	34	ha.	$ 19,500	$ 663,000
Clearing and Grubbing	2.3	ha.	$ 39,000	$ 89,700
Stream Diversion	1	LS	$ 78,000	$ 78,000
Foundation Excavation	7900	m3	$ 20	$ 154,050
Core Trench Excavation	10%	m3	$ 20	$ 2
Embankment Material	140000	m3	$ 27	$ 3,822,000
Drain Material	14300	m3	$ 78	$ 1,115,400
Low Level Outlet Pipe	93	m	$ 780	$ 72,540
Outlet Gate	1	LS	$ 58,500	$ 58,500
Impact Stilling Basin	8	m3	$ 4,680	$ 37,440
Spillway Excavation	11000	m3	$ 12	$ 128,700
Spillway Concrete	35	m3	$ 2,340	$ 81,900
Spillway Rip Rap	1500	m3	$ 117	$ 175,500
Environmental Assessment	1	LS	$ 292,500	$ 292,500
Geotechnical Investigation and Testing	1	LS	$ 292,500	$ 292,500
Subtotal , Construction Cost Estimate				**$ 7,178,732**
Engineering Allowance	10%			$ 717,873
Base Capital Cost				$ 7,896,605
Contingency Allowance	15%			$ 1,184,491
TOTAL CAPITAL COST ESTIMATE				$ 9,081,096

Cost Benefit Assessment	Current Users	DCC Project	New Devel.
Percentage Apportionment	0%	100%	0%
Capital Value Apportionment	$ -	$ 9,081,096	$ -

PRIORITY - LOW	ML/yr	Cost	Cost per ML
COST / ML OF ANNUAL CAPACITY	**2220**	**$ 9,081,096**	**$ 4,091**

DISTRICT OF SUMMERLAND

PROJECT NO. 40

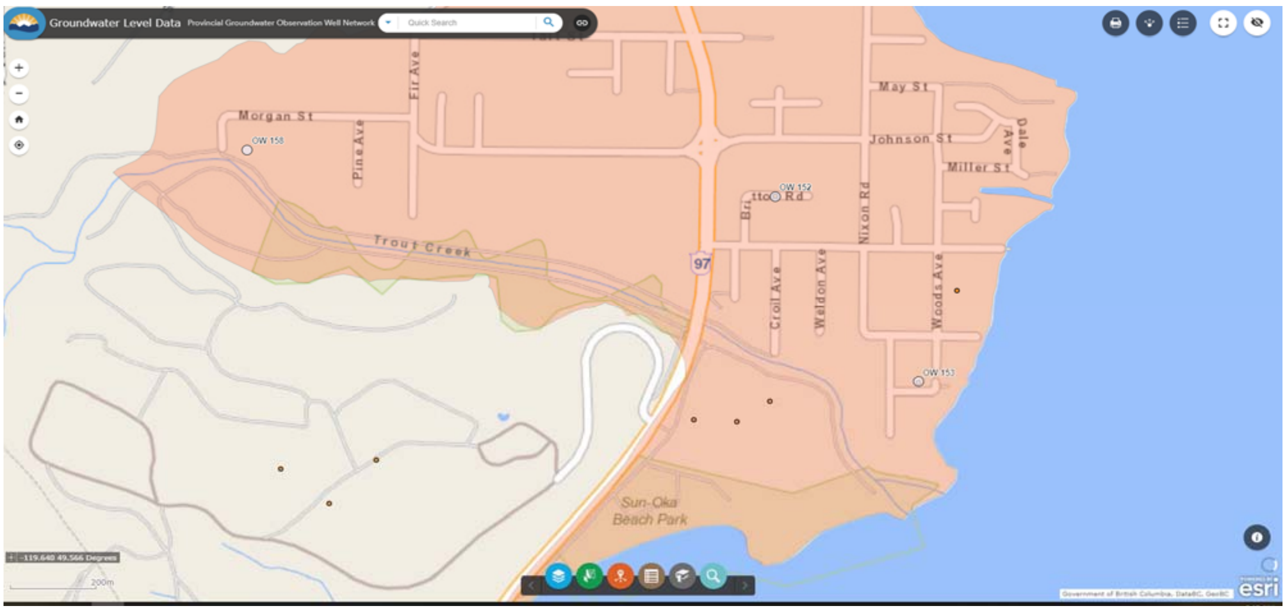
ADDITIONAL GROUNDWATER CAPACITY

Dec. 2021

Project Description

Two options were considered for groundwater expansion, one was to utilize the existing wells, and the second was to develop a new well in Trout Creek. where aquifer capacity is expected to be higher than most other areas of Summerland.

There are three defined aquifers that are within Summerlands District's boundaries, Meadow Valley (Faulder), Summerland and Trout Creek fan
Only the Trout Creek fan appears to have significant flow potential. GW expansion is based on developing an additional well with 30 L/s capacity.
In Trout Creek, electrical Service should be relatively close proximity. Watermains are also nearby for interconnection
The flow estimate is based on the well running for 5 months of the year at a rate of 30 L/s.
Running the well and pumping to the local pressure zone will relieve demands on the WTP. Operational costs will be lower for the well than the WTP.
Aquifer No. 297 (orange shaded) is an unconfined aquifer of loose sands and gravels.



Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Groundwater Well Development, small building over well head	1	Lump Sum	$ 750,000	$ 750,000
Subtotal , Construction Cost Estimate				**$ 750,000**
Engineering Allowance	10%			$ 75,000
Base Capital Cost				$ 825,000
Contingency Allowance	15%			$ 123,750
TOTAL CAPITAL COST ESTIMATE				**$ 948,750**
Cost Benefit Assessment		**Current Users**	**DCC Project**	
Percentage Apportionment		0%	100%	
Capital Value Apportionment		$ -	$ 948,750	$ 948,750
PRIORITY - LOW		**ML/yr**	**Cost**	**Cost per ML**
COST / ML OF ANNUAL CAPACITY		**413**	**$ 948,750**	**$ 2,297**

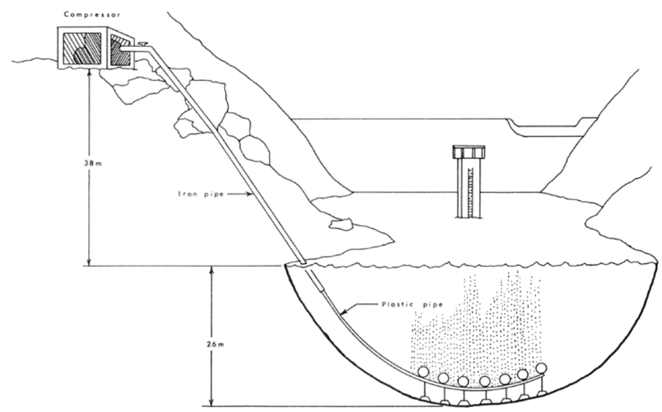
DISTRICT OF SUMMERLAND

PROJECT NO. 41
GARNET RESERVOIR - AERATION SYSTEM

Project Description

Aeration system is to add oxygen to the oxygen depleted areas of Garnet Reservoir located north of the old berm on Garnet Reservoir
Anaerobic zone (oxygen depleleted) is known to exist behind the breached dam. The objective is to reduce this layer of minimal oxygen to improve the overall health of the lake. Aeration has in the past been implemented south of the breached dam.
The extension of aeration to the north would improve the raw water quality and reduce taste and odour issues in the main part of the lake.

Project is of low priority due to system splitting that has been completed for Garnett Valley
Electrical service exists at the dam site. Additional aeration, should that be required at some time in the future, would be constructed and located near to Summerlands existing works.
This project is of much lower priority since Garnett Reservoir is now used solely for irrigation



Concept Diagram of Aeration for Destratification

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Electrical / Instrumentation	1	LS	$ 22,500	$ 22,500
Supply and Install Compressor and Aeration lines	1	LS	$ 67,500	$ 67,500
Enclosure to house compressor and controls	1	LS	$ 22,500	$ 22,500
Subtotal , Construction Cost Estimate				**$ 112,500**
Engineering Allowance	10%			$ 11,250
Base Capital Cost				$ 123,750
Contingency Allowance	15%			$ 18,563
TOTAL CAPITAL COST ESTIMATE	10%			**$ 142,313**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 142,313	$ -

PRIORITY - LOW

DISTRICT OF SUMMERLAND

PROJECT NO. 42

BULK FILL WATER STATIONS

Dec. 2021

Project Description

Water filling station is required for development construction and persons requiring water within the current Summerland boundaries.
Cost for this service is to be set up with full cost pricing principles. i.e. users must pay full cost for access and use over time including renewal.
Station is necessary to reduce potential for contamination through illegal use of water
Station also reduces the risk of compromised fire protection as less private parties would require water from District hydrants.

Several premanufactured water filling stations are available.
Package systems are available for fee as per adjacent photo.
Package system shown is supplied by Birks (Ontario company)
Card read systems complete with backflow prevention and security or SCADA links are available with this technology.

Three sites for stations are proposed:
1 - Prairie Valley at booster station site
2 - North of downtown
3 - Happy Valley and Gartrell Road area

Water fill stations will also be used for new construction for water for road construction. Some minor benefit is assigned to new development for this reason.

Pre-Manufactured Truck Fill station example - Portalogic webpage

Capital Cost Estimate	No.	Unit	Unit Price	Extension
Site preparation, fencing, paving, etc.	3	lump sum	$ 22,500	$ 67,500
Truck Fill station with card lock for year round use	3	lump sum	$ 112,500	$ 337,500
Subtotal , Construction Cost Estimate				**$ 405,000**
Engineering Allowance	10%			$ 40,500
Base Capital Cost				$ 445,500
Contingency Allowance	15%			$ 66,825
TOTAL CAPITAL COST ESTIMATE				**$ 512,325**

Cost Benefit Assessment	Current Users	DCC Project
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 512,325	$ -

PRIORITY - LOW

DISTRICT OF SUMMERLAND

PROJECT No. 43

EMERGENCY INTERCONNECTION - RESEARCH STATION

Dec. 2021

Project Description

Flow at existing the Summerland Research station lake pump is approximately 48 L/s per pump.
Station capacity is rated as two of three pumps running or 96 L/s.
The lake pump station lifts raw water up to the Research Station Reservoir located at elevation 522 metres. This part of the water system is not disinfected.
To connect to District of Summerland system, some additional watermain must be installed and an agreement must be worked out with Environment Canada.

The interconnection distance is 440m from the raw water supply main to the DoS line that feeds potable water to the Research station.
The pressure zone lift from Research Station (PZ 522) to Summerland Canyonview (PZ 548) is 26 metres (static).
A second pump is required to lift water within Summerland from Canyonview (PZ 548) to the main WTP zone (PZ 586)

Capacity potential for lake pump station would be 96 L/s for MDD, = 8.3 ML/day. A critical issue is that Research station still requires water during MDD

Capital Cost Estimate	**No.**	**Unit**	**Unit Price**	**Extension**
Order of magnitude estimate				
Interconnection to existing raw water system.	2	each	$ 9,750	$ 19,500
250mm main to DoS watermain (dig in adjacent to KVR alignment)	440	m	$ 338	$ 148,500
Duplex Pumping system - Lift from PZ 522 to PZ 548 (96 L/s) 2 - 50 hp	1	LS	$ 600,000	$ 600,000
Duplex Pump System - Lift from PZ 548 to PZ 586	1	LS	$ 900,000	$ 900,000
Electrical Service to new pump station sites	2	LS	$ 75,000	$ 150,000
Disinfection system - UV disinfection - duplex system plus building	8.3	ML/day	$ 90,000	$ 747,000
Disinfection system - chlorination	1	LS	$ 45,000	$ 45,000
	10%			
Subtotal , Construction Cost Estimate				**$ 2,610,000**
Engineering Allowance	10%			$ 261,000
Base Capital Cost				$ 2,871,000
Contingency Allowance	15%			$ 430,650
TOTAL CAPITAL COST ESTIMATE				$ 3,301,650

Cost Benefit Assessment	**Current Users**	**DCC Project**
Percentage Apportionment	100%	0%
Capital Value Apportionment	$ 3,301,650	$ -

PRIORITY - LOW	**ML/day**	**Cost**	**Cost per ML**
COST / ML MAX DAY CAPACITY	**8.3**	**$ 3,301,650**	**$ 397,789**

DISTRICT OF SUMMERLAND

Construction Cost Indicies Estimate - Worksheet

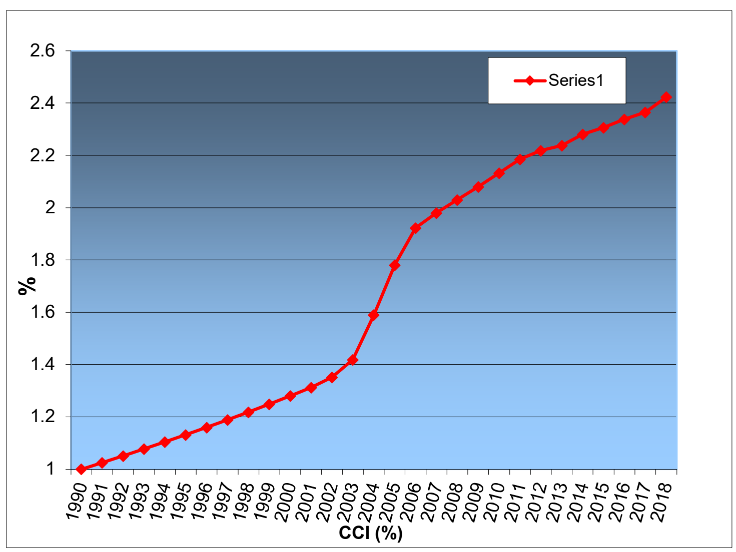
Dec. 2021

Year	BC CPI	Calc. %	Canada CPI	CCI Est. %	CCI	RSMeans	RSMeans	RSMeans
1990	78.4		78.4		**1.000**		94.3	1.000
1991	82.6	5.08%	82.8	2.50%	**1.025**	2.65%	96.8	102.65%
1992	84.8	2.59%	84.0	2.50%	**1.051**	2.69%	99.4	105.41%
1993	87.8	3.42%	85.6	2.50%	**1.077**	2.31%	101.7	107.85%
1994	89.5	1.90%	85.7	2.50%	**1.104**	2.65%	104.4	110.71%
1995	91.6	2.29%	87.6	2.50%	**1.131**	3.07%	107.6	114.10%
1996	92.4	0.87%	88.9	2.50%	**1.160**	2.42%	110.2	116.86%
1997	93.1	0.75%	90.4	2.50%	**1.189**	2.36%	112.8	119.62%
1998	93.4	0.32%	91.3	2.50%	**1.218**	2.04%	115.1	122.06%
1999	94.4	1.06%	92.9	2.50%	**1.249**	2.17%	117.6	124.71%
2000	96.1	1.77%	95.4	2.50%	**1.280**	2.81%	120.9	128.21%
2001	97.7	1.64%	97.8	2.50%	**1.312**	3.47%	125.1	132.66%
2002	100.0	2.30%	100.0	3.00%	**1.351**	2.88%	128.7	136.48%
2003	102.2	2.15%	102.8	5.00%	**1.419**	2.56%	132	139.98%
2004	104.2	1.92%	104.7	12.00%	**1.589**	8.86%	143.7	152.39%
2005	106.3	1.98%	107.0	12.00%	**1.780**	5.50%	151.6	160.76%
2006	108.1	1.67%	109.1	8.00%	**1.922**	6.86%	162	171.79%
2007	110.0	1.73%	111.5	3.00%	**1.980**	4.57%	169.4	179.64%
2008	112.3	2.05%	114.1	2.50%	**2.030**	6.49%	180.4	191.30%
2009	112.3	0.00%	114.4	2.50%	**2.080**	-0.17%	180.1	190.99%
2010	113.8	1.32%	116.5	2.50%	**2.132**	1.89%	183.5	194.59%
2011	116.5	2.32%	119.9	2.50%	**2.186**	4.20%	191.2	202.76%
2012	117.8	1.10%	121.7	1.48%	**2.218**	1.78%	194.6	206.36%
2013	117.7	-0.08%	122.8	0.90%	**2.238**	3.39%	201.2	213.36%
2014	118.9	1.01%	125.2	1.92%	**2.281**	1.84%	204.9	217.29%
2015	120.2	1.08%	126.6	1.11%	**2.306**	0.63%	206.2	218.66%
2016	122.4	1.80%	128.4	1.40%	**2.338**	0.53%	207.3	219.83%
2017	125.0	2.08%	130.4	1.53%	**2.374**	3.04%	213.6	226.51%
2018	128.4	2.65%	133.4	2.25%	**2.428**	4.35%	222.9	236.37%
2019	131.4	2.28%	136.0	1.91%	**2.474**	1.97%	227.3	241.04%
2020	132.4	0.76%	137.0	0.73%	**2.492**	3.40%	235.03	249.24%
2021	135.9	2.58%	141.4	3.11%	**2.570**	*2.97%*	*242*	*256.63%*
AVE. ANNUAL 2011-21		**1.76%**		**1.95%**		**3.49%**		

CONSUMER PRICE INDEX (1992 = 100) - ANNUAL

	CANADA		B.C.		VANCOUVER		VICTORIA	
Year	All Items Index	Annual Percent	All Items Index	Annual Percent	All Items Index	Annual Percent	All Items Index	Annual Percent
1960	18.5	1.1						
1961	18.7	1.1						
1962	18.9	1.1						
1963	19.2	1.6						
1964	19.6	2.1						
1965	20.0	2.0						
1966	20.8	4.0						
1967	21.5	3.4						
1968	22.4	4.2						
1969	23.4	4.5						
1970	24.2	3.4						
1971	24.9	2.9			25.4			
1972	26.1	4.8			26.8	5.5		
1973	28.1	7.7			28.7	7.1		
1974	31.1	10.7			32.1	11.8		
1975	34.5	10.9			35.6	10.9		
1976	37.1	7.5			39.0	9.6		
1977	40.0	7.8			41.8	7.2		
1978	43.6	9.0			45.1	7.9		
1979	47.6	9.2	48.9		48.6	7.8		
1980	52.4	10.1	53.5	9.4	53.1	9.3		
1981	58.9	12.4	61.1	14.2	60.7	14.3		
1982	65.3	10.9	67.5	10.5	67.1	10.5		
1983	69.1	5.8	71.2	5.5	70.8	5.5		
1984	72.1	4.3	74.0	3.9	73.7	4.1		
1985	75.0	4.0	76.4	3.2	76.0	3.1	77.7	
1986	78.1	4.1	78.6	2.9	78.5	3.3	79.1	1.8
1987	81.5	4.4	81.0	3.1	80.9	3.1	81.1	2.5
1988	84.8	4.0	83.9	3.6	83.8	3.6	84.2	3.8
1989	89.0	5.0	87.7	4.5	87.5	4.4	88.0	4.5
1990	93.3	4.8	92.4	5.4	92.3	5.5	92.7	5.3
1991	98.5	5.6	97.4	5.4	97.1	5.2	98.0	5.7
1992	100.0	1.5	100.0	2.7	100.0	3.0	100.0	2.0
1993	101.8	1.8	103.5	3.5	103.6	3.6	103.0	3.0
1994	102.0	0.2	105.5	1.9	105.7	2.0	105.1	2.0
1995	104.2	2.2	107.9	2.3	108.4	2.6	107.7	2.5
1996	105.9	1.6	108.9	0.9	109.2	0.7	108.7	0.9
1997	107.6	1.6	109.7	0.7	109.8	0.5	109.7	0.9
1998	108.6	0.9	110.0	0.3	110.4	0.5	110.0	0.3
1999	110.5	1.7	111.2	1.1	111.4	0.9	111.1	1.0
2000	113.5	2.7	113.3	1.9	113.9	2.2	113.0	1.7
2001	116.4	2.6	115.2	1.7	116.0	1.8	114.3	1.2

Prepared by: BCSTATS
Source: Statistics Canada



APPENDIX B - ECONOMIC MODEL / PROPOSED CEC BYLAW

Commentary on the model is provided below.

- The spreadsheet model is set out in three 11 x 17 size pages.

  Page B-3 contains the financial input parameters, sets out the Capital Projects and costs for DCC funded projects and summarizes the Development Cost Charge fund balances;

  Page B-4 sets out the capital project apportionment that Existing users (Summerland ratepayers) would be responsible for and the operating fund levels at year end including annual average revenue and expenditures;

  Page B-5 sets out the portion of project work that the development community would be responsible for over time including fund level balances.
- The model extends out to a 20-year horizon to assess long term viability. The first 10 years should be closely considered;
- The ability to change input variables is a useful feature of the model. Factors such as growth rate, interest rates, financing costs, and inflation rate are adjustable to test several scenarios;
- Because the majority of DCC contributions will come from single or multi-family development, or the expansion of agriculture, for ease of interpretation, the DCCs from industrial and commercial development are set as a ratio equivalent to a single-family equivalent (SFE) residential unit;
- All project costs are escalated at the construction cost indices rate to the future year of when the project would be implemented;
- A minimum utility balance level of $400,000 is desired at year end so that there are sufficient funds available in the event of an emergency or unforeseen expenditure;
- Although it is desired that all of the projects of High Priority be completed in the 10-year time frame, this is limited by the financial capacity of Summerland and the current debt load.

The model was tested over a variety of scenarios including different rate settings and growth rates.

- Sensitivity of Growth rate: This is one of the highest variable factors within the model. If growth occurred at a faster rate, the model predicts that Summerland will be in a stronger financial position to be able to implement projects. This would be due to additional revenue from taxes and tolls that would be collected and would be available to pay down debt;
- Sensitivity of DCC Rate: The DCC rate was tested at varying levels per single family connection. The DCC rate has a minor influence on the financial position as the revenue and growth rate result in relatively small numbers in the overall scope of funding projects. It is only one source of revenue as tolls and grant monies have formed the largest revenue source;

- Sensitivity of Tolls: The toll rate is a significant factor in determining the financial well being of the District. The toll rate must increase at a rate equal to or greater than the construction inflation rate in order for the utility to be in a healthy economic position. The Construction Cost Indices rate in the last 15 years has been between 2.50% and 2.75% with the exception of the last five years which were much higher. Cost escalations are shown on the graph at the end of Section 2;
- Timing of Projects: Timing of when projects are implemented also has a significant impact on the financial bottom line. To keep the toll rates at the most effective levels, timing must be set out so that there is minimal additional financing in addition to the Districts current debt load.

PROPOSED DEVELOPMENT COST CHARGE RATES

As described in Section 7.8, a proposed DCC rate schedule for dry and irrigated lands is provided for consideration.

Table B.1 – DCC rate schedule

LAND USE DESIGNATION	Dry Lands Rate $/Unit	Arable Land Rate $/Unit	UNIT	Notes
AGRICULTURAL ZONES				
Agricultural Zones	$ 10,000	n/a	ha.	Allowed one house on a single property
	$ 1,600	$ 1,200	bldg.	Farm Workers accom. with water to allow 4 beds, $300 / bed for additional beds
RURAL RESIDENTIAL ZONES				
Country Residential Zone	$ 4,800	$ 3,600	lot	Allows max. outdoor irrigation area of 1000m2
URBAN RESIDENTIAL ZONES				
Large oversized SF home	$ 4,800	$ 4,800		After 1000m2 area exceeded, capital charge applies of $120 per 100 m2 lot area
SF dwelling up to 500m 2 floor area	$ 4,000	$ 3,000	lot	Includes muliple unit manufactured homes
Manufactured Home (single), Duplex per side, strata	$ 3,000	$ 2,400	lot	
Strata, Row Housing, Triplex, Fourplex	$ 3,000	$ 2,400	lot	
Apartments, Cluster Housing, Stacked Row, Carriage House	$ 2,400	$ 2,000	unit	
Hotels and motels, Congregate Care homes, High Density Apts	$ 2,000	$ 1,200	unit	
Secondary Suites	$ 1,600	$ 1,200	unit	
Micro-Units < 50 m2	$ 1,200	$ 1,000	unit	
INDUSTRIAL / COMMERCIAL / INSTITUTIONAL				
ICI Zones	$ 4,800	$ 4,000	ha.	For base amount of water for 150 m2 of floor area including mezzanines
		$ 10.00	per m2>150m2	For remainder area greater than 150m2.
Golf Course	$ 14,000	$ 4,000	ha.	Rate for total irrigated area including greens, fairways and tees
Parks and Recreation Zone	$ 10,000	n/a	ha.	
Forestry Grazing Zone				
NOTES:	Land must be arable designated for commercial, industrial and institutional zones prior to building development.			
	For urban development categories, Dry unit rate charge includes regrade of Dry land to arable			
SINGLE FAMILY EQUIVALENT RATE TABLE	**DRY LAND RATE**	**GRADED LAND RATE**		
	Dry land	**Arable graded**		
LARGE SINGLE FAMILY (> 500 m2 floor area)	$ 4,800	$ 4,000	lot	
SINGLE FAMILY RATE	**$ 4,000**	$ 3,000	lot	
MULTI-FAMILY (Strata lots, Twnhomes)	$ 3,000	$ 2,400	lot or unit	
MULTI-FAMILY (MED. DENSITY, APTS to 5 floors)	$ 2,400	$ 2,000	unit	
MF HIGH DENSITY (APTS > 5 floors, HOTELS, MOTELS)	$ 2,000	$ 1,200	unit	
SECONDARY SUITES	$ 1,600	$ 1,200	each	
MICRO-UNITS	$ 1,200	$ 1,000	each	
ICI CONNECTIONS	$ 4,800	$ 4,000	first 150m2	
AGRICULTURE REGRADE 2 x SF rate	$ 10,000	n/a	ha.	

DISTRICT OF SUMMERLAND

WATER UTILITY CASHFLOW

GREEN TEXT Input data cell
BLACK BOLD TEXT known data cell
BLUE TEXT Calc. cell
BLACK (NOT BOLD) TEXT Estimated raw data entry cell

DEVELOPMENT GROWTH RATES
0.50% SF & ICI LOT GROWTH RATE
5.00% MF UNIT GROWTH RATE
0.50% IRR. DEMAND & ARABLE LAND GROWTH (%)
1.00% LEAKAGE/ UFW REDUCTION GOAL per YR

WATER RATES - CURRENT
2.75% DOM. WATER RATE INCREASE / YEAR
2.75% IRRIGATION WATER RATE INCREASE PER YEAR
$ 638.81 CALCULATED REVENUE PER SFE
$ 192.89 2020 ARABLE LAND TAX RATE

ENTER FINANCIAL PARAMETERS
2.00% INFLATION RATE -EXPENDITURES (%)
2.00% RETURN ON RESERVES
3.00% BORROWING RATE (%)
20 Amortization Period (Yrs)

DCC FOR WTP, SOURCE, AND CONVEYANCE
$ 4,000 SINGLE FAMILY DCC Rate ($)
$ 3,000 MULTI-FAMILY / BARELAND STRATA / MH PARK (0.75 x SFE)
$ 2,400 MULTI-FAMILY RESIDENTIAL 3 STORY WALKUPS (0.60 x SFE)
$ 4,800 COMMERCIAL (1.20 x SFE)
$ 4,800 INDUSTRIAL (1.20 x SFE)
$ 4,800 INSTITUTIONAL (1.20 x SFE)

FUND BALANCES - Year end 2019
$ 708,234 "CAPITAL WORKS FUND" new projects
$ 487,290 "CAPITAL REPLACEMENT FUND" renewal
$ 345,382 WATER DCC FUND
$ 53,368,321 PHYSICAL ASSETS (YEAR END 2007)
1.106% RENEWAL CONTRIB. % OF ASSETS = $ 590,253.63 $ 171,487,500 FULL REPLACEMENT COST
0.344% RENEWAL % BASED ON REPLACEMENT = $ 589,917.00

REVENUES AND EXPENDITURES SHEET

	YEAR ENDING	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Unit & Area Count																									
3850	Single Family Residential Lots				3850	3869	3889	3908	3928	3947	3967	3987	4007	4027	4047	4067	4087	4108	4128	4149	4170	4191	4212	4233	4254
970	Multi-Family Residential / Bareland Strata (1 MF unit = 0.60 SFE Unit)				970	1019	1069	1123	1179	1238	1300	1365	1433	1505	1580	1659	1742	1829	1921	2017	2117	2223	2334	2451	2574
270	ICI (1 ICI unit = 1.20 SFE units)				270	271	273	274	275	277	278	280	281	282	284	285	287	288	290	291	292	294	295	297	298
	TOTAL SINGLE-FAMILY-EQUIVALENT UNITS (SFE)	**SF + MF + ICI**			**4821**	**4874**	**4929**	**4986**	**5044**	**5105**	**5167**	**5232**	**5299**	**5369**	**5441**	**5515**	**5593**	**5673**	**5756**	**5843**	**5932**	**6026**	**6122**	**6223**	**6328**
Population Forecast																									
2.670	Population - SF				10280	10331	10383	10434	10487	10539	10592	10645	10698	10751	10805	10859	10914	10968	11023	11078	11133	11189	11245	11301	11358
1.750	Population - MF				1698	1782	1871	1965	2063	2166	2275	2389	2508	2633	2765	2903	3048	3201	3361	3529	3705	3891	4085	4289	4504
	TOTAL POPULATION (est.)				**11977**	**12113**	**12254**	**12400**	**12550**	**12706**	**12867**	**13033**	**13206**	**13385**	**13570**	**13763**	**13962**	**14169**	**14384**	**14607**	**14839**	**15080**	**15330**	**15591**	**15862**
ANNUAL WATER DEMAND CONSUMPTION FORECAST (ML/yr)																									
432	(m3/lot) SF Residential Water Demand				1663	1672	1680	1688	1697	1705	1714	1722	1731	1740	1748	1757	1766	1775	1783	1792	1801	1810	1819	1829	1838
241	(m3/conn) MF Residential Water Demand				234	245	258	271	284	298	313	329	345	363	381	400	420	441	463	486	510	536	563	591	620
990	(m3/conn) ICI				267	269	270	271	273	274	275	277	278	280	281	282	284	285	287	288	290	291	292	294	295
2525	Leakage / UFW				2525	2500	2475	2450	2426	2401	2377	2353	2330	2307	2284	2261	2238	2216	2194	2172	2150	2128	2107	2086	2065
	Water usage (ML)				**4689**	**4685**	**4682**	**4680**	**4679**	**4679**	**4680**	**4681**	**4684**	**4688**	**4694**	**4700**	**4708**	**4716**	**4727**	**4738**	**4751**	**4766**	**4782**	**4799**	**4818**
2997	**TOTAL ARABLE LAND (acreage)**				2997	**3012**	**3027**	**3042**	**3057**	**3073**	**3088**	**3103**	**3119**	**3135**	**3150**	**3166**	**3182**	**3198**	**3214**	**3230**	**3246**	**3262**	**3279**	**3295**	**3311**
0.33	**TOTAL EST. IRRIGATION DEMAND (ML)**				4002	4022	4043	4063	4083	4103	4124	4145	4165	4186	4207	4228	4249	4270	4292	4313	4335	4357	4378	4400	4422
	TOTAL WATER USE (ML)				**8692**	**8708**	**8725**	**8743**	**8762**	**8782**	**8804**	**8826**	**8850**	**8875**	**8901**	**8928**	**8957**	**8987**	**9018**	**9051**	**9086**	**9122**	**9160**	**9199**	**9241**

WATER REVENUES AND EXPENDITURES

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
WATER TOLLS ESTIMATE																									
	Calculated water rate per SFE unit (Revenue divide by SFE units)				$ 638.81	$ 656.38	$ 674.43	$ 692.97	$ 712.03	$ 731.61	$ 751.73	$ 772.40	$ 793.65	$ 815.47	$ 837.90	$ 860.94	$ 884.61	$ 908.94	$ 933.94	$ 959.62	$ 986.01	$ 1,013.13	$ 1,040.99	$ 1,069.61	$ 1,099.03
	Total Number of SFE Units including all ICI accounts				4821	4874	4929	4986	5044	5105	5167	5232	5299	5369	5441	5515	5593	5673	5756	5843	5932	6026	6122	6223	6328
	Effective Irrigation Tax Rate (per acre)				$ 192.89	$ 198.19	$ 203.64	$ 209.25	$ 215.00	$ 220.91	$ 226.99	$ 233.23	$ 239.64	$ 246.23	$ 253.00	$ 259.96	$ 267.11	$ 274.46	$ 282.00	$ 289.76	$ 297.73	$ 305.92	$ 314.33	$ 322.97	$ 331.85
OPERATING REVENUES (increasing at Annual Water Rate Increase %)																									
	Domestic Water Rates (Incl. ICI and MF)				$ 3,079,492	$ 3,199,100	$ 3,324,117	$ 3,454,841	$ 3,591,584	$ 3,734,683	$ 3,884,492	$ 4,041,394	$ 4,205,792	$ 4,378,119	$ 4,558,835	$ 4,748,434	$ 4,947,439	$ 5,156,411	$ 5,375,951	$ 5,606,698	$ 5,849,337	$ 6,104,600	$ 6,373,271	$ 6,656,186	$ 6,954,244
	Irrigation Taxes				$ 566,738	$ 596,959	$ 613,375	$ 630,243	$ 647,575	$ 665,383	$ 683,681	$ 702,482	$ 721,800	$ 741,650	$ 762,045	$ 783,002	$ 804,534	$ 826,659	$ 849,392	$ 872,750	$ 896,751	$ 921,412	$ 946,750	$ 972,786	$ 999,538
	Water Tax Levies				$ 1,534,500	$ 1,534,500	$ 1,534,500	$ 1,534,500	$ 1,534,500	$ 1,534,500	$ 1,075,000	$ 500,000													
	Other Revenue				$ 294,964	$ 300,863	$ 306,881	$ 313,018	$ 319,279	$ 325,664	$ 332,177	$ 338,821	$ 345,597	$ 352,509	$ 359,559	$ 366,751	$ 374,086	$ 381,567	$ 389,199	$ 396,983	$ 404,922	$ 413,021	$ 421,281	$ 429,707	$ 438,301
	Government Grants				$ 391,307																				
	Transfer from Reserves				$ 185,800		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	TOTAL ANNUAL REVENUE	$ -	$ -	$ -	**$ 6,052,801**	**$ 5,631,422**	**$ 5,778,873**	**$ 5,932,602**	**$ 6,092,937**	**$ 6,260,230**	**$ 5,975,351**	**$ 5,582,697**	**$ 5,273,190**	**$ 5,472,278**	**$ 5,680,440**	**$ 5,898,186**	**$ 6,126,058**	**$ 6,364,638**	**$ 6,614,542**	**$ 6,876,431**	**$ 7,151,010**	**$ 7,439,033**	**$ 7,741,302**	**$ 8,058,679**	**$ 8,392,082**
OPERATING EXPENDITURES (increasing at rate of inflation)																									
	Administration				$ 671,890	$ 685,328	$ 699,034	$ 713,015	$ 727,275	$ 741,821	$ 756,657	$ 771,790	$ 787,226	$ 802,971	$ 819,030	$ 835,411	$ 852,119	$ 869,161	$ 886,545	$ 904,275	$ 922,361	$ 940,808	$ 959,624	$ 978,817	$ 998,393
	WTP				$ 1,058,702	$ 1,079,876	$ 1,101,474	$ 1,123,503	$ 1,145,973	$ 1,168,893	$ 1,192,270	$ 1,216,116	$ 1,240,438	$ 1,265,247	$ 1,290,552	$ 1,316,363	$ 1,342,690	$ 1,369,544	$ 1,396,935	$ 1,424,874	$ 1,453,371	$ 1,482,438	$ 1,512,087	$ 1,542,329	$ 1,573,175
	Dam maintenance				$ 369,347	$ 376,734	$ 384,269	$ 391,954	$ 399,793	$ 407,789	$ 415,945	$ 424,264	$ 432,749	$ 441,404	$ 450,232	$ 459,237	$ 468,421	$ 477,790	$ 487,346	$ 497,092	$ 507,034	$ 517,175	$ 527,518	$ 538,069	$ 548,830
	Water Distribution				$ 378,110	$ 385,672	$ 393,386	$ 401,253	$ 409,278	$ 417,464	$ 425,813	$ 434,330	$ 443,016	$ 451,876	$ 460,914	$ 470,132	$ 479,535	$ 489,126	$ 498,908	$ 508,886	$ 519,064	$ 529,445	$ 540,034	$ 550,835	$ 561,852
	Residential Water Meters				$ 293,019	$ 298,879	$ 304,857	$ 310,954	$ 317,173	$ 323,517	$ 329,987	$ 336,587	$ 343,318	$ 350,185	$ 357,189	$ 364,332	$ 371,619	$ 379,051	$ 386,632	$ 394,365	$ 402,252	$ 410,297	$ 418,503	$ 426,873	$ 435,411
	Pump Stns				$ 233,630	$ 238,303	$ 243,069	$ 247,930	$ 252,889	$ 257,946	$ 263,105	$ 268,367	$ 273,735	$ 279,209	$ 284,794	$ 290,490	$ 296,299	$ 302,225	$ 308,270	$ 314,435	$ 320,724	$ 327,138	$ 333,681	$ 340,355	$ 347,162
	Miscellaneous Categories				$ 823,376	$ 839,844	$ 856,640	$ 873,773	$ 891,249	$ 909,074	$ 927,255	$ 945,800	$ 964,716	$ 984,011	$ 1,003,691	$ 1,023,765	$ 1,044,240	$ 1,065,125	$ 1,086,427	$ 1,108,156	$ 1,130,319	$ 1,152,925	$ 1,175,984	$ 1,199,503	$ 1,223,493
	Debt Servicing - WTP and Thirsk Reservoir				$ 1,356,358	$ 1,356,358	$ 1,356,358	$ 1,356,358	$ 1,356,358	$ 1,356,358	$ 1,000,000	403,879													
	Transfer to Reserves				$ 868,369	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Capital Expenditures LINK from PAGE B-3				$ -	$ 870,758	$ 2,073,029	$ 927,234	$ 1,147,694	$ 942,137	$ 955,143	$ 869,664	$ 885,858	$ 902,375	$ 919,222	$ 936,407	$ 953,935	$ 971,814	$ 990,050	$ 1,008,651	$ 1,027,624	$ 1,046,976	$ 1,066,716	$ 1,086,850	$ 1,107,387
	SUBTOTAL - WATER EXPENDITURES				$ 6,052,801	**$ 6,131,752**	**$ 7,412,116**	**$ 6,345,975**	**$ 6,647,682**	**$ 6,524,998**	**$ 6,266,176**	**$ 5,670,797**	**$ 5,371,056**	**$ 5,477,278**	**$ 5,585,623**	**$ 5,696,136**	**$ 5,808,858**	**$ 5,923,835**	**$ 6,041,112**	**$ 6,160,734**	**$ 6,282,749**	**$ 6,407,204**	**$ 6,534,148**	**$ 6,663,631**	**$ 6,795,704**
	Surplus Revenues minus Expenditures					**$ (500,330)**	**$ (1,633,243)**	**$ (413,373)**	**$ (554,745)**	**$ (264,768)**	**$ (290,825)**	**$ (88,100)**	**$ (97,867)**	**$ (4,999)**	**$ 94,817**	**$ 202,050**	**$ 317,200**	**$ 440,802**	**$ 573,430**	**$ 715,697**	**$ 868,261**	**$ 1,031,829**	**$ 1,207,154**	**$ 1,395,048**	**$ 1,596,378**
LINK FROM PAGE 2																									
WATER CAPITAL FUND (Start of Year)					$ -	$ 708,234	$ 207,903	$ (1,425,339)	$ (1,838,712)	$ (2,393,457)	$ (2,658,226)	$ (2,949,050)	$ (3,037,150)	$ (3,135,017)	$ (3,140,017)	$ (3,045,200)	$ (2,843,149)	$ (2,525,949)	$ (2,085,147)	$ (1,511,717)	$ (796,021)	$ 72,241	$ 1,104,069	$ 2,311,223	$ 3,706,271
	Subtract Existing Debt Servicing				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
WATER FUND BALANCE (End of Year)					$ 708,234	$ 207,903	$ (1,425,339)	$ (1,838,712)	$ (2,393,457)	$ (2,658,226)	$ (2,949,050)	$ (3,037,150)	$ (3,135,017)	$ (3,140,017)	$ (3,045,200)	$ (2,843,149)	$ (2,525,949)	$ (2,085,147)	$ (1,511,717)	$ (796,021)	$ 72,241	$ 1,104,069	$ 2,311,223	$ 3,706,271	$ 5,302,650
PROJECTED ADD'L UNITS SF/MF/APT/IRRIG																									
	Additional Arable land (acres)				3012	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**
	Single Family Residential Lots				3850	**19**	**19**	**19**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	Multi-Family Residential - High Density 3 story walkups				970	**49**	**51**	**53**	**56**	**59**	**62**	**65**	**68**	**72**	**75**	**79**	**83**	**87**	**91**	**96**	**101**	**106**	**111**	**117**	**123**
	Business / Govt Accounts Industrial / Commercial / Institutional				270	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
DCC REVENUE FORECAST																									
	Single Family Residential Lots				**$ -**	**$ 77,000**	**$ 77,385**	**$ 77,772**	**$ 78,161**	**$ 78,552**	**$ 78,944**	**$ 79,339**	**$ 79,736**	**$ 80,134**	**$ 80,535**	**$ 80,938**	**$ 81,342**	**$ 81,749**	**$ 82,158**	**$ 82,569**	**$ 82,982**	**$ 83,396**	**$ 83,813**	**$ 84,233**	**$ 84,654**
	Multi-Family Residential - High Density 3 story walkups				**$ -**	**$ 116,400**	**$ 122,220**	**$ 128,331**	**$ 134,748**	**$ 141,485**	**$ 148,559**	**$ 155,987**	**$ 163,786**	**$ 171,976**	**$ 180,575**	**$ 189,603**	**$ 199,084**	**$ 209,038**	**$ 219,490**	**$ 230,464**	**$ 241,987**	**$ 254,087**	**$ 266,791**	**$ 280,130**	**$ 294,137**
	Business Accounts Industrial / Commercial / Institutional				**$ -**	**$ 6,480**	**$ 6,512**	**$ 6,545**	**$ 6,578**	**$ 6,611**	**$ 6,644**	**$ 6,677**	**$ 6,710**	**$ 6,744**	**$ 6,778**	**$ 6,811**	**$ 6,845**	**$ 6,880**	**$ 6,914**	**$ 6,949**	**$ 6,983**	**$ 7,018**	**$ 7,053**	**$ 7,089**	**$ 7,124**
TOTAL PROJECTED DCC REVENUE					**$ -**	**$ 199,880**	**$ 206,117**	**$ 212,648**	**$ 219,486**	**$ 226,647**	**$ 234,147**	**$ 242,003**	**$ 250,232**	**$ 258,854**	**$ 267,887**	**$ 277,353**	**$ 287,271**	**$ 297,667**	**$ 308,562**	**$ 319,981**	**$ 331,952**	**$ 344,501**	**$ 357,658**	$ 371,452	$ 385,915
	DCC FUNDS AT BEGINNING OF YEAR				$ -	$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205	$ 2,945,596	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416
	DCC EXPENDITURE DURING CURRENT YEAR				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	DCC BALANCE (earning interest)				$ -	$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205	$ 2,945,596	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416
	Interest Earned (excludes present year DCCs)				$ -	$ 6,908	$ 11,043	$ 15,387	$ 19,947	$ 24,736	$ 29,764	$ 35,042	$ 40,583	$ 46,399	$ 52,504	$ 58,912	$ 65,637	$ 72,695	$ 80,103	$ 87,876	$ 96,033	$ 104,593	$ 113,575	$ 122,999	$ 132,888
	Subtract Debt Principal				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	DCC Revenue from new Development				$ -	$ 199,880	$ 206,117	$ 212,648	$ 219,486	$ 226,647	$ 234,147	$ 242,003	$ 250,232	$ 258,854	$ 267,887	$ 277,353	$ 287,271	$ 297,667	$ 308,562	$ 319,981	$ 331,952	$ 344,501	$ 357,658	$ 371,452	$ 385,915
DCC FUNDS - cumulative sum					$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205	$ 2,945,596	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416	$ 7,163,219
SUM OF CAPITAL & DCC REVENUE at YEAR END					$ 1,053,615	$ 753,165	$ (673,960)	$ (874,685)	$ (1,209,944)	$ (1,248,065)	$ (1,304,743)	$ (1,150,840)	$ (998,474)	$ (744,620)	$ (381,915)	$ 97,487	$ 701,959	$ 1,440,428	$ 2,322,419	$ 3,358,097	$ 4,558,310	$ 5,934,640	$ 7,499,452	$ 9,265,952	$ 11,248,245

DISTRICT OF SUMMERLAND

WATER UTILITY CASHFLOW

GREEN TEXT Input data cell
BLACK BOLD TEXT known data cell
BLUE TEXT Calc. cell
BLACK (NOT BOLD) TEXT Estimated raw data entry cell

DEVELOPMENT GROWTH RATES

- 0.50% SF & ICI LOT GROWTH RATE
- 5.00% MF UNIT GROWTH RATE
- 0.50% IRR. DEMAND & ARABLE LAND GROWTH (%)
- 1.00% LEAKAGE/ UFW REDUCTION GOAL per YR

WATER RATES - CURRENT

- 2.75% DOM. WATER RATE INCREASE / YEAR
- 2.75% IRRIGATION WATER RATE INCREASE PER YEAR
- $ 638.81 CALCULATED REVENUE PER SFE
- $ 192.89 2020 ARABLE LAND TAX RATE

ENTER FINANCIAL PARAMETERS

- 2.00% INFLATION RATE -EXPENDITURES (%)
- 2.00% RETURN ON RESERVES
- 3.00% BORROWING RATE (%)
- 20 Amortization Period (Yrs)

DCC FOR WTP, SOURCE, AND CONVEYANCE

- $ 4,000 SINGLE FAMILY DCC Rate ($)
- $ 3,000 MULTI-FAMILY / BARELAND STRATA / MH PARK (0.75 x SFE)
- $ 2,400 MULTI-FAMILY RESIDENTIAL 3 STORY WALKUPS (0.60 x SFE)
- $ 4,800 COMMERCIAL (1.20 x SFE)
- $ 4,800 INDUSTRIAL (1.20 x SFE)
- $ 4,800 INSTITUTIONAL (1.20 x SFE)

FUND BALANCES - Year end 2019

- $ 708,234 "CAPITAL WORKS FUND" new projects
- $ 487,290 "CAPITAL REPLACEMENT FUND" renewal
- $ 345,382 WATER DCC FUND
- $ 53,368,321 PHYSICAL ASSETS (YEAR END 2007)
- 1.106% RENEWAL CONTRIB. % OF ASSETS = $ 590,253.63 $ 171,487,500 FULL REPLACEMENT COST
- 0.344% RENEWAL % BASED ON REPLACEMENT = $ 589,917.00

YEAR ENDING: 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040

EXISTING USER PROJECTS

COST ESCALATION TABLE OVER TIME - EXISTING USER PORTION

No.	Project	YEAR END 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Water Main RENEWAL (ANNUAL COST)	$ 504,862	$ 514,959	$ 525,258	$ 535,763	$ 546,478	$ 557,408	$ 568,556	$ 579,927	$ 591,526	$ 603,356	$ 615,423
2	METERING UPGRADES, (ANNUAL COST)	$ 200,000	$ 204,000	$ 208,080	$ 212,242	$ 216,486	$ 220,816	$ 225,232	$ 229,737	$ 234,332	$ 239,019	$ 243,799
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ 200,000	$ 204,000	$ 148,080	$ 91,042	$ 32,862	$ (26,480)	$ (87,010)	$ (148,750)	$ (211,725)	$ (275,960)	$ (341,479)
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ 90,000	$ 91,799	$ 93,635	$ 95,508	$ 97,418	$ 99,367	$ 101,354	$ 103,381	$ 105,449	$ 107,558	$ 109,709
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 1,090,000	$ 1,111,800	$ 1,134,036	$ 22,681	$ 454	$ 463	$ 472	$ 481	$ 491	$ 501	$ 511
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 50,000	$ 51,000	$ 52,020	$ 1,040	$ 21	$ 21	$ 22	$ 22	$ 23	$ 23	$ 23
7	CRESCENT DAM SPILLWAY - UPGRADE	$ 210,000	$ 214,200	$ 218,484	$ 222,854	$ 227,311	$ 4,546	$ 91	$ 93	$ 95	$ 96	$ 98
8	TROUT CREEK FLUME - REPLACEMENT	$ 7,090,000	$ 7,231,800	$ 7,376,436	$ 7,523,965	$ 7,674,444	$ 7,827,933	$ 7,984,492	$ 8,144,181	$ 8,307,065	$ 8,473,206	$ 8,642,670
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 67,551	$ 68,902	$ 70,280	$ 71,686	$ 73,119	$ 74,582	$ 76,073	$ 77,595	$ 79,147	$ 80,730	$ 82,344
10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,350,000	$ 1,377,000	$ 1,404,540	$ 1,432,631	$ 1,461,283	$ 1,490,509	$ 1,520,319	$ 1,550,726	$ 1,581,740	$ 1,613,375	$ 1,645,642
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 70,000	$ 71,400	$ 72,828	$ 74,285	$ 75,770	$ 77,286	$ 78,831	$ 80,408	$ 82,016	$ 83,656	$ 85,330
12	DAM SAFETY REVIEWS	$ 345,000	$ 351,900	$ 358,938	$ 366,117	$ 373,439	$ 380,908	$ 388,526	$ 396,297	$ 404,222	$ 412,307	$ 420,553
13	ENEAS DAM - DECOMMISSIONING	$ 110,000	$ 112,200	$ 114,444	$ 116,733	$ 119,068	$ 121,449	$ 123,878	$ 126,355	$ 128,883	$ 131,460	$ 134,089
14	WTP - SLUDGE HANDLING - UPGRADES	$ 6,280,000	$ 6,405,600	$ 6,533,712	$ 6,664,386	$ 6,797,674	$ 6,933,627	$ 7,072,300	$ 7,213,746	$ 7,358,021	$ 7,505,181	$ 7,655,285
15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
17	SOURCE WATER ASSESSMENT PLAN	$ 80,000	$ 81,600	$ 83,232	$ 84,897	$ 86,595	$ 88,326	$ 90,093	$ 91,895	$ 93,733	$ 95,607	$ 97,520
18	TSUH DAM - DECOMMISSIONING	$ 70,000	$ 71,400	$ 72,828	$ 74,285	$ 75,770	$ 77,286	$ 78,831	$ 80,408	$ 82,016	$ 83,656	$ 85,330
19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,110,000	$ 1,132,200	$ 1,154,844	$ 1,177,941	$ 1,201,500	$ 1,225,530	$ 1,250,040	$ 1,275,041	$ 1,300,542	$ 1,326,553	$ 1,353,084
20	JAMES LAKE PUMP STATION UPGRADE	$ 210,000	$ 214,200	$ 218,484	$ 222,854	$ 227,311	$ 231,857	$ 236,494	$ 241,224	$ 246,048	$ 250,969	$ 255,989
21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 3,490,000	$ 3,559,800	$ 3,630,996	$ 3,703,616	$ 3,777,688	$ 3,853,242	$ 3,930,307	$ 4,008,913	$ 4,089,091	$ 4,170,873	$ 4,254,291
22	**WTP - FLOWMETER AND PROGRAMMING**	$ 40,000	$ 40,800	$ 41,616	$ 42,448	$ 43,297	$ 44,163	$ 45,046	$ 45,947	$ 46,866	$ 47,804	$ 48,760
23	**SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)**	$ 520,000	$ 530,400	$ 541,008	$ 551,828	$ 562,865	$ 574,122	$ 585,604	$ 597,317	$ 609,263	$ 621,448	$ 633,877
24	**AILEEN ROAD - WATER SYSTEM SEPARATION**	$ 190,000	$ 193,800	$ 197,676	$ 201,630	$ 205,662	$ 209,775	$ 213,971	$ 218,250	$ 222,615	$ 227,068	$ 231,609
25	**SYSTEM SEPARATION - FRONT BENCH ROAD**	$ 390,000	$ 397,800	$ 405,756	$ 413,871	$ 422,149	$ 430,592	$ 439,203	$ 447,987	$ 456,947	$ 466,086	$ 475,408
26	**SYSTEM SEPARATION - HAPPY VALLEY**	$ 480,000	$ 489,600	$ 499,392	$ 509,380	$ 519,567	$ 529,959	$ 540,558	$ 551,369	$ 562,397	$ 573,644	$ 585,117
27	**SYSTEM SEPARATION - HESPLER ROAD**	$ 80,000	$ 81,600	$ 83,232	$ 84,897	$ 86,595	$ 88,326	$ 90,093	$ 91,895	$ 93,733	$ 95,607	$ 97,520
28	**SYSTEM SEPARATION - LOWER JONES FLATS (EAST)**	$ 1,160,000	$ 1,183,200	$ 1,206,864	$ 1,231,001	$ 1,255,621	$ 1,280,734	$ 1,306,348	$ 1,332,475	$ 1,359,125	$ 1,386,307	$ 1,414,034
			$ 22,820,002	$ 23,276,402	$ 22,555,874	$ 22,983,271	$ 23,215,625	$ 23,675,391	$ 24,148,899	$ 24,631,877	$ 25,124,515	$ 25,627,005

No.	Project	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	Water Main RENEWAL (ANNUAL COST)	$ 627,732	$ 640,286	$ 653,092	$ 666,154	$ 679,477	$ 693,067	$ 706,928	$ 721,067	$ 735,488	$ 750,198
2	METERING UPGRADES, (ANNUAL COST)	$ 248,675	$ 253,648	$ 258,721	$ 263,896	$ 269,174	$ 274,557	$ 280,048	$ 285,649	$ 291,362	$ 297,189
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ (408,308)	$ (476,475)	$ (546,004)	$ (616,924)	$ (689,263)	$ (763,048)	$ (838,309)	$ (915,075)	$ (993,377)	$ (1,073,244)
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ 111,903	$ 114,141	$ 116,424	$ 118,752	$ 121,127	$ 123,550	$ 126,021	$ 128,541	$ 131,112	$ 133,735
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 521	$ 531	$ 542	$ 553	$ 564	$ 575	$ 587	$ 599	$ 611	$ 623
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 24	$ 24	$ 25	$ 25	$ 26	$ 26	$ 27	$ 27	$ 28	$ 29
7	CRESCENT DAM SPILLWAY - UPGRADE	$ 100	$ 102	$ 104	$ 107	$ 109	$ 111	$ 113	$ 115	$ 118	$ 120
8	TROUT CREEK FLUME - REPLACEMENT	$ 8,815,524	$ 8,991,834	$ 9,171,671	$ 9,355,104	$ 9,542,207	$ 9,733,051	$ 9,927,712	$ 10,126,266	$ 10,328,791	$ 10,535,367
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 83,991	$ 85,671	$ 87,384	$ 89,132	$ 90,915	$ 92,733	$ 94,588	$ 96,479	$ 98,409	$ 100,377
10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,678,555	$ 1,712,126	$ 1,746,369	$ 1,781,296	$ 1,816,922	$ 1,853,261	$ 1,890,326	$ 1,928,132	$ 1,966,695	$ 2,006,029
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 87,036	$ 88,777	$ 90,552	$ 92,364	$ 94,211	$ 96,095	$ 98,017	$ 99,977	$ 101,977	$ 104,016
12	DAM SAFETY REVIEWS	$ 428,964	$ 437,543	$ 446,294	$ 455,220	$ 464,325	$ 473,611	$ 483,083	$ 492,745	$ 502,600	$ 512,652
13	ENEAS DAM - DECOMMISSIONING	$ 136,771	$ 139,507	$ 142,297	$ 145,143	$ 148,046	$ 151,006	$ 154,027	$ 157,107	$ 160,249	$ 163,454
14	WTP - SLUDGE HANDLING - UPGRADES	$ 7,808,391	$ 7,964,558	$ 8,123,850	$ 8,286,327	$ 8,452,053	$ 8,621,094	$ 8,793,516	$ 8,969,386	$ 9,148,774	$ 9,331,750
15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
17	SOURCE WATER ASSESSMENT PLAN	$ 99,470	$ 101,459	$ 103,489	$ 105,558	$ 107,669	$ 109,823	$ 112,019	$ 114,260	$ 116,545	$ 118,876
18	TSUH DAM - DECOMMISSIONING	$ 87,036	$ 88,777	$ 90,552	$ 92,364	$ 94,211	$ 96,095	$ 98,017	$ 99,977	$ 101,977	$ 104,016
19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,380,145	$ 1,407,748	$ 1,435,903	$ 1,464,621	$ 1,493,914	$ 1,523,792	$ 1,554,268	$ 1,585,353	$ 1,617,060	$ 1,649,402
20	JAMES LAKE PUMP STATION UPGRADE	$ 261,109	$ 266,331	$ 271,657	$ 277,091	$ 282,632	$ 288,285	$ 294,051	$ 299,932	$ 305,930	$ 312,049
21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 4,339,376	$ 4,426,164	$ 4,514,687	$ 4,604,981	$ 4,697,081	$ 4,791,022	$ 4,886,843	$ 4,984,579	$ 5,084,271	$ 5,185,956
22	**WTP - FLOWMETER AND PROGRAMMING**	$ 49,735	$ 50,730	$ 51,744	$ 52,779	$ 53,835	$ 54,911	$ 56,010	$ 57,130	$ 58,272	$ 59,438
23	**SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)**	$ 646,555	$ 659,486	$ 672,675	$ 686,129	$ 699,852	$ 713,849	$ 728,126	$ 742,688	$ 757,542	$ 772,693
24	**AILEEN ROAD - WATER SYSTEM SEPARATION**	$ 236,241	$ 240,966	$ 245,785	$ 250,701	$ 255,715	$ 260,829	$ 266,046	$ 271,367	$ 276,794	$ 282,330
25	**SYSTEM SEPARATION - FRONT BENCH ROAD**	$ 484,916	$ 494,614	$ 504,507	$ 514,597	$ 524,889	$ 535,386	$ 546,094	$ 557,016	$ 568,156	$ 579,519
26	**SYSTEM SEPARATION - HAPPY VALLEY**	$ 596,820	$ 608,756	$ 620,931	$ 633,350	$ 646,017	$ 658,937	$ 672,116	$ 685,558	$ 699,269	$ 713,255
27	**SYSTEM SEPARATION - HESPLER ROAD**	$ 99,470	$ 101,459	$ 103,489	$ 105,558	$ 107,669	$ 109,823	$ 112,019	$ 114,260	$ 116,545	$ 118,876
28	**SYSTEM SEPARATION - LOWER JONES FLATS (EAST)**	$ 1,442,314	$ 1,471,160	$ 1,500,584	$ 1,530,595	$ 1,561,207	$ 1,592,431	$ 1,624,280	$ 1,656,766	$ 1,689,901	$ 1,723,699
		$ 26,139,545	$ 26,662,336	$ 27,195,583	$ 27,739,494	$ 28,294,284	$ 28,860,170	$ 29,437,373	$ 30,026,121	$ 30,626,643	$ 31,239,176

PROJECT TIMING, EXISTING USER PROJECTS

No.	Project	Note	YEAR END 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Water Main RENEWAL (ANNUAL COST)		$ 504,862	514,959	525,258	535,763	546,478	557,408	568,556	579,927	591,526	603,356	615,423
2	METERING UPGRADES, (ANNUAL COST)		$ 200,000	204,000	208,080	212,242	216,486	220,816	225,232	229,737	234,332	239,019	243,799
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)		$ 200,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)		$ 90,000	91,799	93,635	95,508	97,418	99,367	101,354				
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE		$ 1,090,000		1,134,036	22,681							
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)		$ 50,000		52,020	1,040							
7	CRESCENT DAM SPILLWAY - UPGRADE		$ 210,000				227,311	4,546					
8	TROUT CREEK FLUME - REPLACEMENT		$ 7,090,000										
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION		$ 67,551										
10	GARNETT RESERVOIR SPILLWAY - UPGRADE		$ 1,350,000										
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR		$ 70,000										
12	DAM SAFETY REVIEWS	DCC project	$ 345,000										
13	ENEAS DAM - DECOMMISSIONING		$ 110,000										
14	WTP - SLUDGE HANDLING - UPGRADES		$ 6,280,000										
15	OKANAGAN LAKE PUMP STATION (PHASE 1)		$ -										
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)		$ -										
17	SOURCE WATER ASSESSMENT PLAN		$ 80,000										
18	TSUH DAM - DECOMMISSIONING		$ 70,000										
19	SUMMERLAND RESERVOIR SPILLWAY	DCC project	$ 1,110,000										
20	JAMES LAKE PUMP STATION UPGRADE	DCC project	$ 210,000										
21	ISINTOK DAM - RECONSTRUCTION AND RAISE		$ 3,490,000										
22	**WTP - FLOWMETER AND PROGRAMMING**		$ 40,000										
23	**SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)**		$ 520,000										
24	**AILEEN ROAD - WATER SYSTEM SEPARATION**		$ 190,000										
25	**SYSTEM SEPARATION - FRONT BENCH ROAD**		$ 390,000										
26	**SYSTEM SEPARATION - HAPPY VALLEY**		$ 480,000										
27	**SYSTEM SEPARATION - HESPLER ROAD**		$ 80,000										
28	**SYSTEM SEPARATION - LOWER JONES FLATS (EAST)**		$ 1,160,000										
	SUM OF USER FUNDED CAPITAL PROJECTS			$ 870,758	$ 2,073,029	$ 927,234	$ 1,147,694	$ 942,137	$ 955,143	$ 869,664	$ 885,858	$ 902,375	$ 919,222
	WATER CAPITAL FUND (Start of Year)			$ 708,234	$ (162,525)	$ (2,235,554)	$ (3,162,788)	$ (4,310,482)	$ (5,252,619)	$ (6,207,762)	$ (7,077,426)	$ (7,963,283)	$ (8,865,658)
	Subtract Existing Debt Servicing												
	WATER FUND BALANCE (End of Year)		$ 708,234	$ (162,525)	$ (2,235,554)	$ (3,162,788)	$ (4,310,482)	$ (5,252,619)	$ (6,207,762)	$ (7,077,426)	$ (7,963,283)	$ (8,865,658)	$ (9,784,880)

No.	Project	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	Water Main RENEWAL (ANNUAL COST)	627,732	640,286	653,092	666,154	679,477	693,067	706,928	721,067	735,488	750,198
2	METERING UPGRADES, (ANNUAL COST)	248,675	253,648	258,721	263,896	269,174	274,557	280,048	285,649	291,362	297,189
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
	SUM OF USER FUNDED CAPITAL PROJECTS	$ 936,407	$ 953,935	$ 971,814	$ 990,050	$ 1,008,651	$ 1,027,624	$ 1,046,976	$ 1,066,716	$ 1,086,850	$ 1,107,387
	WATER CAPITAL FUND (Start of Year)	$ (9,784,880)	$ (10,721,287)	$ (11,675,222)	$ (12,647,035)	$ (13,637,085)	$ (14,645,736)	$ (15,673,360)	$ (16,720,336)	$ (17,787,052)	$ (18,873,902)
	WATER FUND BALANCE (End of Year)	$ (10,721,287)	$ (11,675,222)	$ (12,647,035)	$ (13,637,085)	$ (14,645,736)	$ (15,673,360)	$ (16,720,336)	$ (17,787,052)	$ (18,873,902)	$ (19,981,289)

DISTRICT OF SUMMERLAND

WATER UTILITY CASHFLOW

GREEN TEXT Input data cell
BLACK BOLD TEXT known data cell
BLUE TEXT Calc. cell
BLACK (NOT BOLD) TEXT Estimated raw data entry cell

DEVELOPMENT GROWTH RATES

- 0.50% SF & ICI LOT GROWTH RATE
- 5.00% MF UNIT GROWTH RATE
- 0.50% IRR. DEMAND & ARABLE LAND GROWTH (%)
- 1.00% **LEAKAGE/ UFW REDUCTION GOAL per YR**

WATER RATES - CURRENT

- 2.75% **DOM. WATER RATE INCREASE / YEAR**
- 2.75% IRRIGATION WATER RATE INCREASE PER YEAR
- $ 638.81 **CALCULATED REVENUE PER SFE**
- $ 192.89 **2020 ARABLE LAND TAX RATE**

ENTER FINANCIAL PARAMETERS

- 2.00% INFLATION RATE -EXPENDITURES (%)
- 2.00% RETURN ON RESERVES
- 3.00% BORROWING RATE (%)
- 20 Amortization Period (Yrs)

DCC FOR WTP, SOURCE, AND CONVEYANCE

- $ 4,000 SINGLE FAMILY DCC Rate ($)
- $ 3,000 MULTI-FAMILY / BARELAND STRATA / MH PARK (0.75 x SFE)
- $ 2,400 MULTI-FAMILY RESIDENTIAL 3 STORY WALKUPS (0.60 x SFE)
- $ 4,800 COMMERCIAL (1.20 x SFE)
- $ 4,800 INDUSTRIAL (1.20 x SFE)
- $ 4,800 INSTITUTIONAL (1.20 x SFE)

FUND BALANCES - Year end 2019

- $ 708,234 **"CAPITAL WORKS FUND" new projects**
- $ 487,290 **"CAPITAL REPLACEMENT FUND" renewal**
- $ 345,382 **WATER DCC FUND**
- $ 53,368,321 **PHYSICAL ASSETS (YEAR END 2007)**
- 1.106% **RENEWAL CONTRIB. % OF ASSETS =** $ 590,253.63 $ 171,487,500 FULL REPLACEMENT COST
- 0.344% **RENEWAL % BASED ON REPLACEMENT =** $ 589,917.00

PROJECT COST ESCALATION - DCC ELIGIBLE

#	YEAR ENDING	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Water Main RENEWAL (ANNUAL COST)				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2	METERING UPGRADES, (ANNUAL COST)				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE				$ 1,090,000	$ 1,111,800	$ 1,134,036	$ 1,156,717	$ 1,179,851	$ 1,203,448	$ 1,227,517	$ 1,252,067	$ 1,277,109	$ 1,302,651	$ 1,328,704
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)				$ 50,000	$ 51,000	$ 52,020	$ 53,060	$ 54,122	$ 55,204	$ 56,308	$ 57,434	$ 58,583	$ 59,755	$ 60,950
7	CRESCENT DAM SPILLWAY - UPGRADE				$ 210,000	$ 214,200	$ 218,484	$ 222,854	$ 227,311	$ 231,857	$ 236,494	$ 241,224	$ 246,049	$ 250,970	$ 255,989
8	TROUT CREEK FLUME - REPLACEMENT				$ 7,090,000	$ 7,231,800	$ 7,376,436	$ 7,523,965	$ 7,674,444	$ 7,827,933	$ 7,984,492	$ 8,144,181	$ 8,307,065	$ 8,473,206	$ 8,642,670
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION				$ 67,551	$ 68,902	$ 70,280	$ 71,686	$ 73,119	$ 74,582	$ 76,073	$ 77,595	$ 79,147	$ 80,730	$ 82,344
10	GARNETT RESERVOIR SPILLWAY - UPGRADE				$ 1,350,000	$ 1,377,000	$ 1,404,540	$ 1,432,631	$ 1,461,283	$ 1,490,509	$ 1,520,319	$ 1,550,726	$ 1,581,740	$ 1,613,375	$ 1,645,642
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR				$ 70,000	$ 71,400	$ 72,828	$ 74,285	$ 75,770	$ 77,286	$ 78,831	$ 80,408	$ 82,016	$ 83,656	$ 85,330
12	DAM SAFETY REVIEWS				$ 345,000	$ 351,900	$ 358,938	$ 366,117	$ 373,439	$ 380,908	$ 388,526	$ 396,297	$ 404,222	$ 412,307	$ 420,553
13	ENEAS DAM - DECOMMISSIONING				$ 110,000	$ 112,200	$ 114,444	$ 116,733	$ 119,068	$ 121,449	$ 123,878	$ 126,355	$ 128,883	$ 131,460	$ 134,089
14	WTP - SLUDGE HANDLING - UPGRADES				$ 6,280,000	$ 6,405,600	$ 6,533,712	$ 6,664,386	$ 6,797,674	$ 6,933,627	$ 7,072,300	$ 7,213,746	$ 7,358,021	$ 7,505,181	$ 7,655,285
15	OKANAGAN LAKE PUMP STATION (PHASE 1)				$ 6,410,000	$ 6,538,200	$ 6,668,964	$ 6,802,343	$ 6,938,390	$ 7,077,158	$ 7,218,701	$ 7,363,075	$ 7,510,337	$ 7,660,543	$ 7,813,754
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)				$ 2,750,000	$ 2,805,000	$ 2,861,100	$ 2,918,322	$ 2,976,688	$ 3,036,222	$ 3,096,947	$ 3,158,886	$ 3,222,063	$ 3,286,505	$ 3,352,235
17	SOURCE WATER ASSESSMENT PLAN				$ 80,000	$ 81,600	$ 83,232	$ 84,897	$ 86,595	$ 88,326	$ 90,093	$ 91,895	$ 93,733	$ 95,607	$ 97,520
18	TSUH DAM - DECOMMISSIONING				$ 70,000	$ 71,400	$ 72,828	$ 74,285	$ 75,770	$ 77,286	$ 78,831	$ 80,408	$ 82,016	$ 83,656	$ 85,330
19	SUMMERLAND RESERVOIR SPILLWAY				$ 1,110,000	$ 1,132,200	$ 1,154,844	$ 1,177,941	$ 1,201,500	$ 1,225,530	$ 1,250,040	$ 1,275,041	$ 1,300,542	$ 1,326,553	$ 1,353,084
20	JAMES LAKE PUMP STATION UPGRADE				$ 210,000	$ 214,200	$ 218,484	$ 222,854	$ 227,311	$ 231,857	$ 236,494	$ 241,224	$ 246,048	$ 250,969	$ 255,989
21	ISINTOK DAM - RECONSTRUCTION AND RAISE				$ 3,490,000	$ 3,559,800	$ 3,630,996	$ 3,703,616	$ 3,777,688	$ 3,853,242	$ 3,930,307	$ 4,008,913	$ 4,089,091	$ 4,170,873	$ 4,254,291
22	WTP - FLOWMETER AND PROGRAMMING				$ 40,000	$ 40,800	$ 41,616	$ 42,448	$ 43,297	$ 44,163	$ 45,046	$ 45,947	$ 46,866	$ 47,804	$ 48,760
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)				$ 2,070,000	$ 2,111,400	$ 2,153,628	$ 2,196,701	$ 2,240,635	$ 2,285,447	$ 2,331,156	$ 2,377,779	$ 2,425,335	$ 2,473,842	$ 2,523,318
24	AILEEN ROAD - WATER SYSTEM SEPARATION				$ 190,000	$ 193,800	$ 197,676	$ 201,630	$ 205,662	$ 209,775	$ 213,971	$ 218,250	$ 222,615	$ 227,068	$ 231,609
	TOTALS				$ 33,082,551	$ 33,744,202	$ 34,419,086	$ 35,107,468	$ 35,809,617	$ 36,525,810	$ 37,256,326	$ 38,001,452	$ 38,761,481	$ 39,536,711	$ 40,327,445

#	YEAR ENDING	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	Water Main RENEWAL (ANNUAL COST)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2	METERING UPGRADES, (ANNUAL COST)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 1,355,278	$ 1,382,384	$ 1,410,031	$ 1,438,232	$ 1,466,996	$ 1,496,336	$ 1,526,263	$ 1,556,788	$ 1,587,924	$ 1,619,683
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 62,169	$ 63,412	$ 64,680	$ 65,974	$ 67,293	$ 68,639	$ 70,012	$ 71,412	$ 72,841	$ 74,297
7	CRESCENT DAM SPILLWAY - UPGRADE	$ 261,109	$ 266,331	$ 271,658	$ 277,091	$ 282,633	$ 288,285	$ 294,051	$ 299,932	$ 305,931	$ 312,049
8	TROUT CREEK FLUME - REPLACEMENT	$ 8,815,524	$ 8,991,834	$ 9,171,671	$ 9,355,104	$ 9,542,207	$ 9,733,051	$ 9,927,712	$ 10,126,266	$ 10,328,791	$ 10,535,367
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 83,991	$ 85,671	$ 87,384	$ 89,132	$ 90,915	$ 92,733	$ 94,588	$ 96,479	$ 98,409	$ 100,377
10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,678,555	$ 1,712,126	$ 1,746,369	$ 1,781,296	$ 1,816,922	$ 1,853,261	$ 1,890,326	$ 1,928,132	$ 1,966,695	$ 2,006,029
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 87,036	$ 88,777	$ 90,552	$ 92,364	$ 94,211	$ 96,095	$ 98,017	$ 99,977	$ 101,977	$ 104,016
12	DAM SAFETY REVIEWS	$ 428,964	$ 437,543	$ 446,294	$ 455,220	$ 464,325	$ 473,611	$ 483,083	$ 492,745	$ 502,600	$ 512,652
13	ENEAS DAM - DECOMMISSIONING	$ 136,771	$ 139,507	$ 142,297	$ 145,143	$ 148,046	$ 151,006	$ 154,027	$ 157,107	$ 160,249	$ 163,454
14	WTP - SLUDGE HANDLING - UPGRADES	$ 7,808,391	$ 7,964,558	$ 8,123,850	$ 8,286,327	$ 8,452,053	$ 8,621,094	$ 8,793,516	$ 8,969,386	$ 9,148,774	$ 9,331,750
15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ 7,970,029	$ 8,129,430	$ 8,292,019	$ 8,457,859	$ 8,627,016	$ 8,799,556	$ 8,975,547	$ 9,155,058	$ 9,338,160	$ 9,524,923
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ 3,419,279	$ 3,487,665	$ 3,557,418	$ 3,628,567	$ 3,701,138	$ 3,775,161	$ 3,850,664	$ 3,927,677	$ 4,006,231	$ 4,086,355
17	SOURCE WATER ASSESSMENT PLAN	$ 99,470	$ 101,459	$ 103,489	$ 105,558	$ 107,669	$ 109,823	$ 112,019	$ 114,260	$ 116,545	$ 118,876
18	TSUH DAM - DECOMMISSIONING	$ 87,036	$ 88,777	$ 90,552	$ 92,364	$ 94,211	$ 96,095	$ 98,017	$ 99,977	$ 101,977	$ 104,016
19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,380,145	$ 1,407,748	$ 1,435,903	$ 1,464,621	$ 1,493,914	$ 1,523,792	$ 1,554,268	$ 1,585,353	$ 1,617,060	$ 1,649,402
20	JAMES LAKE PUMP STATION UPGRADE	$ 261,109	$ 266,331	$ 271,657	$ 277,091	$ 282,632	$ 288,285	$ 294,051	$ 299,932	$ 305,930	$ 312,049
21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 4,339,376	$ 4,426,164	$ 4,514,687	$ 4,604,981	$ 4,697,081	$ 4,791,022	$ 4,886,843	$ 4,984,579	$ 5,084,271	$ 5,185,956
22	WTP - FLOWMETER AND PROGRAMMING	$ 49,735	$ 50,730	$ 51,744	$ 52,779	$ 53,835	$ 54,911	$ 56,010	$ 57,130	$ 58,272	$ 59,438
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ 2,573,785	$ 2,625,261	$ 2,677,766	$ 2,731,321	$ 2,785,947	$ 2,841,666	$ 2,898,500	$ 2,956,470	$ 3,015,599	$ 3,075,911
24	AILEEN ROAD - WATER SYSTEM SEPARATION	$ 236,241	$ 240,966	$ 245,785	$ 250,701	$ 255,715	$ 260,829	$ 266,046	$ 271,367	$ 276,794	$ 282,330
	TOTALS	$ 41,133,994	$ 41,956,674	$ 42,795,807	$ 43,651,724	$ 44,524,758	$ 45,415,253	$ 46,323,558	$ 47,250,029	$ 48,195,030	$ 49,158,931

PROJECT TIMING, DCC WATER PROJECTS

#	Project	2020
1	Water Main RENEWAL (ANNUAL COST)	$ -
2	METERING UPGRADES, (ANNUAL COST)	$ -
3	ELECTRICAL-INSTRUM & GENSETS (ANNUAL COST)	$ -
4	PRV STATION - MOVE ABOVE GROUND (ANNUAL COST)	$ -
5	WTP - CONVERSION CL2 GAS TO SODIUM HYPOCHLORITE	$ 1,090,000
6	RESERVOIR SPILLWAY WEIR MONITORS (5 sites)	$ 50,000
7	CRESCENT DAM SPILLWAY - UPGRADE	$ 210,000
8	TROUT CREEK FLUME - REPLACEMENT	$ 7,090,000
9	THIRSK DAM - ANCHOR GREASING - CONC PROTECTION	$ 67,551
10	GARNETT RESERVOIR SPILLWAY - UPGRADE	$ 1,350,000
11	THIRSK DAM - GATE REPLACEMENT AND OUTFLOW WEIR	$ 70,000
12	DAM SAFETY REVIEWS	$ 345,000
13	ENEAS DAM - DECOMMISSIONING	$ 110,000
14	WTP - SLUDGE HANDLING - UPGRADES	$ 6,280,000
15	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ 6,410,000
16	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ 2,750,000
17	SOURCE WATER ASSESSMENT PLAN	$ 80,000
18	TSUH DAM - DECOMMISSIONING	$ 70,000
19	SUMMERLAND RESERVOIR SPILLWAY	$ 1,110,000
20	JAMES LAKE PUMP STATION UPGRADE	$ 210,000
21	ISINTOK DAM - RECONSTRUCTION AND RAISE	$ 3,490,000
22	WTP - FLOWMETER AND PROGRAMMING	$ 40,000
23	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ 2,070,000
24	AILEEN ROAD - WATER SYSTEM SEPARATION	$ 190,000

DCC PROJECT EXPENDITURE / DCC REVENUE FORECAST

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
DCC PROJECT EXPENDITURE		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC REVENUE FORECAST											
Single Family Residential Lots		$ 77,000	$ 77,385	$ 77,772	$ 78,161	$ 78,552	$ 78,944	$ 79,339	$ 79,736	$ 80,134	$ 80,535
Multi-Family Residential - High Density 3 story walkups		$ 116,400	$ 122,220	$ 128,331	$ 134,748	$ 141,485	$ 148,559	$ 155,987	$ 163,786	$ 171,976	$ 180,575
Business Accounts Industrial / Commercial / Institutional		$ 6,480	$ 6,512	$ 6,545	$ 6,578	$ 6,611	$ 6,644	$ 6,677	$ 6,710	$ 6,744	$ 6,778
TOTAL PROJECTED DCC REVENUE		$ 199,880	$ 206,117	$ 212,648	$ 219,486	$ 226,647	$ 234,147	$ 242,003	$ 250,232	$ 258,854	$ 267,887
DCC FUNDS AT BEGINNING OF YEAR		$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205
DCC EXPENDITURE DURING CURRENT YEAR		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC BALANCE (earning interest)		$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205
Interest Earned (excludes present year DCCs)		$ 6,908	$ 11,043	$ 15,387	$ 19,947	$ 24,736	$ 29,764	$ 35,042	$ 40,583	$ 46,399	$ 52,504
Subtract Debt Principal		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC Revenue from new Development		$ 199,880	$ 206,117	$ 212,648	$ 219,486	$ 226,647	$ 234,147	$ 242,003	$ 250,232	$ 258,854	$ 267,887
DCC FUNDS AT YEAR END	$ 345,382	$ 552,169	$ 769,330	$ 997,365	$ 1,236,798	$ 1,488,181	$ 1,752,092	$ 2,029,137	$ 2,319,952	$ 2,625,205	$ 2,945,596
cumulative DCC Revenue from 2021 on		$ 199,880	$ 405,997	$ 618,645	$ 838,131	$ 1,064,778	$ 1,298,926	$ 1,540,929	$ 1,791,161	$ 2,050,015	$ 2,317,902

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
DCC PROJECT EXPENDITURE	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC REVENUE FORECAST										
Single Family Residential Lots	$ 80,938	$ 81,342	$ 81,749	$ 82,158	$ 82,569	$ 82,982	$ 83,396	$ 83,813	$ 84,233	$ 84,654
Multi-Family Residential - High Density 3 story walkups	$ 189,603	$ 199,084	$ 209,038	$ 219,490	$ 230,464	$ 241,987	$ 254,087	$ 266,791	$ 280,130	$ 294,137
Business Accounts Industrial / Commercial / Institutional	$ 6,811	$ 6,845	$ 6,880	$ 6,914	$ 6,949	$ 6,983	$ 7,018	$ 7,053	$ 7,089	$ 7,124
TOTAL PROJECTED DCC REVENUE	$ 277,353	$ 287,271	$ 297,667	$ 308,562	$ 319,981	$ 331,952	$ 344,501	$ 357,658	$ 371,452	$ 385,915
DCC FUNDS AT BEGINNING OF YEAR	$ 2,945,596	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416
DCC EXPENDITURE DURING CURRENT YEAR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC BALANCE (earning interest)	$ 2,945,596	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416
Interest Earned (excludes present year DCCs)	$ 58,912	$ 65,637	$ 72,695	$ 80,103	$ 87,876	$ 96,033	$ 104,593	$ 113,575	$ 122,999	$ 132,888
Subtract Debt Principal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCC Revenue from new Development	$ 277,353	$ 287,271	$ 297,667	$ 308,562	$ 319,981	$ 331,952	$ 344,501	$ 357,658	$ 371,452	$ 385,915
DCC FUNDS AT YEAR END	$ 3,281,861	$ 3,634,769	$ 4,005,131	$ 4,393,795	$ 4,801,653	$ 5,229,638	$ 5,678,732	$ 6,149,965	$ 6,644,416	$ 7,163,219
cumulative DCC Revenue from 2021 on	$ 2,595,255	$ 2,882,526	$ 3,180,193	$ 3,488,754	$ 3,808,736	$ 4,140,688	$ 4,485,189	$ 4,842,847	$ 5,214,299	$ 5,600,214

DISTRICT OF SUMMERLAND

WATER UTILITY CASHFLOW

GREEN TEXT Input data cell
BLACK BOLD TEXT known data cell
BLUE TEXT Calc. cell
BLACK (NOT BOLD) TEXT Estimated raw data entry cell

DEVELOPMENT GROWTH RATES

0.50%	SF & ICI LOT GROWTH RATE
5.00%	MF UNIT GROWTH RATE
0.50%	IRR. DEMAND & ARABLE LAND GROWTH (%)
1.00%	**LEAKAGE/ UFW REDUCTION GOAL per YR**

WATER RATES - CURRENT

2.75%	**DOM. WATER RATE INCREASE / YEAR**
2.75%	IRRIGATION WATER RATE INCREASE PER YEAR
$ 638.81	**CALCULATED REVENUE PER SFE**
$ 192.89	**2020 ARABLE LAND TAX RATE**

ENTER FINANCIAL PARAMETERS

2.00%	INFLATION RATE -EXPENDITURES (%)
2.00%	RETURN ON RESERVES
3.00%	BORROWING RATE (%)
20	Amortization Period (Yrs)

DCC FOR WTP, SOURCE, AND CONVEYANCE

$ 4,000	SINGLE FAMILY DCC Rate ($)
$ 3,000	MULTI-FAMILY / BARELAND STRATA / MH PARK (0.75 x SFE)
$ 2,400	MULTI-FAMILY RESIDENTIAL 3 STORY WALKUPS (0.60 x SFE)
$ 4,800	COMMERCIAL (1.20 x SFE)
$ 4,800	INDUSTRIAL (1.20 x SFE)
$ 4,800	INSTITUTIONAL (1.20 x SFE)

FUND BALANCES - Year end 2019

$ 708,234	**"CAPITAL WORKS FUND" new projects**				
$ 487,290	**"CAPITAL REPLACEMENT FUND" renewal**				
$ 345,382	**WATER DCC FUND**				
$ 53,368,321	**PHYSICAL ASSETS (YEAR END 2007)**				
1.106%	**RENEWAL CONTRIB. % OF ASSETS =**	$ 590,253.63	$ 171,487,500	FULL REPLACEMENT COST
0.344%	**RENEWAL % BASED ON REPLACEMENT =**	$ 589,917.00			

YEAR ENDING	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040

APPENDIX C - ELECTRICAL, INSTRUMENTATION AND CONTROLS AUDIT

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Summerland Water Master Plan – Electrical, Instrumentation and Controls

1 Communication System

1.1 Existing Equipment

The water system communication system consists mainly of SCADA communications (communications from each site to the SCADA system, for monitoring and alarming), with minimal process communications (communications between sites for process control). All of the booster pump stations and water reservoirs are connected to the SCADA system, and some of the PRV stations are connected. The existing SCADA system communications uses Freewave 900MHz spread spectrum radios, with a serial connection to the site Programmable Logic Controller (PLC). The existing communication paths are not well documented in that there is not a communications map or report that shows the routing each station takes back to the central SCADA computer, or the location of repeater sites that are external to water sites.

Call out alarming for the water system originates from the SCADA monitoring site, so the communication system to the local sites is critical in the collection of alarms. If the communication fails to a site, any local alarms that occur are not received at the SCADA monitoring site and operations staff are not alerted. For this reason, a communication failure to a remote site should be a call out alarm, however; many of the sites do not have strong communication paths resulting in regular failures, so the communication alarms are often bypassed because they result in too many nuisance alarms that the operators can't resolve.

1.2 Communication Options

The existing SCADA system uses radios with a serial (RS-232) connection to the site PLC, which means that the data is sent one bit at a time over a serial stream. This type of communication limits the maximum speed of the communication system to the speed of that serial stream. Other RS-232 serial limitations include the hardware connection between devices, as the RS-232 serial connection can only support a single link, and the distance for a hardwired connection is limited to 50 feet. When using RS-232 serial communications, a radio system is the only real, practical connection means, as the radio system can allow communication to multiple serial devices, although only one at a time. RS-232 serial is an older communication standard, and is losing support in new equipment in favour of newer, faster and more flexible communication options.

Ethernet based communication systems are becoming the most commonly used industrial communication systems for new systems and system upgrades. Ethernet communications are much faster than serial since they support multiple channels rather than a single stream, and also supports communications from multiple devices simultaneously. PLC manufacturers have developed protocols to work in Ethernet communication systems, and the connecting hardware (CAT 6 copper cabling, optical fibre, radios, cellular modems, satellite modems) is more diverse than serial for communications.

In order to improve SCADA system communication speed as well as enable growth of the system to include additional stations without compromising the data collection speed, it is recommended that the SCADA communication system be migrated to an Ethernet based system.

1.3 Ethernet Connection Options

There are many options for the hardware to make an Ethernet connection. For connections within a panel or a building, where the distance between the end points is less than 100m, Cat6 cable is generally the best choice. For connections over longer distances, like for the SCADA connection from a remote station to the SCADA computer, the options are generally optical fibre, radio, cellular modem, or satellite modem.
Optical fibre provides the fastest and most robust connection out of the longer range options. The type of fibre (multi mode or single mode) as well as the converter used determines the maximum distance the fibre signal can propogate, and distances of up to 20km are easily achievable. The main disadvantage of optical fibre is the cost, as supply and installation costs increase with the length of the fibre run. Installation is either underground in conduit, or on utility poles with other communication cabling (telephone, cable television). It is an advantage that the District of Summerland operates and maintains its own electrical utility, as it is expected that will make it easier to coordinate with the utility to use their overhead poles for the SCADA communication network, and to update their underground standards to include conduits for underground fibre alongside the underground electrical distribution. Because of the expense, it is most practical to use optical fibre for the connection to critical sites that have large amounts of data to transfer, as well as for sites that are near the central SCADA site, or near another site on the network.

Ethernet radios are available in a number of different bands, including UHF licensed radios, 900MHz spread spectrum unlicensed, 2.4GHz unlicensed, and 5.8GHz broadband unlicensed. The higher frequencies offer high speed communications, but they are less robust so require cleaner radio paths. A radio Ethernet communication system often consists of a mixture of radios in the different bands, with the higher speed bands used for a communication backbone to sites that have good paths or lots of data to transfer, and 900MHz or UHF radios to sites that have weaker radio paths or small amounts of data to transfer. The sites with the higher speed (backbone) radios can serve as collector sites to pick up data from the sites with the slower radios.

Some of the more remote sites, like the dams, are too far away and across terrain that is too difficult to support a radio path. For those sites, cellular modems are a communication option if a cellular signal is available. If there is no cellular coverage, then satellite communications are the remaining option. Both cellular and satellite communications will have monthly fees for data usage, with satellite being the most expensive. Unlike a radio system which is owned and maintained by the user, both cellular and satellite communication systems rely on third parties to keep the systems operational. Because of the ongoing operational costs and reliance on a third party for functionality, radio communications are preferable when a radio path is possible.

1.4 Communication Recommendations

The SCADA communication system should be updated to use Ethernet based communications, using a mixture of optical fibre and wireless connections. The SCADA communication system must be reliable, as it is important to the call out alarming, so the communication upgrade should be approached in a systematic manner.

A communication study should be contracted, in which all of the site and repeater location information is gathered. Sites that are good candidates for optical fibre connections should be selected, taking into account the amount of critical monitoring data at the site as well as the level of effort required to make the optical fibre connection.

A radio path study is required as part of the communication study, using recognized radio path analysis software. The radio path study should incorporate all of the site and repeater location information, and the radio paths should be considered for UHF, 900MHz, 2.4GHz, and 5.8GHz so that you know what frequencies can work for each site. Once the available radio paths are determined by the path study, upgrade radio hardware can be selected for each site, cost estimates completed, and a plan for system wide upgrade determined. Cellular or satellite communications are the available options for sites that cannot be reached by radio.

In order to make the alarm notification system more robust, a local alarm dialer should be considered for sites that have very time sensitive alarms, or alarms that have critical consequences. Cellular alarm dialers are available which support voice alarms as well as text alarms, and they are generally easier to retrofit into a site that does not have an existing phone line.

2 Station Control Systems Equipment

2.1 Existing Equipment

Two new water pumping stations have been added since the 2008 report: The James Lake Pump Station and the Garnett Valley Booster Station. The James Lake Pump Station has an Allen Bradley SLC5/05 PLC CPU, which is designated as Active Mature by Allen Bradley (meaning it is not a current model, but it has not been discontinued yet), and an Allen Bradley Panelview Plus HMI. The PLC does support Ethernet communications, and there is an Ethernet switch in the control panel. The Garnett Valley Booster has an Allen Bradley MicroLogix 1400 PLC, which is a current PLC model that supports Ethernet, and a Schneider HMI.

The remaining pump stations, reservoirs and PRVs have control system hardware that is largely unchanged since the 2008 report. The sites were retrofit with Programmable Logic Controllers (PLCs) into their existing control panels to connect to the SCADA system, and the PLCs that were installed at that time are now discontinued and do not support Ethernet communications. Some of the sites have also had Human Machine Interfaces (HMIs) added, to provide local displays of statuses, alarms, and some trending information.

2.2 Control System Upgrades

The stations that have older PLC equipment that does not support Ethernet communications will require updates as part of the communication system upgrade. Most of the outdated PLCs have corresponding new models from the manufacturer with onboard Ethernet ports, so the simplest PLC upgrades would be to the new model. Another option to incorporate Ethernet communications at the sites where the PLCs only support serial communications is to install a serial to Ethernet gateway, to convert the serial signal to Ethernet and keep the same PLC. The main drawback to this option is that there would not be any increase in the communication speed to the site with the Ethernet upgrade, as the speed limitation would still be the serial communication speed of the PLC port. Additionally, the existing PLC hardware that doesn't support Ethernet is aging and has been discontinued by the manufacturer, so it could not be

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replaced by the same model in the event of a failure. The communication upgrade provides a good opportunity to also upgrade the discontinued PLC hardware.

The PLC model(s) selected for the upgrades should be standardized to a limited number of models, and that standard should become part of the development bylaw for future stations. Additionally, the District should develop PLC programming standards to ensure that future stations that may be programmed by personnel hired by a developer will meet minimum requirements, and conform with programming elsewhere in the system.

There are a number of HMIs from different manufacturers throughout the system. While the general functionality of an HMI is similar across different manufacturers, there are differences in display capabilities and navigation through the screens. It is easier for operations staff to use the HMIs if there is continuity in the HMIs between sites, in that the navigation between screens is the same, screen layouts and naming follows the same conventions, and alarming is displayed in the same manner. The District should select a standard HMI and develop application programming standards, which can be incorporated into the development bylaw to ensure continuity in future developments.

The main PRV stations have PLC control panels and are connected to the SCADA system, but most of the stations do not have any external monitoring. There are numerous PRV stations throughout the District, so it would be an expensive endeavor to add full SCADA monitoring to each one, matching the monitoring at the main stations. For the smaller PRV stations that serve a small population, the incorporation of limited monitoring and alarming should be considered. As a minimum, a flood alarm should be added to these sites, as well as a low temperature alarm to call out if there is a danger the piping freezing. A small PLC panel with a cellular dialer would provide this alarm call out functionality, as well as provide the ability to add monitoring signals or incorporate the site into the SCADA system in the future, with the addition of a radio. Alternatively, the alarm signals can connect directly to a cellular dialer.

3 Central SCADA System

The central SCADA system hardware and software has been updated since the 2008 report, following the recommendations provided in that report. The Central SCADA system has an ongoing hardware and software maintenance plan, and efforts are made to keep that system up to date. The District has recently added remote access to the SCADA application for the operations staff, so that they can check statuses and alarms when working in the field or on call, enhancing the utility of the system.

The outstanding recommendations for the central SCADA system are related to the communications, and are detailed in the preceding section.

4 Power Supplies and Distribution

4.1 PRV Stations

The power supplies to the PRV stations are largely unchanged since the 2008 report. There are multiple underground PRV stations without power or any monitoring. They would benefit from the addition of a utility service, to allow the addition of ventilation, heating, and lighting as well as a monitoring and

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alarming panel. For any station that is relocated above ground, a utility electrical service will be required as the structure will require heating.

The addition of rudimentary alarming, consisting of just flood and low temperature alarms connected directly to a cellular alarm dialer, would have low power requirements. For that addition, a solar panel and battery would provide adequate power, and would be less costly and labour intensive than installing a utility service.

PRV Stations 6 and 10 do have utility services and electrical equipment. At those stations, all of the electrical service equipment and controls panels should be located above ground, so they can be accessed without entering the confined space.

[redacted]

Electrical, Instrumentation, and Controls Upgrade Projects

CENTRIX control solutions

Project: District of Summerland Water Master Plan Update
Job Number: so18260
Date: 23-Sep-19

ITEM	DESCRIPTION	UNIT	$/UNIT	QTY	EXT$	PRIORITY
1	Communication Study Including Radio Path Analysis and Cost Estimates	lump sum	$ 15,000.00	1	$ 15,000.00	High
2	Develop Control Equipment Hardware Standards and Programming Standards Documents	lump sum	$ 7,000.00	1	$ 7,000.00	High
3	Pump Station, Reservoir, PRV (10 & 6) Repeater and WTP SCADA Communication Equipment Upgrades (Radio Equipment)	per site	$ 7,000.00	18	$ 126,000.00	High/Mod
4	Pump Station Control Equipment Upgrades (PLC, HMI, Ethernet Switch, Programming, Schematic Drawings)	per site	$ 25,000.00	8	$ 200,000.00	High/Mod
5	Reservoir Control Equipment Upgrades (PLC, HMI, Ethernet Switch, Programming, Schematic Drawings)	per site	$ 15,000.00	3	$ 45,000.00	High/Mod
6	SCADA Monitored PRV Control Equipment Upgrades (PLC, HMI, Ethernet Switch, Programming, Schematic Drawings)	per site	$ 20,000.00	2	$ 40,000.00	High/Mod
7	SCADA Monitored PRVs - Add Flood, Low Temperature and Intrusion Alarming	per site	$ 2,500.00	2	$ 5,000.00	Moderate
8	Unmonitored PRVs - Add Cellular Alarm Dialer with Flood, Low Temperature, High Discharge Pressure, and Intrusion Alarming	per site	$ 25,000.00	13	$ 325,000.00	Moderate
9	Thirsk Dam - Reinstate Satellite Communications	lump sum	$ 5,000.00	1	$ 5,000.00	High
10	Thirsk Dam - Add Electric Actuators and Programming to Allow Remote Gate Operation	lump sum	$ 20,000.00	1	$ 20,000.00	Moderate
11	Thirsk Dam - Update Level Monitoring Equipment	lump sum	$ 2,500.00	1	$ 2,500.00	High
12	Pump Stations - Add Standby Power at Booster Stations That Pump into Closed Systems (ie no reservoir storage)	per site	$ 120,000.00	6	$ 720,000.00	Low

Subtotal:		$ 1,510,500.00
Engineering Allowance	10%	$ 151,050.00
Base Capital Cost		**$ 1,661,550.00**
Contingency Allowance	15%	$ 249,232.50
Total Capital Cost Estimate		**$1,910,782.50**

APPENDIX D - SUMMERLAND WATER SUPPLY HISTORY

WATER SUPPLY HISTORY

This Appendix provides a condensed history of water supply in the Summerland region.

Summerland holds some of the oldest water licenses in the Okanagan Valley, dating back to December, 1888. The evolution of the community of Summerland is closely tied to its water system. We can be assured that the future of the community will be very reliant on its water supply system. The study team assembled a brief history of events that influenced the formation of the water system. This was first presented in the 2008 Water Master Plan and it has been updated with more research and additional information that has been collected since that report. This section is provided in order to gain a better appreciation of the wisdom of earlier generations and of the importance of Summerland's community water supply system.

A historical account of the development of Summerland is available on the District website at www.summerland.ca . Other key sources of information are listed at the end of this section.

First Settlers

The first settlements in the Trout Creek area were in the second half of the 19th century. The land was accessible via sternwheelers that traveled up and down Okanagan Lake. Early farming consisted of hay and grain crops in support of livestock and mixed farming. Prior to 1902, Summerland was referred to as Trout Creek. The earliest rights for water on Eneas Creek were taken out in 1880. Trout Creek was not applied for until 1888.

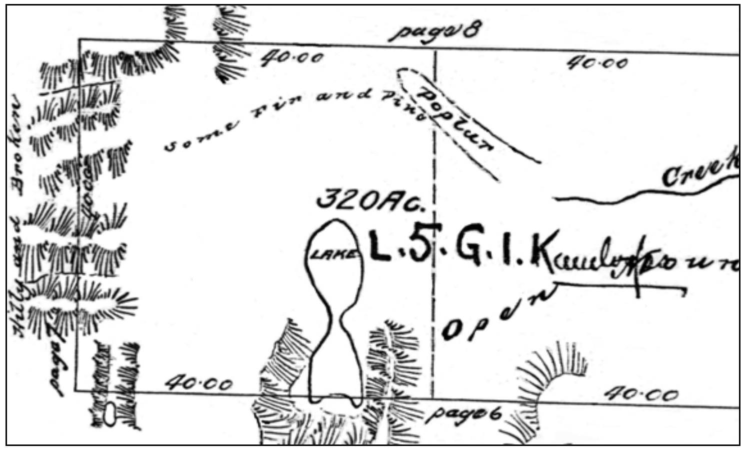
In **1887** the first commercial orchard, which was apple trees, was planted by James Gartrell and family. The first legal water rights were issued to Gartrell and Wood. They were allowed to withdraw 300 acre-inches per year from lower Trout Creek (25 acre-feet). Early licensing was issued in acre-inches or 1/12 of the current day acre-foot. The largest land holdings in the area were the Trout Creek Ranch held by George Barclay who held 3,320 acres of land, of which 500 acres had rights to irrigation. The Trout Creek Ranch carried out mixed farming consisting of livestock and grain crops. They held water rights on Eneas Creek and Prairie Valley Creek. Trout Creek was known as a larger source, but no diversion of water had yet been planned.

Late **1890's** - There was a great deal of interest in the Trout Creek area by J.M Robinson and Thomas Shaughnessy of the Canadian Pacific Railway. They were interested in supporting fruit production in the Okanagan Valley. The initial success of the Coldstream valley to the north resulted in considerable attention being given to the Trout Creek area.

1900 - Offers were being considered for the purchase of the Trout Creek Ranch.

1902 - Thomas Shaughnessy commissioned a comprehensive water study by Frank Herbert Latimer to review the potential of supplying additional water to the area from Trout Creek.

1902 - Construction of a major diversion ditch from Trout Creek to the Prairie Creek holding pond began. At the time Trout Creek was referred to by some as Poplur Creek. The project was substantial in comparison with any other projects in the region.



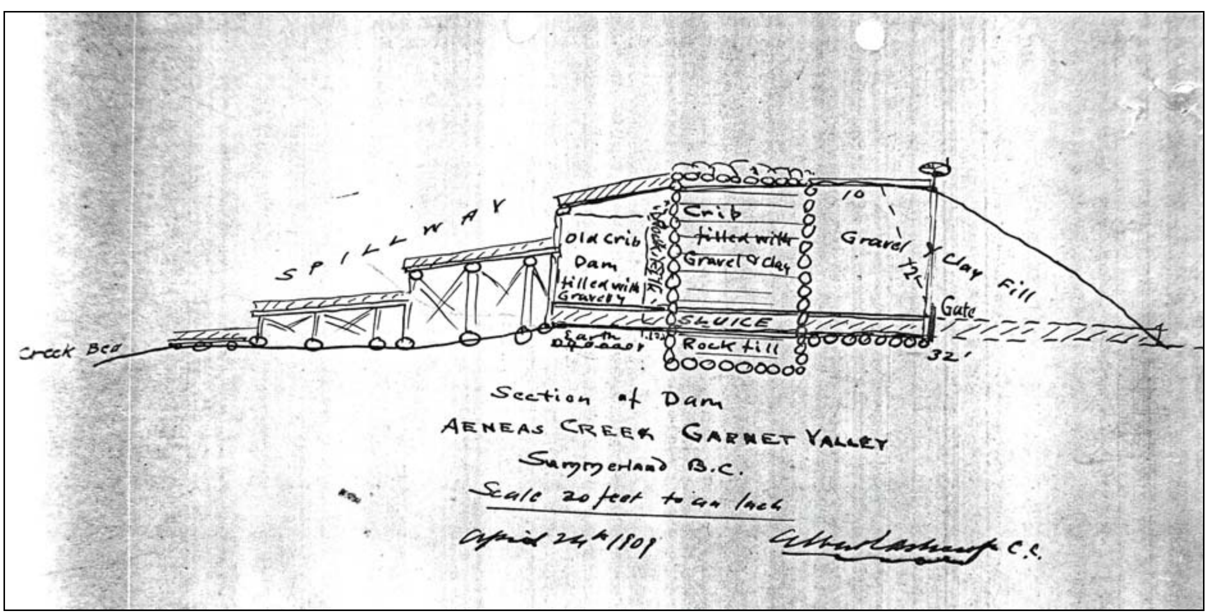
1889 Plan- Barclay Lake, now the Trout Creek Reservoir Site. Poplur Creek was originally referred to as Keremeos (Split) Creek. Measurements are in chains (66 ft)

1903 - On May 27, J.M. Robinson formed the Summerland Development Company and a town-site began developing along the shoreline of Okanagan Lake. J.M. Robinson (Manager) was a promoter and began referring to the Trout Creek as Summerland. Thomas Shaughnessy was President. The Summerland Development Company developed Dams No. 1, 2 and 3 at Headwaters Lakes. The ditch was built from Trout Creek to Summerland Reservoir at the top of Prairie Valley.

1905 – Summerland is the first town in the Okanagan to receive electricity.

1906 - The Town incorporated and the Lower Town area was the centre of the community.

1906 - James Ritchie formed the Garnet Valley Land Company taking over most of the water licenses on Eneas Creek. A flume system was constructed to convey water from Garnett Reservoir to the lower valley to new subdivided lots. West Summerland town centre is formed on the upper flats near the north base of Giants' Head Mountain. Drinking water in Garnett Valley is accessed via private shallow wells.



James Ritchie Dam – Circa **1909**

1906 - The Municipality of Summerland is incorporated.

1910 - The Municipality of Summerland takes over the irrigation and domestic water systems from the Summerland Development Company and the irrigation system from the Garnet Valley Land Company. The irrigation system was the first publicly owned water system in the Okanagan Valley.

1910-15 – Water conveyance is via wood stave pipes covered with tar and wrapped with wire. It became clear that the seepage from the ditches and wooden flumes was much too extensive. Therefore, some of the ditches were lined with concrete and wooden flumes began to be replaced with metal ones.

1920-40s - "Ditch Men" would patrol the flumes and ditches during the irrigation season. They would use horses, bicycles, motorbikes and/or walk to get around the system. They would repair the flumes in the spring and be responsible for cleaning the ditches and removing obstacles such as beaver dams or fallen trees or branches. Their responsibility was making sure the water got down to the growers.

1911 - The Trout Creek diversion dam was built in the Canyon in Trout Creek. The dam was only four feet high, but it was raised several times through the years. In 1912 a 14-inch diameter wood stave pipe was installed on the south side of the creek and it ran eastward into an open dirt ditch. In 1918, five hundred feet of wood stave pipe was laid on the north side of the creek.

1912 - The Apple market was flooded for the first time with fruit from Washington State. The product exceeded the consumer demand. In the following years, the apple industry also suffered from the Great War.

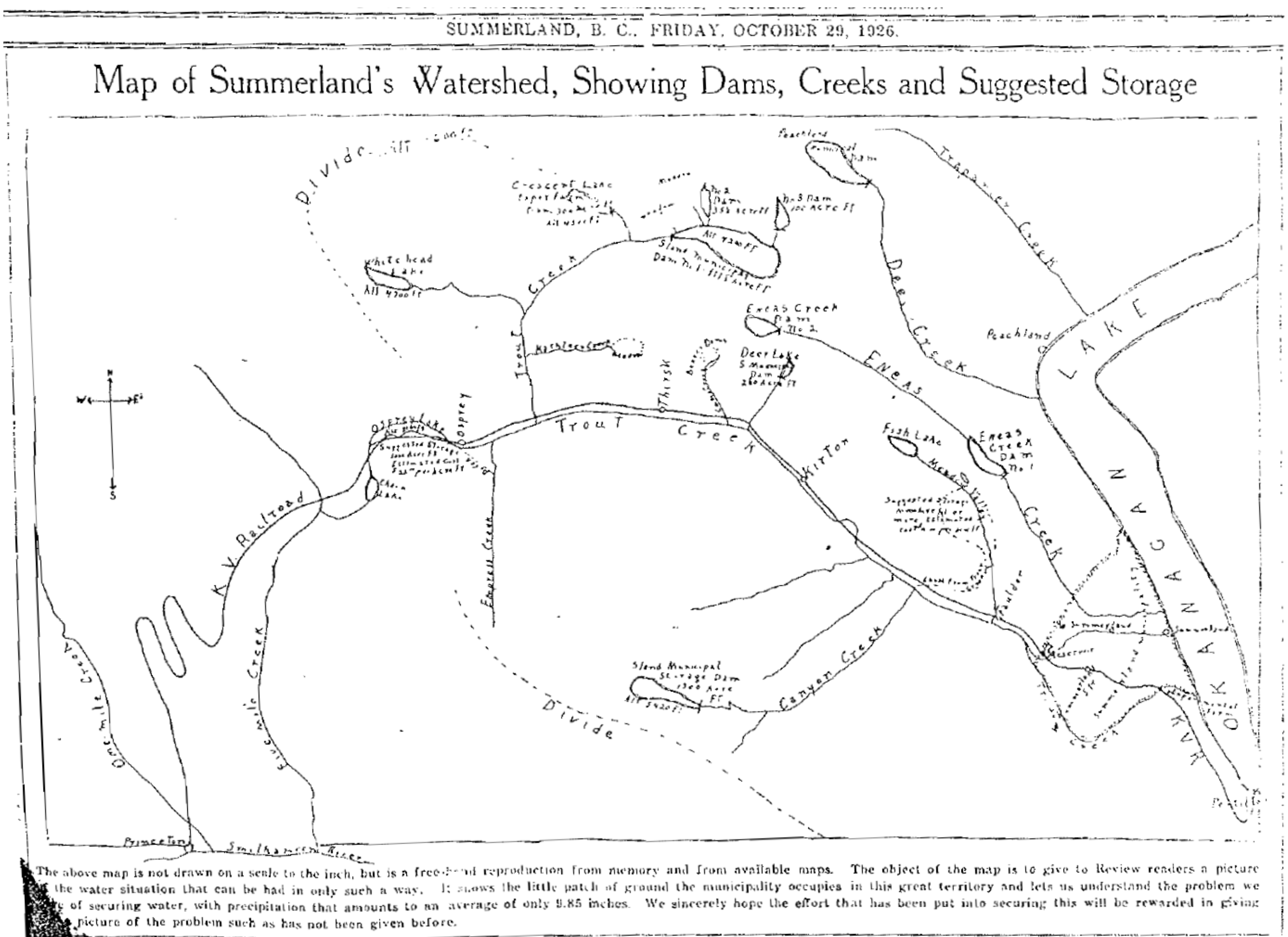
1915 - The Dominion Experimental Station was set up on Penticton Indian Band lands to help the orchard industry. Water supply was set up via a deal with Summerland and the Federal government. The deal allowed the Dominion Experimental station to pump water up through a small pipe from the bottom of Trout Creek canyon.

1921 – Surveys were undertaken in the upper watershed at Headwaters, Crescent and Site 1 by Mr. J.C. Dufreschne, Civil Engineer.

1922 - Great fires devastate the town of Summerland.

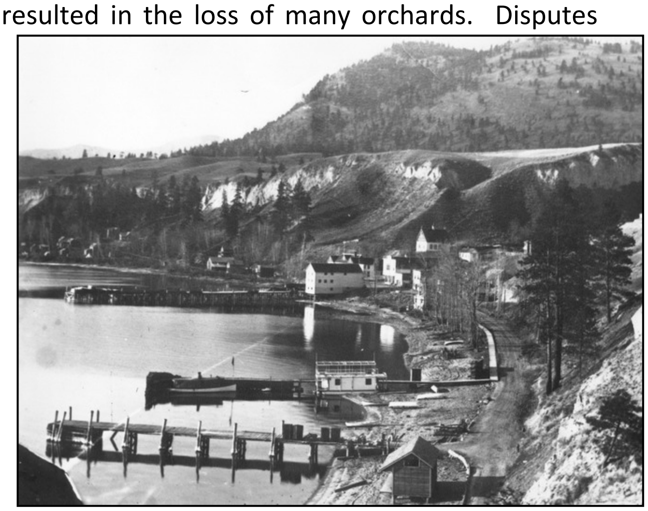
1922 - Trout Creek Flats was not part of the municipality and the Trout Creek Water Users Community (TCWUC) was formed to service this area. The concrete dam, built in 1911, at the mouth of the Trout Creek canyon was donated by the Municipality to the TCWUC and served their needs.

1924 - System demands increased with the demands from the Trout Creek, the Dominion Experimental Station and the Municipality. Crescent Lake storage dam was completed by the Dominion Experimental Station. Crescent Lake Reservoir held 300 acre-feet of water.



Courtesy of The Summerland Review

Late **1920s** – early **1930s** – Drought and lack of water resulted in the loss of many orchards. Disputes occurred between the orchardists and utility.



1926 - The Canyon Dam (now Isintok) was rebuilt. Canyon Creek is the largest tributary to Trout Creek. The original dam was log crib and filled with pure sand. It stored 100 acre-feet of water. The new dam increased the storage volume to 1,300 acre-feet. With many challenges faced, the dam was completed in the fall of 1926.

1928 - The first spillway was installed on the Trout Creek dam in the canyon. It washed out in 1928 and was replaced and then that one washed out in 1948.

1928-32 - Trout Creek Water Users Community – Summerland – Dominion Experimental Station dispute. The amount of water in Trout Creek was limited in these years and although the TCWUC had prior rights to water in Trout Creek, very little was making it down to their intake. There were threats to blow up the Dominion Experimental station's dam however a solution was found with a $21,000 pump station being built on Sun-Oka beach, being officially commissioned in 1933.

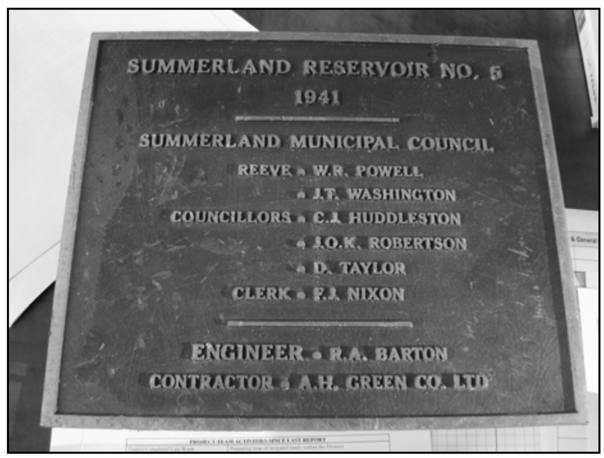
1930s – Drought worsened through these years. In the mid-1930s Summerland undertook another scheme to increase water flow to Summerland. A 3-4-mile-long diversion ditch from Crescent Lake Reservoir to Headwaters Reservoirs was constructed. Headwaters Dam No. 4 was constructed to increase storage.

In **1933**, the TCWUC became the Trout Creek Irrigation District (TCID). For 27 years, the TCID was managed by Magnus Tait.

1935-39: A significant length of cast iron water mains (24 kilometers) was installed throughout town. Some of these mains are still in-use today.

1940 – The lack of storage was noted and the Garnet Valley dam was reconstructed and raised.

Late **1930's through 1940s**– Sprinkler systems began to replace the furrow irrigation techniques, but water pressures were typically inadequate to maintain the required pressures. Localized pressure water systems began to develop by single growers or groups of growers.



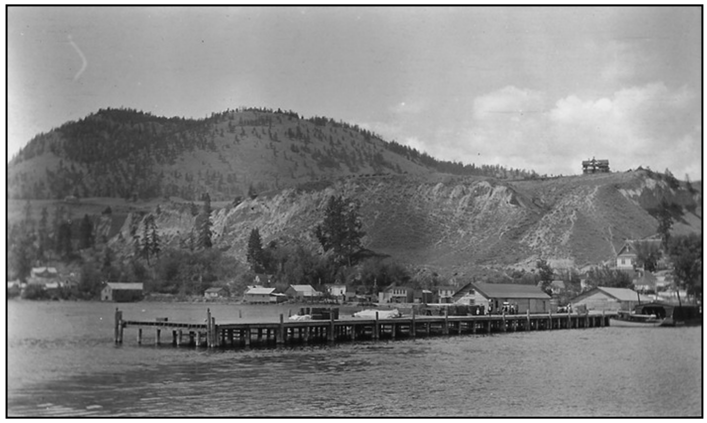
1940 – The new Thirsk Dam (Summerland Reservoir No. 5) is located and constructed on Trout Creek 35 km upstream of the Trout Creek intake. The Engineer is R.A. Barton and the contractor is A.H Green Co. Ltd. On May 24, 1941, a ten-car train of Summerland residents travel up the Kettle Valley Railway to the site of the dam. They walk one and a half miles from the train stop to the dam to attend the grand opening of the dam. The anaerobic water from the decaying logs and vegetation is released for the first time from the dam. The smell was noted to be awful and sent people running from the site. In time the poorer quality water lessened. The dam was a success storing 2,630 acre-feet of water.

1940s - Through the 1940s, World War II resulted in lesser maintenance of the water system. The wooden flumes fell into disrepair. In the late 1940s, concrete flumes replaced the wooden ones.

Late 1940s - Sprinklers irrigation begins to be implemented in Summerland. Furrow irrigation starts to be phased out and water use efficiencies increase.

1948 – A chlorination system was installed by the Municipality for the domestic customers at the top of Prairie Valley. It is placed in service Nov 8th, 1948.

There are start-up issues to resolve with manual operation of the system for the first three months of operation.



1950's - Highway 97 was re-routed above to the West benchlands.

1951 – Trout Creek Hatchery builds a dam on Shaughnessy Brook. It has competing interests for water with the Cornwall Cannery which used water for fruit preservation production. Old Town is fed with water from the brook and excess water from the brook was used by the hatchery.

1964 - Town Centre was moved to "West" Summerland and the "West" term was dropped.

1968-69 - The water pump station and lake intake near the cannery in Lower Town were rebuilt to provide domestic water to the Lower Town area. The Old Town area joins the main domestic water system.

1972-73 - The Province completes preliminary studies for pressurization of the water system.

1975 - The ARDA program pressurized the water system and infrastructure was added including screens and chlorination. The irrigation and domestic water systems were combined into a single pressurized and chlorinated water system. Approximately 88 km of new water main is installed throughout Summerland. Most of the main is Asbestos Concrete pipe and is still in service.

1976-77 – Garnet Reservoir was reconstructed approximately 100m downstream of the original dam and raised to its present level. Anaerobic conditions were present behind the old dam and short circuiting of this water to the intake created taste and odour problems in the Garnet water supply. An aerator was installed in 1982 and the situation improved.

1977 – The TCID was amalgamated with the Municipality consolidating the major water suppliers in the area.

1980s - Water demands increase in the late 1970's and through the 1980's making Summerland review their reservoir storage capacity and the reliability of the water supply to the community. Numerous studies were undertaken by consultants.

1990s –Several studies were conducted to improve water supply. Two key works include the *1992 Reservoir Alternatives Study* by UMA and the *1997 Master Water Plan* by Associated Engineering.

2001-02 - Water quality option studies were conducted by Associated Engineering and by Earth Tech Canada Inc.

2003 – During this year water treatment funding grant was in the process of being awarded to the District of Summerland. The summer of 2003 was very dry and arid with severe fires taking place in Penticton and in Kelowna. Flow capacity concerns resulted within Trout Creek and a conflict occurred between the Department of Fisheries and Oceans and the District regarding the release of water from Thirsk Reservoir and the supply of water for fish flows in lower Trout Creek. Two emergency water wells are installed above Trout Creek Intake Reservoir on the Rodeo Grounds with disappointing results in terms of quality and quantity. Emergency water supply options are also investigated at that time including revamping the intake on Okanagan Lake and interconnection to the Summerland Research station water system.

2004 – Water Use Plan process within the Water Act, was commissioned by the District. Summerland becomes the first water supplier in the Province to carry out a water use plan. The outcome of the plan is summarized within the Water Master Plan. The plan is based on equitable mutual benefit and/or suffering of the key stakeholders in the watershed. It was successfully administered by David Sellars of Water Management Consultants and it was updated in 2008.

2005 – The agricultural metering program begins. Summerland receives grant monies for 1/3 of the cost of supply of agriculture meters. All larger parcels with water connections requiring water for irrigation are metered under this program.

2005 – In 2006, the reconstruction of Thirsk Dam begins. The design engineer is Associated Engineering. The contractor for this work is Jim Dent Construction Ltd. from Hope, BC. The dam was raised with the high-water level being increased by 5.30m to a top of dam height of 1030.60 m. The storage volume in the reservoir was increased from 3,400 ML to 6,490 ML. The work was completed in 2007 however there were disputes in the construction between the Engineer, Contractor and the District that were eventually resolved in 2011.

2006 - The District's system separation works were being considered by consultants in conjunction with the water treatment plant works. A WTP with a design capacity of 75 ML was tendered and awarded to Maple Reinders Inc. Although the flow capacity was insufficient to treat all of the summer demands, with separation, the plant, in time would be able to treat all of the domestic water needs for Summerland.

2007 – Water Treatment Plant construction begins. The Engineer is Urban Systems Ltd. out of Kelowna, BC. The General Contractor is Maple Reinders out of Kelowna. The treatment process selected is an "Acti-flo" system where ballasted sand is added to the water with a flocculant to aid in the settling of water treatment plant flocs. Construction was completed in the spring of 2008. The plant was sized to have a capacity of 75 ML/day with the provision that over time, the District would separate off larger agricultural irrigation water from the domestic system.

2008 - Water Master Plan - With the new dam at Thirsk Reservoir, and with the new water treatment plant, the District retained Agua Consulting Inc. to provide a direction for the District to follow in the upcoming years. The challenges facing Summerland included where to separate the water system and where not to, which reservoir sites were worth expanding in the future, and how much water demand would have to be planned for in upcoming years.

2009-10 - Irrigation System Separation - Prairie Valley. In 2009 and 2010, the majority of irrigated lands in Prairie Valley were separated. The irrigation demand resulted in less water being treated by the Water Treatment Plant and less time that Summerland would be out-of-compliance with Interior Health regarding turbidity levels in the water.

2017-18 -- Irrigation System Separation - Garnett Valley – Jones Flats Road. In 2017, additional lands including Garnett Valley and upper Jones Flats were separated with treated domestic water provided from the Water Treatment Plant and the irrigation water provided from Garnett Reservoir. With reduced irrigation demands on the treatment plant, Summerland was now able to fully comply with the regulatory requirements of turbidity levels always below 1.0 NTU.

Historical Considerations and Future Direction

Summerland's history is founded on agriculture with strong dependence on their water supply. Inevitably society has changed and there is less economic value in local agriculture and globalization has brought in lower cost food from around the world. Higher fuel and transportation costs may see a reversal in this trend, but that remains to be seen.

The residents of Summerland have a high awareness of the importance of their water supply. The critical balance of supply with nature was brought to the forefront in 2003 when there were conflicting objectives between Summerland and the government fisheries staff.

Within Summerland, the issues of water for agriculture, water quality, and differing needs of different user groups will inevitably result in conflicting objectives for the stakeholders. Historically the water system was primarily used for agricultural purposes. Drinking water quality and the cost for such is now a primary factor if further development of the water system is permitted.

By following the principles in Section 1.2 of this report, the decisions for water management will be well grounded and follow broader principles. Specific issues to consider in further evolution of the water system are as follows:

- *Water is a service provided to the citizens of Summerland for the beneficial use of all;*
- *Water is to be developed so that there is sufficient supply to meet existing and future demands and so that the impacts of climate change can be confronted with manageable risk;*
- *Safe, high quality water is to be provided to the residents of Summerland for domestic purposes;*
- *Water of appropriate quality is to be utilized for appropriate use;*
- *Where there is separated water distribution, all outdoor watering should be provided, where possible, through the irrigation system;*
- *Agricultural water use should continue to be as efficient as practical and understand that the domestic users provides a larger share of the total water system revenue;*
- *Water is to be utilized to support the long-term health and well-being of the community, with specific consideration given to allocation of water to the agricultural land base for food production.*

Sustainability is a very common term related to water supply that is often tied to water conservation, metering and reduced use. A similar goal for sustainability would be to improve water use efficiencies to maximize its beneficial use. The largest beneficial uses for water should be for drinking water and for growing food.

The excesses of our current society have driven people away from historical practices of growing their own gardens to provide local sustenance. Local food production is one of the most sustainable strategies available to a community. Domestic home gardens are less common now than they have been historically, however this may change with the global trends of higher food and transportation costs. Irrigation customers require water for growing their crops. They require large volumes of water in the local arid climate, but of lower quality than what is required for domestic use. The plans of this report consider the development of projects that separates out the higher and lower quality waters for long term appropriate uses.

APPENDIX E - REFERENCE DOCUMENTATION

Reference documentation utilized in the preparation of this report includes:

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- Trout Creek Water Use Plan Update, Water Management Consultants Inc., 2008;
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- Turbidity and Microbial Risk in Drinking Water, Ministry of Health, Technical Advisory Committee Report, M. Allen, R. Brecher, R. Copes, S. Hrudey and P. Payment, February 28, 2008;
- USEPA, LT1ESWTR Disinfection Profiling and Benchmarking, Technical Guidance Manual, May, 2003;
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