Agua Consulting Inc.
"Engineered Water Solutions"
Agua file 023-02

November 12, 2008

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

Attention: Mr. Don Darling, AScT, GSC
Director Engineering and Public Works

Dear Don:

Re: 2008 Water Master Plan and Financial Review

We are pleased to submit the 2008 Water Master Plan for the District of Summerland. The report provides a comprehensive summary 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 water source capacity, including a summary 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;
- A summary of historic water use and a projection of future water use based on expected impacts from population growth and climate change;
- Appendix A, which provides a listing of 49 Capital Projects that are considered for implementation by the District;
- Prioritization of Capital Projects based on their need to be implemented and the ability for the District to fund such improvements;
- Recommendations for Development Cost Charge, water tax levels, and water toll rates;
- A summary of conclusions and recommendations based on our investigation.

We thank you for the opportunity to be of service on this interesting and important work for the District. Please call us directly if you have any questions related to any of the report contents.

Yours truly:

Agua Consulting Inc.

R.J. Hrasko, P.Eng.
Principal

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CONTENTS

APPENDICIES

EXECUTIVE SUMMARY

INTRODUCTION

The Summerland 2008 Water Master Plan and Financial Review provides a comprehensive review of the community water supply system. The report is the result of seven months of extensive review and analysis of the current situation and expected challenges that the District will be facing. This plan is a guide for Summerland to use and consider so that informed decisions can be made related to all aspects of the water supply system.

The report provides an overview of source capacity, water treatment capacity, water distribution system performance, and probable projects, their costs and the impact on present water rates. The report forecasts to a 20 year horizon with a longer timelines considered for issues such as climate change and water availability.

Section 1 provides a summary of general water supply objectives and the project work plan. A key component of this section is the twelve Guiding Principles for water supply. These principles form a firm foundation from which good decisions can be made on water supply and management.

The concepts and recommendations proposed in this study have evolved from successful initiatives carried out elsewhere in the Okanagan Valley. The proposed distribution system separation works for Summerland are refined concepts and procedures of earlier work elsewhere in the Okanagan Valley.

CRITERIA

Criteria 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.

It is noted that there is a trend towards higher density development in the District and throughout the Okanagan Valley. This is driven by economics and less land area remaining for development. Higher density development results in lower per person water demand rates as the irrigated land area is increasing at a much slower rate than the population. Recommendations are to reduce the per capita criteria for water to new development so that more efficient practices are developed and the expectation of water to be received is also lower.

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. The irrigated areas and depth of water were reviewed in conjunction with the best available information from the *Agricultural Water Demand Model* developed by the Ministry of Agriculture and Lands (MoAL). The historic moisture deficit information from the MoAL was reviewed and the recommended annual water allocation for the taxed properties larger than 0.20 ha. is a water depth of 800mm.

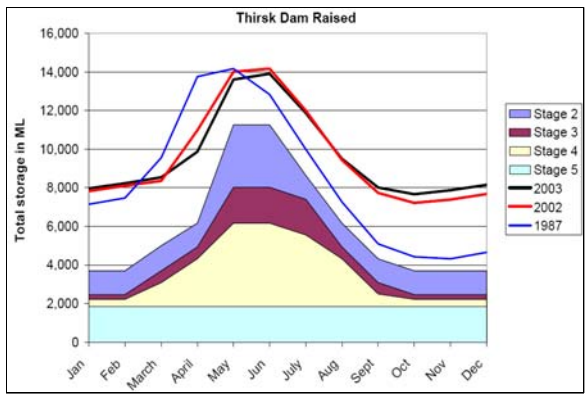
EXISTING WATER SUPPLY

A four page history of the existing District of Summerland water supply system is included in Section 3 of this report. A history of dates and water related events that shaped the community is listed. The water supply has evolved over the years and will continue to do so as changes are required.

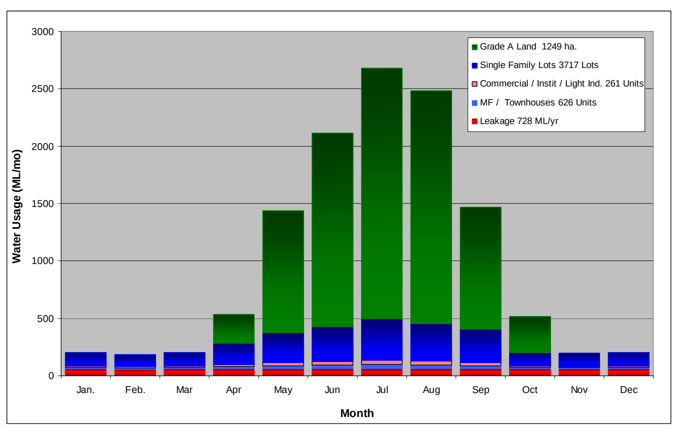
Sources The District has four water sources available; Trout Creek, Eneas Creek, groundwater, and Okanagan Lake. Groundwater is considered a supplemental source. Okanagan Lake is presently available as an emergency supply source.

Licences Water licensing was reviewed. Summerland holds sufficient water licensing on Trout Creek, Eneas Creek and Okanagan Lake for the foreseeable future. At Thirsk Reservoir and Headwaters Reservoirs minor modifications are required to adjust the licensed storage volumes to match existing volumes.

Reliability The water reservoir capacity and reliability was reviewed with the use of the *Watershed Reservoir Model*. Watershed reservoir operating procedures were confirmed and are presented in this report. The impact that raising Thirsk Dam has on reliability is reviewed. The additional storage provided at this key location improves the reliability of supply from Trout Creek to the point where, with the revised Trigger Graph for Trout Creek, drought conditions would not normally be encountered except in extremely dry years. The raising of Thirsk Dam allows the community some flexibility in allowing new development to help fund overall water system improvements.



Water Demand A key graph developed in the study was a historical trend of Summerland's total annual water use since 1977. The trend shows a decrease in water use (middle figure) however, this trend is not expected to continue. There are numerous factors that have caused this decrease, but the long term trend is expected to rise as more development occurs and the more agriculture is developed. Water use throughout the community was determined with daily, monthly and annual estimates made for the various user groups. The monthly pattern for usage is presented on the adjacent figure. Based on a year of normal water demand (average temperatures and precipitation), it was estimated that agriculture and irrigation used 8,650 ML (green bars), residential use was 2,650 ML (dark blue bars) , industry and commercial used 250 ML (white bars), and there was 730 ML of unaccounted for water (red bars). Total annual normalized water demand is currently estimated to be 12,280 ML.



Projects There are numerous projects identified for the water system. Some of them are on-going and some will require special funding. Definitive programs and focused public works funding will be necessary for hydrant infilling, blow-off installations at dead end mains, SCADA system improvements, reservoir circulation, chlorine residual monitors, and PRV and pump station upgrades. Improvements in these areas should be carried out at a steady rate over time.

Fire protection and reservoir storage to cover high demand fires in the downtown core of the District is presently considered to be adequate. With proposed high density multi-family projects, higher levels of fire protection may be requested from the Summerland water system. A maximum fire demand of 225 L/s for a duration of 2.875 hours is the current recommended maximum fire condition for the District. Previously, with Trout Creek Reservoir on-line above town, the volume and duration of fire flow was not an issue. With the WTP on-line, the WTP clearwell has only a portion of it committed to fire protection.

Detailed projects related to the existing water distribution system are discussed in Section 3. Projects assigned to existing users are defined in the project summary sheets in Appendix A.

WATER QUALITY REVIEW

Raw Water Quality Source water quality does not appear to have significantly changed over the last 14 years. More monitoring of the watershed reservoirs is recommended in order to establish a baseline of water quality data at the reservoir surface and at depth. Monitoring will also allow some early warning indications of algae blooms in these reservoirs. Neurotoxins can form from blue-green algae blooms and in 2005, a link was proven between these neurotoxins and Alzheimer's disease. The WTP will not provide sufficient protection from these contaminants should they form in the watershed. Therefore monitoring is necessary at the upper watershed reservoirs as is source protection for the entire watershed. Garnet and Trout Creek Reservoirs provide settling time for particulate matter in the water which in turn reduces *E.Coli* and Total Coliform levels but does not eliminate them.

Multi-Barrier Approach The water quality and treatment issues for the District have significantly changed in the last five years. The Water Treatment Plant (WTP) is a major step forwards in providing 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. A multi-barrier approach to drinking water is sound practise and recognized as such by the Health Authorities and industry experts. By minimizing the amount of contamination in the water, the treatment barriers will not be significantly challenged resulting in reduced risk potential.

WTP Capacity The WTP has a design capacity of 75 ML/day which is insufficient to treat the entire current MDD of 112 ML/day. The plant may be capable of producing a higher treated flow and this is the first and most cost effective option for providing high quality water to all residents. Additional flow capacity remains to be proven through WTP commissioning in 2009. System separation is recommended to make up the shortfall in capacity that cannot be provided by the water treatment plant.

Garnet Reservoir Quality The water quality data for Garnet Reservoir suggests that it is substantially influenced by groundwater. The water quality appears to meet all of the GCDWQ criteria, but concerns of its acceptability for drinking water need to be investigated with the local residents. It is recommended that a customer survey be sent to all residents in this area so that direct feedback from those connected to this source can be confirmed. Two project options are included for Garnet, UV disinfection and system separation. Public input should be requested for both options as the cost differences are substantial.

Water Quality Direction: The key steps to be taken with respect to improving water quality are as follows:

1. Maximize the process capacity of the WTP to beyond the design capacity for those short periods of time when flows are above 75 ML/day;
2. Begin system separation starting at the west end of Prairie Valley in order to free up drinking water capacity from the WTP;
3. Plan for development of a source of potable water from Okanagan Lake. The planning should begin with sampling at depth in the vicinity of the proposed lake intake locations.

FUTURE WATER SYSTEM

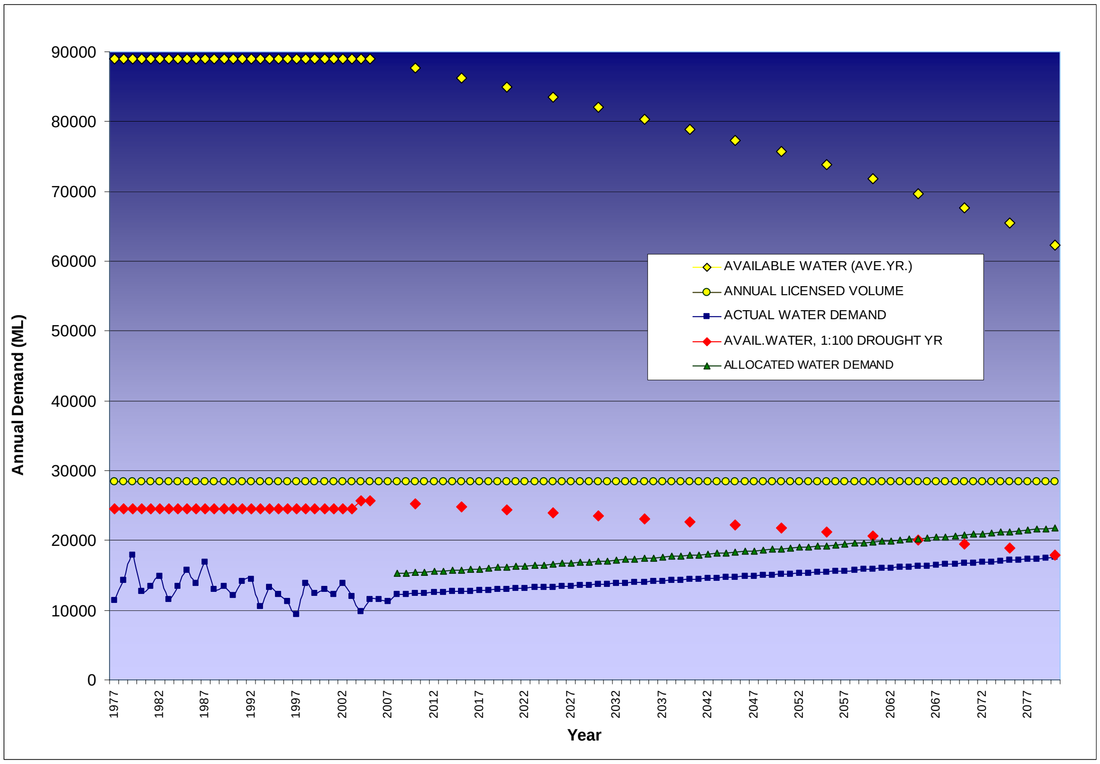
Sustainability Sustainability is a very common term related to water supply that is often tied to water conservation, metering and reduced use. A more focused goal for water sustainability would be to improve water use efficiencies to maximize its beneficial use for all. The largest beneficial use of water should be for human consumption and for growing food. The current practices to transport drinking water and food by vehicle to a community should be minimized.

An objective for water supply is to ensure supply when adverse conditions or emergencies occur. The ability of a community to deal with shortages or surplus is a part of the development of a sustainable water supply. Resiliency is the ability of a community to adjust and adapt in adverse conditions. Developing water supply resiliency includes an educated public and the ability to draw on numerous sources in the event of an emergency event such as a drought.

The future development of the water system will be influenced by many external factors such as Climate Change and global financial markets. Internal factors include development, land use and policies within the control of the District of Summerland. The concepts and objectives presented within the report should help to align Summerland with the basin-wide initiatives that are underway. Climate change and the impacts on water supply are presented in Section 5.3.

Water Availability Forecast Population growth estimates are predicted to be 2.00%, however the projects for the economic model were set out for a lower growth rate of 1.25%. The impacts of increased water demand over time, and decreased water availability as predicted by Climate Change scientists is illustrated on the following figure. The water demand and water availability for Summerland is presented from 1977 to 2080.

Projected Source Capacity vs Annual Water Demand



A detailed explanation of the above graph is provided in Section 5.6. The red diamonds show the predicted annual water availability from all sources in an extreme 1:100 year return period drought with the 15% and 30% reduced water availability as predicted in the Global Warming study for the Okanagan. The green line shows the predicted water use for Summerland including the allocated demands for lands that are taxed but not presently using water. The graph shows that there should be sufficient water for the foreseeable future.

Cost-Benefit Analyses Water source development projects were assessed on a cost per ML basis. These projects included leakage reduction, efficiency improvement projects and the development of additional raw water storage. The order of projects was developed based on necessity of the project, physical location, cost and the physical order in which the projects must progress.

Penticton Indian Band Water An allowance for water supply to the Penticton Indian Band lands in the Trout Creek watershed is included in Section 5.5. The assessment is made based on usable land area in the valleys on the band lands.

Project Priority List There are 36 projects considered to be viable at this time. An assessment of benefit to either new development or existing users is listed in the table. System separation projects are listed as development projects as separation of the distribution system frees up WTP to become available for new development. The WTP is presently at capacity. By allowing the DCC charge to be used for system separation, the developer would be paying for their share of WTP capacity.

Table 1 provides a listing of the water system projects recommended for the District of Summerland. The projects are in order of priority with an assessment of where funding should be obtained.

Project Priority List and Costs

Priority	#	PROJECT NAME	Current Users	DCC Project	TOTAL
H	**1**	JAMES LAKE PUMP STATION	$ 764,138	$ -	$ 764,138
H	**2**	WTP - SLUDGE HANDLING SYSTEM	$ 822,250	$ -	$ 822,250
H	**3**	DOMESTIC METERING PROGRAM	$ 674,800	$ -	$ 674,800
H	**4**	AGRICULTURAL METERING PROGRAM	$ 291,077	$ -	$ 291,077
H	**5**	SYSTEM SEPARATION - PRAIRIE VALLEY (WEST)	$ -	$ 557,190	$ 557,190
H	**6**	SYSTEM SEPARATION - PRAIRIE VALLEY (EAST)	$ -	$ 596,907	$ 596,907
H	**7**	THIRSK OUTLET MODIFICATIONS	$ -	$ 183,425	$ 183,425
H	**8**	ELECTRICAL AND INSTRUMENTATION UPGRADES	$ 792,902	$ -	$ 792,902
H	**9**	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ 3,131,508	$ 3,131,508
H	**10**	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ 2,121,721	$ 2,121,721
M	**11**	TROUT CREEK RESERVOIR SCREENING WORKS	$ 638,825	$ -	$ 638,825
M	**12**	SYSTEM SEPARATION - GARNET VALLEY	$ -	$ 2,126,541	$ 2,126,541
M	**13**	SYSTEM SEPARATION - JONES FLATS (WEST) & CARTWRIG	$ -	$ 836,798	$ 836,798
M	**14**	RESERVOIR SPILLWAY WEIR MONITORS	$ 15,813	$ -	$ 15,813
M	**15**	CHLORINE RESIDUAL MONITORS	$ 18,975	$ -	$ 18,975
M	**16**	PUMP STATION 2B - SOLENOID VALVE	$ 44,275	$ -	$ 44,275
M	**17**	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ -	$ 1,204,944	$ 1,204,944
M	**18**	SYSTEM SEPARATION - FRONT BENCH ROAD	$ -	$ 796,444	$ 796,444
M	**19**	SYSTEM SEPARATION - HAPPY VALLEY	$ -	$ 1,033,632	$ 1,033,632
M	**20**	SYSTEM SEPARATION - HESPLER ROAD	$ -	$ 156,354	$ 156,354
M	**21**	TROUT CREEK INTAKE MONITORING & CONTROLS	$ 139,229	$ 46,410	$ 185,639
M	**22**	GARNET RES. INTAKE MONITORING AND CONTROLS	$ 50,600	$ -	$ 50,600
M	**23a**	ADDITIONAL GROUNDWATER CAPACITY	$ -	$ 347,875	$ 347,875
M	**23b**	CONNECT TW 3 AND 5	$ -	$ 543,824	$ 543,824
M	**24**	TROUT CREEK DISTRIBUTION SYSTEM INTERCONNECT	$ 107,019	$ 107,019	$ 214,038
M	**25**	BULL CREEK HYDROMETRIC STATION	$ 9,488	$ -	$ 9,488
M	**26**	GARNET RESERVOIR - AERATION SYSTEM	$ 43,643	$ -	$ 43,643
L	**27**	SITE 2 RESERVOIR, 7600 ML	$ -	$ 10,727,100	$ 10,727,100
L	**28**	PITIN CREEK DIVERSION TO SITE 2	$ -	$ 1,310,129	$ 1,310,129
L	**29**	RESERVOIR TANK MIXING IMPROVEMENTS	$ 142,313	$ -	$ 142,313
L	**30**	HYDRANT INSTALLATIONS	$ 257,600	$ -	$ 257,600
L	**31**	BLOW-OFF PROGRAM	$ 86,250	$ -	$ 86,250
L	**32**	TROUT CREEK RESERVOIR EXPANSION	$ 3,055,608	$ -	$ 3,055,608
L	**33**	WTP - FLOWMETER AND PROGRAMMING	$ 12,650	$ -	$ 12,650
L	**34**	DISTRIBUTION STORAGE PROJECTS	$ -	$ 1,391,500	$ 1,391,500
L	**35**	SYSTEM SEPARATION - JONES FLATS (EAST)	$ -	$ 2,389,060	$ 2,389,060
L	**36**	PRV STATION UPGRADES	$ 295,193	$ -	$ 295,193
		TOTALS	**$ 8,262,644**	**$ 29,608,379**	**$ 37,871,023**

FINANCIAL PLAN

Existing Debt Two major projects have been recently completed by the District of Summerland: the raising of Thirsk Dam; and the completion of the Water Treatment Plant. The debt servicing for the two projects is substantial and limits the ability of the community to carry out all of the desired water system works. This plan is developed considering current toll rates and debt servicing requirements.

Development Cost Charges

Development Cost Charges are low in comparison with the cost to fund improvements. The DCCs should cover the cost to replace capacity for various water system components. The capacity replacement cost for an average single family residential unit is:

▪ Watershed Reservoir Storage	$ 990
▪ WTP Capacity	$ 1,728
▪ Distribution Storage (concrete reservoir)	$ 1,238
▪ Conveyance	$ 44
TOTAL DCC per SFE	**$ 4,000**

A ratio of the SFE charge is recommended for multi-family development and for other uses. It is recommended that lands applying for agricultural water be allowed to connect, but a reduced DCC charge should apply only for the *Watershed Reservoir Storage* component in the amount of 25% of the above numbers. An agricultural rate of $10,000/ha. ($4,046/acre) is recommended. Development cost charge rates throughout the Okanagan are provided in Appendix B. The rates are generally lower for those utilities that do not have a WTP, or those that draw from lake pumping systems and do not have reservoir storage.

Toll Rates Summerland's water rates, including parcel taxes and tolls, are among the higher rates in the Okanagan. Rates are provided for all of the larger Okanagan utilities in Appendix B. In order to accomplish all of the existing user requirements within a reasonable time frame, a $3.00/month increase for each of the next two years is proposed. The recommended amount is preliminary and the increase would have to ratified by staff and then council.

Economic Model An Economic Spreadsheet model was developed to provide a forecasting tool of revenues, expenditures, debt servicing and project implementation. This forecasting 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 more detailed explanation of the model is included as Appendix B.

Revenue Limitations Although the system separation projects are identified to be funded through new development, this may not be achievable in a reasonable time frame. Even if development rates were to double or triple, the revenue generated with the recommended DCC increases would be insufficient to separate out enough of the water system in a reasonable time frame. Subsidies from toll rates or government grants will be required to fund sufficient separation of the distribution system in a reasonable time frame.

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;
- **Thirsk Reservoir** Trigger graphs for the Water Use Plan were updated with the inclusion of additional storage at Thirsk Reservoir. The watershed analysis work confirms that the raising of Thirsk Dam substantially improves the reliability of supply for the District;
- **Okanagan Lake Expansion** In expanding the water supply consideration should be given to drawing water from Okanagan Lake as it provides substantial supply capacity and allows redundancy in the supply from Trout Creek. The Trout Creek area adjacent to Okanagan Lake was considered the most feasible location for a new lake source water supply;
- **Water Quality Options** Two methods are available to provide all of Summerland with high quality drinking water, either expand the WTP or separate the irrigation from the WTP fed distribution system. The WTP capacity is limited to 75 ML/day which is insufficient to treat the entire MDD for Summerland. The WTP will be tested for flows greater than 75 ML/day in the late spring of 2009 by the supplier, John Meunier. System separation must make up the shortfall in capacity;
- **Long Term Water Demand** Water demand is expected to grow within the next 20 years at a rate slightly lower than that of new development. The District of Summerland OCP has predicted an average growth rate of 2.00% for the District for the upcoming years. Long term trending leads us to believe there will be adequate raw water available for the District for the foreseeable future;
- **Projects** A total of forty-nine (49) projects are listed within the 2008 Water Master Plan. Thirty six (36) of these projects are considered to be valid and worthwhile at this time. Projects that should be reconsidered some time in the future are included as Projects No. 37 to 49;
- **WTP Sludge Handling System** Sludge withdrawal, handling, drying and disposal is required for the WTP. A preliminary budget number is allowed for within this report. Details will be forthcoming from Earth Tech Canada on options available to Summerland;
- **Grant Funding** Funding in the amount $3,199,056 was recently received and the monies are slated to fund domestic water meters and the first two phases of system separation. This project agrees with the allocation of these funds towards the two slated projects and this is reflected within the project cost sheets;
- **Recommended DCC Rate Increase** The DCC rate for water is much lower than levels elsewhere in the Okanagan Valley. It is recommended that development cover their share of costs so that the infrastructure does not erode over time. The cost must cover a fair share of watershed reservoir storage, a portion of water treatment costs, conveyance and balancing storage. The rate for a single family unit works out to a DCC charge of approximately $4,000 per SF equivalent housing unit;
- **Recommended Toll Rate Increase** A rate increase of $3.00 per month (per single family equivalent unit) for each of the next two years is recommended. After that time, water rates must increase at a 2.75% rate which is equal to the historic construction inflation rate, otherwise the ability for Summerland to implement upgrading and improvement projects for the long term benefit of the ratepayers will become limited.

CONCLUSIONS AND RECOMMENDATIONS

This section provides a summary of the major conclusions and recommendations of the 2008 Water Master Plan and Financial Review. Each conclusion and recommendation references the location in the Water Master Plan document where additional information may be located. Major conclusions generated during the development of this plan are as follows:

C-1 The strategic water supply principles of this report, developed by the Okanagan Water Stewardship Council, are recommended for management of water resources throughout the Okanagan. These principles provide a foundation for morally responsible and technically sound decision-making on water supply issues; (refer to Section 1.2)

C-2 Criteria used within the plan are set out in Table 2.1. The criteria are consistent with good engineering practices in the Okanagan Valley. Where criterion deviates from the existing Subdivision Servicing Bylaw is noted. Reduced allowances of water to new development both on a per capita basis and on a per development unit basis should be considered in the bylaw update (refer to Section 2.3 & 2.4);

C-3 Water allocation per irrigated area was reviewed and discussed with the Ministry of Agriculture and Lands staff. The MoAL have created an *Agricultural Water Demand Model* to assess water use for agriculture in the Okanagan. It is estimated that the average annual application depth for agriculture for the arable lands in Summerland is currently 690mm. An annual average annual allocation depth of 800mm is utilized in this report to ensure there is sufficient water for the years with higher moisture deficit (refer to Section 2.4);

C-4 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. Continued investment in water supply system is necessary to protect the community in times drought, fire or other emergencies and to maintain a high quality of life (refer to Section 3.2);

C-5 Summerland holds 25 licenses for storage, waterworks local authority, and irrigation on Eneas Creek, Trout Creek, and Okanagan Lake. The total annual allotments are 20,926 ML for Irrigation, 7,491 ML for WWLA, and 18,883 ML for storage. These licensed volumes should be adequate for the foreseeable future (refer to Section 3.3);

C-6 A summary of the watershed storage reservoirs owned and operated by Summerland is presented in Section 3.4. Details for each reservoir include storage volume, surface area, watershed catchment area, reliability to fill and other relevant data;

C-7 Trout Creek Balancing Reservoir, located at the top of Prairie Valley, is of concern as the reservoir has leakage in the amount of 4.0 ML/day as measured by District staff during the winter season. This amount works out to a total volume of 1,460 ML/year. This leakage charges the groundwater aquifer to supply lower areas in town. If this flow is reduced it may have a negative impact on the water supply for the Summerland Fish Hatchery (refer to Section 3.4);

C-8 A second off-stream balancing reservoir site is possible immediately to the west of Trout Creek Reservoir. The reservoir would provide additional off-stream balancing storage, protection from landfill leachate, and the ability to clean out the existing Trout Creek Reservoir. Costs can be offset for this project over time through gravel extraction (refer to Section 3.4);

C-9 Two important tools were used in the review and analysis of the Summerland water supply system. An EPANET *Water Distribution Computer Model* was developed by Agua Consulting Inc. for the analysis of the water distribution system. A *Watershed Reservoir Model* was developed by Water Management Consultants as part of the Water Use Plan and was updated and used to analyze watershed reliability. These two models should continue to be used on issues related to the water distribution system or the watershed (refer to Sections 3.4 & 3.11);

C-10 The watershed analysis confirmed that the recent Reservoir Drawdown Operating Procedures for Summerland set out in the 2004 Water Use Plan and repeated in this report are still valid (refer to Section 3.4);

C-11 The current annual reliable watershed yield is estimated to be in the range of 83,000 ML at the Summerland intake on Trout Creek. Of this annual average volume, a volume of 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 is available to Summerland in the amount of the current water licenses (refer to Section 3.5);

C-12 A frequency analysis was conducted and is summarized in Section 3.5 of this report. The frequency analysis shows that 10,600 ML of water should be available to Summerland in the event of a 1:100 year drought. At the same time, based on utilizing the trigger graph and operating scenario in the Water Use Plan, only 8,100 ML of water should be required from storage (refer to Section 3.5);

C-13 Trigger graphs from the Water Use Plan were updated with the inclusion of additional storage at Thirsk Reservoir. Updated graphs are included in Section 3.6 and Appendix F. The work confirms that the raising of Thirsk substantially improves the reliability of supply for Summerland (refer to Section 3.6);

C-14 Expansion of the water system should consider development of an Okanagan Lake water supply as it provides substantial supply capacity, should reduce system separation requirements, and allows redundancy in the supply from Trout Creek. Trout Creek is considered the most feasible area for a lake intake as larger capacity mains already exist to service this pressure zone and there is a substantial land area at low elevation where minimal pumping of water would be required. Sites to consider for the lake intake are Powell Beach and Wharf Street (refer to Section 3.7);

C-15 Groundwater is available to the District from Test Well 3 and 5. The total amount of water is 5.82 ML/day. Pumping this water directly into the irrigation system would reduce the treated water demand. System separation must first occur in west Prairie Valley for this to be viable (refer to Section 3.8);

C-16 A total of fifty (50) projects are listed within the 2008 Water Master Plan. Thirty six (36) of these projects are considered to be valid and worthwhile at this time. Projects that should be reconsidered some time in the future are included as Projects No. 37 to 49 (refer to Section 3.8);

C-17 The population growth rate for Summerland since 1921 has been 2.07%. The OCP projects an expected growth rate of 2 percent. A 1.25% population growth rate was used within the economic model analyses as it provides a more conservative financial plan. If growth occurs at a faster rate, Summerland will be in a stronger financial position (refer to Section 3.9);

C-18 Summerland's total annual water demand has decreased in recent years for numerous reasons including less agricultural production, transition to crop types with less intensive water requirements, public awareness and education, and more efficient irrigation practices (refer to Section 3.10) ;

C-19 Annual water use estimates for the various user groups in Summerland are listed on Table 3.10 of this report (refer to Section 3.11);

C-20 The total normalized (average) annual domestic system demand including ICI connections is estimated to be 2,900 ML (refer to Section 3.11);

C-21 Total normalized annual irrigation demand is estimated to be 8,650 ML (refer to Section 3.11);

C-22 Based on winter midnight water flows, the total distribution system leakage for both the Summerland and Garnet systems is estimated to be 23.11 L/s or 729 ML per year. The District should consider a leak detection program that, as a minimum, considers inspection of the water infrastructure ahead of any surface works such as paving (refer to Section 3.12) ;

C-23 If the Trout Creek Reservoir is drawn down too low, the possibility exists of leachate contamination through groundwater seepage from the landfill. The question is whether to carry out remedial works now or to invest the monies into an alternative source such as Okanagan Lake. Keeping Trout Reservoir full is the best defence without constructing an impermeable barrier. A second lined reservoir is being considered immediately to the west of Trout Creek Reservoir in the long term. This reservoir would be constructed once gravel extraction operations are completed in this area (refer to Section 3.4, Project 32 in Appendix A)

C-24 Should there be a drawdown of Trout Reservoir, then the emergency plan should provide methods for flushing and removal of leachate contamination and alternative supply methods. This item belongs in the Summerland Emergency Response Plan (refer to Section 4.2);

C-25 Based on the last 14 years of raw water data, source water quality appears to have been stable in the watershed. Drinking water risks presented in the 2002 Earth Tech report in Appendix G are still present today within the watershed. The largest risks that exist are cattle, recreation, wildlife and nutrient level changes that can cause algae blooms. Monitoring of water quality in upper watershed storage reservoirs remains a critical task necessary in order to establish a baseline of data (refer to Section 4.5);

C-26 Trout Creek Reservoir appears to have some benefits as levels of coliforms and *E.Coli* leaving the reservoir are significantly lower than the raw water levels in Trout Creek (refer to Section 4.6);

C-27 Water treatment plant capacity is limited to 75 ML/day which is insufficient to treat the entire maximum day demand for Summerland. System separation is required to reduce treated water demands to less than 75 ML/day. The WTP will be tested for expanded capacity greater than 75 ML/day in the late spring of 2009 with the supplier, John Meunier (refer to Sections 4.10 & 4.11);

C-28 A recent climate change study specific to the Okanagan predicted a decrease in precipitation in the next 75 years. It has been predicted that the total water supply volume could be reduced by 15% by the year 2050 and 30% by the year 2080. Figure 5.4 provides an indication of the reliability of the Summerland water sources considering the impact of climate change and a 1:100 year drought. Summerland should have sufficient source water available for the foreseeable future but may eventually have to develop additional reservoir storage (refer to Section 5.6);

C-29 For the foreseeable future, water demand is expected to grow at a lesser rate than that of new development. This is based on the growth rate and water trends that have occurred in the last 30 years in the Okanagan Valley. The District of Summerland OCP has predicted a low growth rate of 2.00% for the District for the upcoming years (refer to Section 5.6);

C-30 Two methods are available to provide all of Summerland with high quality drinking water: either expand the WTP capacity; or separate out the water system into domestic and irrigation systems (refer to Section 5.7);

C-31 Based on a lifecycle analysis, system separation appears to be cost effective in the long term for irrigated parcels of land larger than 0.40 ha. (refer to Section 5.7);

C-32 Presently the District has sufficient watershed storage reservoir capacity, adequate water treatment capacity for domestic water, but insufficient dual distribution mains to be able to fully utilize the WTP to supply all domestic demands. To provide high quality water to all residents of Summerland requires additional system separation (refer to Section 5.7);

C-33 The plan shows that the largest upcoming projects will be system separation in the Prairie Valley area and construction of a pump station along Okanagan Lake in the Trout Creek area (refer to Section 5.8) ;

C-34 Current debt servicing of the Thirsk Reservoir expansion and the Water Treatment Plant limits the ability of Summerland to fund additional projects in the short term. Time will be required to generate funds and move forward on separation and lake source development (refer to Section 6.4);

C-35 The development cost charge (DCC) 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 6.6);

C-36 A charge for buying in new arable lands for irrigation has been set at 10,000 per ha. (refer to Section 6.6)

C-37 Based on the economic analysis, there is a valid and technically defendable argument to allow water DCC charges to pay for system separation as the DCC would be paying for their share of WTP capacity that is being freed up through system separation (refer to Section 6.6) ;

C-38 There is insufficient capital reserve funds and DCC revenue to fund system separation projects within a reasonable time frame. This will delay the ability for Summerland to provide high quality drinking water throughout the community. Even with raised DCC levels, the funds generated through DCC revenue will be low and revenue support may be required through tax and toll rates and/or Grant monies; (refer to Section 6.8)

C-39 The existing debt load and present water rates are at significant levels. Further increases in the water rates should be moderate. Rate increase of $3.00 per month in 2009 and again in 2010 is necessary to be able to fund the projects in a reasonable time frame as set out in Appendix B; (refer to Section 6.8)

C-40 Development revenues will be dependant on the pace at which development occurs in Summerland. A rate of 1.25%, which is lower than the 2.00% OCP rate, was utilized in the Economic Model so that conservative financial projections were made. (refer to Section 6.8)

RECOMMENDATIONS

The major recommendations of this Capital Plan Update are as follows:

R-1 The District of Summerland should consider adopting the water supply principles in Section 1.2 of this document (refer to Section 1.2);

R-2 An 800mm depth of water should be held by the District and allocated to the irrigable taxed lands within the District that are greater than 0.2 ha. in size. The annual volume of water allocated would be the depth (800mm) multiplied by the arable (taxed) land area (refer to Section 2.4);

R-3 The District of Summerland should update their Subdivision Servicing Bylaw. Part of this update would include reducing the maximum day water demand criteria per person from 3,000 to 2,400 L/ca/day (refer to Section 2.4);

R-4 Storage license adjustments are required for Thirsk Reservoir and for Headwaters Reservoirs to make the licensed volumes match the volumes in-place (refer to Section 3.2);

R-5 The WUP plan review identified several scenarios for Summerland for drought frequencies and resulting reservoir storage levels. It is recommended that development and additional irrigation areas be permitted and not be held up due to water source capacity concerns, providing they pay the appropriate DCC charges. Development charges are a critical source of revenue for many of the proposed projects (refer to Section 3.6);

R-6 When upgrading or renewing PRV 10, additional consideration should be given to determine if hydro-electric generation is economically viable. PRV 10 is the only station with significant flows within the District (refer to Section 3.11)

R-7 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 duration (refer to Section 3.11)

R-8 With respect to water conservation initiatives, water metering and the installation of remote read technology throughout Summerland are strongly recommended. The remote reads will allow monthly reporting of water consumption throughout the District. The addition of remote read technology to the new irrigation meters is recommended as providing the water use information to the customers in a timely manner is a critical part of a successful education program (refer to Section 3.12);

R-9 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 nominal budget per year so that these works are a normal part of on-going operations (refer to Section 3.14) ;

R-10 The WTP should be tested to the highest possible flow levels in 2009 with the assistance and direction of the supplier, John Meunier (refer to Section 4.10);

R-11 Sludge withdrawal, handling, drying and disposal are required for the WTP. A preliminary budget number is provided within this report to install a sludge removal system to convey thickened sludge to the landfill for drying. The sludge handling is a bottleneck in the current water treatment process (refer to Section 4.10);

R-12 Water quality testing is recommended twice per year for each of Summerland's reservoirs. This will provide a baseline of data for Summerland so that any future changes or external influences can be measured and confirmed (refer to Section 4.10 & 4.11);

R-13 With respect to the watershed, the District of Summerland should continue to lobby the Province to stop the sale of lease lots and put in more stringent controls to the occupancy of leases around the reservoirs. An application to the Crown should be considered for a 200m covenant around the reservoir foreshore to protect these water reservoirs in perpetuity (refer to Section 4.11);

R-14 The WTP has a capacity of 75 ML/day while the District water demands in the summer can reach 112 ML/day. The shortfall must be made up by either expanded WTP capacity or system separation and system separation is recommended. It is recommended that separation be funded through DCC contributions to free up WTP capacity. WTP expansion is more expensive on a unit cost basis than the system separation works (refer to Section 5.7);

R-15 Funding applications should be submitted to continue the system separation works. The economic benefits of separation are set out with the lifecycle analysis in Appendix E of this report (refer to Section 5.7);

R-16 There are 36 Capital Projects identified in this report that should be implemented generally in the order provided. Timing will be dependant upon when Summerland can afford the works. The projects are to be funded by user rates, DCCs, direct developer contributions, government grants, or a combination of these capital funding sources (refer to Section 5.8) ;

R-17 Grant funding in the amount $3,199,056 was recently received by Summerland. The monies are slated to fund domestic water meters and the first two phases of system separation in Prairie Valley. This report agrees with the project selection and expenditure of these funds for the projects selected (refer to Section 6.3);

R-18 Applications for funding should continue to be made for the continuation of the system separation works. The economic benefits of separation are set out with the lifecycle analysis in Appendix E (refer to Section 6.3).

R-19 The water DCC rate is much lower in Summerland than elsewhere in the Okanagan Valley. It is recommended that development be required to cover their share of costs so that infrastructure capacity does not erode over time. The recommended DCC rate works out to $4,000 per single family lot. If a lower rate is utilized, development is being subsidized by existing ratepayers (refer to Section 6.6);

R-20 A dry land rate and arable land development rate is proposed to allow irrigation to continue to buy into the water district at rates to cover upper watershed reservoir storage capacity. This rate works out to $10,000 per hectare (refer to Section 6.6);

R-21 The recommended financial plan is presented in Section 6.8. The economic model is presented for consideration in Appendix B. An increase in the water toll rate in the amount of $3.00 per month in 2009 and another $3.00 per month in 2010 is required to allow Summerland to complete the highest priority projects within a realistic time frame. Toll rate increases beyond the year 2010 should be at a minimum rate of 2.50% or equal to the historic construction inflation rate. Otherwise the ability for Summerland to implement upgrading and improvement projects will become limited (refer to Section 6.8);

R-22 Rate increases should be implemented across all user groups at generally the same percentage rate. This maintains the social balance within the District when considering the needs of various water user groups (refer to Section 6.8).

1. INTRODUCTION

1.1 GENERAL

The 2008 Water Master Plan provides a comprehensive working outline for the District of Summerland with respect to water supply issues, projects, financing requirements, toll rate adjustments, and setting of Development Cost Charge rates.

The intent of this document is to prioritize and plan the necessary improvements that will allow Summerland to manage its water resources effectively now and for the foreseeable future.

This plan forms the final product of the watershed and distribution system analysis works. The plan is based on our review of probable projects that Summerland will be facing in the near future, the cost of those projects, and the impact on existing water rates and Development Cost Charge rates (DCCs).

Thirsk Dam – Crest and Walkway

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 Okanagan Lake. Summerland is in the process of commissioning a new water treatment plant which will have the ability to provide 75 ML/day of drinking water that meets national guidelines and provincial regulations.

With the recent raising of Thirsk Dam, development pressures have increased within the District and expanded water supply will be required for the following development areas as set out in the Summerland Official Community Plan (OCP).

- Summerland Hills Development
- Cartwright Mountain (future growth area)
- Rattlesnake Mountain Development Permit area
- Summerland Vista area
- Victoria Road Development
- Jersey Lands Development
- Infilling and densification in the town core, Lower Town and Trout Creek areas with higher density development and residences.

This plan is to be used for the technical basis for an updated Development Cost Charge Bylaw and an updated Subdivision Servicing and Development Bylaw. It is suitable for submission to the Ministry of Community Services for review in support of the revised bylaws.

1.2 WATER SUPPLY – GUIDING PRINCIPLES

The District of Summerland must work to provide water of high quality and adequate quantity. Historically, the focus of the district has been to provide water of adequate quantity for agriculture. Recently, there has been a concerted effort by the Interior Health Authority to have all domestic water within the Okanagan treated to a higher standard. The supply of water has always considered both the quantity and quality aspects however the quality issues are presently what is driving the major expenditures.

There is presently an extensive amount of scientific analysis underway within the Okanagan Valley with respect to overall valley water supply. The key basin-wide works are the *Okanagan Water Supply and Demand Study* which is being administered through the Okanagan Basin Water Board, and the *Sustainable Water Strategy* which is being developed by the Okanagan Water Stewardship Council. The *Water Supply and Demand Study* is a technical review of the current state of water supply in the valley. The second report by the OWSC is a broader policy document designed to align and coordinate water management initiatives throughout the Okanagan Basin.

Twelve guiding principles of the draft Okanagan Water Stewardship Council *Sustainable Water Strategy* are stated below. By aligning the District of Summerland direction with these broad principles, the District will be able to better integrate their specific initiatives with those of the larger Okanagan Basin.

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 Aboriginal people, and aesthetic values.

Principle 2: Control Pollution at its Source:
Water 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 to ensure clean 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. Land use decisions will work to minimize the impact of urbanization and reduce the human footprint on the environment, which will in-turn reduce impacts on water resources.

Principle 5: Clearly Allocate Water Within the Okanagan Water Budget:
Identifying how and when water will be allocated is critically important to prepare for the possibility of increasing drought cycles in the Okanagan. Sufficient water must be available for the environment, agriculture, basic human needs, and economic development now and in the future.

Principle 6: 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 7: Ensure Water Supplies are Flexible and Resilient:
Even with improved conservation and efficiencies, water storage capacity will need to be increased in some sub-basins in the Okanagan to meet the joint challenges of population growth and climate change.

Principle 8: Think and Act Like a Region:
The challenges facing water sustainability in the Okanagan Basin must be addressed on both local and regional scales. Decisions must consider watershed and aquifer interconnections with the larger Basin. Cooperation and collaboration among communities supports the greater public good.

Principle 9: Collect and Disseminate Scientific Information:
The best available technology and science must be used to inform water management decision making. Information will be managed in an integrated manner that is readily available to stakeholders basin-wide.

Principle 10: Provide Sufficient Resources for Local Water Management Initiatives:
Opportunities to make better use of supplies of water that we have already developed, to employ new technology and infrastructure, to improve and refine management practices, and to draw on better information, must be supported by sufficient financial resources.

Principle 11: Encourage Active Community Engagement, Education and Participation 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 will be provided with meaningful opportunities to consult, advise, and participate directly in activities that support sustainable water management.

Principle 12: Practice Adaptive Management:
Continuous learning, innovation, and improvement are essential to effective and efficient implementation of a Sustainable Water Strategy. The ability for decision makers and the public to change their water use habits based on available water is part of adaptive management.

It is recommended that the District of Summerland consider these principles developed within the *Sustainable Water Strategy* and utilize them as the foundation for making decisions related to their water supply. The water available to Summerland is part of the larger hydrological cycle in the Okanagan basin. Decisions made by Summerland impact on downstream users in the basin and should not be considered in isolation, but rather in the context of the entire basin. Responsible practices and policies by the District will lead to confidence by external higher authority regulators that the District is in full compliance and is operating in a proactive manner. Having principles in-line with larger valley wide principles will assist the District to this end.

1.3 WATER SUPPLY ISSUES

In the preparation of this proposal, the following steps were taken to clearly understand the requirements of the project:

- A thorough review of the Terms of Reference was conducted;
- Our project team members met with District staff and attended the consultant's meeting to ask questions and understand the District's needs;
- The earlier Summerland projects prepared by our project team were reviewed with respect to information related to this project;
- Financial data from the 2006 District of Summerland Annual Report was reviewed to understand the current financial capacity of the water utility;
- Previously completed Capital Plans, Engineering Studies, Planning Documents and Financial Documents were reviewed to determine if there were areas of investigation that would be useful to the District water utility.

General Issues

The outcome of the research into the District water utility provided us with areas of what we consider to be risks and/or challenges for the District water utility for the future:

- ☐ Provision of sufficient water through the existing infrastructure so that the District is not obligated to go onto a Water Quality Advisory or Boil Water Notice due to the IHA notification requirements. With the expenditure made for the water treatment plant, any shortcomings in supply will be problematic for the community;
- ☐ The ability to meet the 43210 IHA water treatment protocol;
- ☐ Protection for the watersheds, including Okanagan Lake, management of cattle and agriculture, the stopping the sale of leased lots on the reservoir-lakes, and monitoring septic tank effluent impacts in Falder area;
- ☐ Drought management plans in the event of an extended duration, valley-wide drought;
- ☐ Contamination / vandalism of the source water and or facilities;
- ☐ The value of water and the competitive aspects facing water utilities by the home treatment and bottled water services;
- ☐ Developing a truer sustainability model for the community based on increased agriculture and securing of water for growing food. This point seems to be missed in most of the recent sustainability forums and water management strategies that have been discussed;
- ☐ Setting aside sufficient monies for system renewal;
- ☐ Integrations of water system improvements with the other municipal services provided by the District such as sewer upgrading, road repair and replacement works.

These challenges must be dealt with by approaching them with knowledge and understanding of the mechanisms that are currently in place which are affecting the water-use habits of the ratepayers. These mechanisms and a future forecast for water supply for the valley are presented in Section 5 of this report. The mechanisms include such items as densification of housing forms; reduced agriculture in the region, metering and the price and value of water, long term sustainability, and full cost accounting.

1.4 2008 WATER MASTER PLAN – SPECIFIC TASKS

Based on our discussions with the District and a review of the RFP, the following is a list of tasks to be carried out for the required work.

Physical Water System

1. Confirm the comprehensive list of objectives for the Master Water Plan as stated in the RFP;
2. Identify project constraints, milestones, tasks, delivery dates and budgets;
3. Develop a work plan and schedule for stakeholder consultation and meetings, as well as District review and approval;
4. Review and provide options to upgrade existing infrastructure to meet the IHA "43210" water quality requirements;
5. Produce and evaluate a water system model which will be able to integrate with the District of Summerland's WaterCAD water distribution software and GIS formats;
6. Summarize existing water licenses in terms of type (storage, waterworks local authority or irrigation), annual volume, and date of priority. Where possible, points of diversion from the water source will be provided on the watershed map. Existing licenses will be compiled in PDF format in a binder for the District c/w mapping;
7. Compare and tabulate water allocation commitments to water supply availability;
8. Assess reliability of the watershed and determine which watershed areas and storage reservoirs are more at-risk to the impacts of drought;
9. Recommend options for reducing impact on the water system of supply and demand variability;
10. Set out technical data for extension and compilation into a future drought management plan;
11. Quantify and identify timing for existing water demands based on best available data;
12. Quantify future water demands and timing based on the District OCP;
13. Compare existing and future demands in relation to existing licensing and recommend options for transferring, securing or increasing licenses as necessary;
14. Identify existing and long-term water supply, storage and distribution requirements;
15. Identify options and provide a cost-benefit analysis for reducing water supply and storage requirements through water conservation initiatives;
16. Review irrigation and domestic water separation options and potential staging and priorities;
17. Summarize water system interconnection options and provide recommendations;
18. Integrate the information from the 2002 Risk Assessment (including source, supply and demand) on existing and potential additional water sources into the Master Plan. Updating of risk assessment is listed as an optional task;
19. Review DFO requirements for flow and timing of releases and identify impacts on the water system. The Trout Creek Water Use Plan is a key document in this assessment;
20. Review the direction and commitments for water quality and quantity improvements;

21. Review the current municipal Design Criteria for completeness and accuracy and recommend changes where necessary;
22. Review distribution system with respect to storage and balancing capacity and summarize;
23. Review distribution system pump stations for capacity and redundancy and summarize;
24. Provide preliminary design options including existing and proposed routing, infrastructure and facilities; and
25. Provide the following mapping within the plan: Watershed maps (including sub-basins in the Trout Creek watershed), aquifer maps, existing water service Pressure Zones, Key Infrastructure, Hydrant Coverage, and Future Growth Areas.

Financial Tasks

26. Provide capital project costs estimates (20 year horizon);
27. Set out cost estimates with apportionment of who benefits and who pays, including existing users, renewal, DCC eligible or totally paid for by new development;
28. Identify funding sources, potential grant monies and funding agencies;
29. Provide a priority list for recommended projects based on costs, benefits, detriments and financial details; and
30. Prepare a dynamic financial spreadsheet which takes into account various horizons, component lifespan, various analysis periods and amortization rates, rate of return on reserve fund monies, depreciation, construction inflation (for project cost escalations), cost of living inflation (for water rate increases), growth rates and water demand rates. Tax and toll levels as well as DCC levels are to be integral components of the financial model.
31. The information compiled within this report is expected to be used as the starting point for the assembly of an asset management program of the water system components.

The above tasks were reviewed and approved by District staff and have subsequently been carried out.

1.5 UNITS / CONVERSIONS / TERMINOLOGY

Units used within this report are primarily metric. Volumes provided are in mega litres (ML) as the major valley-wide studies underway and trend provincially is towards utilizing mega litres as the primary volume unit. Areas are in hectares or square kilometres for the largest areas, and flow rates are provided in ML/day or L/s.

A Conversion Table is provided on the back inside cover of this report to convert units to Imperial.

Terminology and spelling of facility names is consistent with Provincial designations.

1.6 ABBREVIATIONS / DEFINITIONS

The abbreviations used in this report are listed on the inside of the front cover for easy reference. Table 1.1 presents definitions of key terms used within this report.

Table 1.1 Definitions of Key Terms

Key Terms	Definition
algal bloom (AL-gull)	Sudden, massive growths of micro- scopic and macroscopic plant life, such as green or blue- green algae, which develop in lakes and reservoirs.
Anaerobic	A condition in which "free" (atmospheric) or dissolved oxygen is NOT present in water.
Aquifer	Ground formation containing enough saturated permeable materials to produce significant amounts of water to wells and/or springs
Average Daily Demand (ADD)	Annual water demand from all sources averaged to a single day (used, for example, to determine water licensing requirements).
Base Demand	For this report it is defined as the indoor domestic demand component plus leakage.
Development Cost Charge (DCC)	Charge applied to new development that increases the capacity of the water sources and the ability to convey the water to the larger new development service areas.
Diurnal Pattern	Pattern describing the variance in water-use over an entire day.
EPANET	Computer model program used in the analysis of the water distribution systems developed and available from the USEPA.
Extended Period Simulation (EPS)	Refers to a computer model simulation that recreates the characteristics of the water distribution system over a period of time.
Eutrophic	Reservoirs / lakes which are rich in nutrients and very productive in terms of aquatic animal and plant life
Irrigation Demand	Consists of seasonal demands for irrigation or other strictly outdoor uses such as sports fields and parks.
Lifecycle Cost	Is the sum of the capital cost and the operational costs for a given time frame in present year dollars.
Maximum Day Demand (MDD)	Water demand for the highest typical day water use.
Mesotrophic	Reservoirs and lakes which contain moderate quantities of nutrients and are moderately productive in terms of aquatic animal and plant life.
Normalized Demand	Is the annual average water demand for a year of average precipitation and average temperatures. Normalization also considers the annual water trend that changes due to implementation of meters and pricing controls or from extensive development
Oligotrophic	Reservoirs / lakes which are nutrient poor and contain little aquatic plant or animal life.
Peak Hour Demand (PHD)	Water demand for the highest typical hourly water use recorded.
Reservoir-Lakes	Bodies of water where snowmelt runoff is stored behind a dam structure during the spring runoff and then released by the utility over the summer to supply the water demand needs of the community. The water level is controlled by a licensee.
Seiches	Wind driven lake current that is capable of driving warm surface water to depth
Water Age	Length of time that water is within the distribution system measured from point where chlorination is introduced.

1.7 ACKNOWLEDGEMENTS

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2. CRITERIA

2.1 Introduction

This section provides the criteria used for this report. The criteria include:

- Requirements to meet Provincial Regulations;
- Water demand criteria utilized;
- Hydraulic criteria for the water distribution system;
- Land use and population growth criteria; and
- Financial and cost estimating criteria.

2.2 Regulations

Under the previous Provincial water supply legislation, BC Regulation No. 230/92, each water supplier was required to disinfect all of their potable drinking water, with microbiological standards of 0 fecal coliform and 0 total coliform in a 100 ml sample.

Currently, for the delivery of safe water, the District of Summerland is obligated to meet these criteria as well as meet the new Drinking Water Protection Regulation, BC Reg. 200/2003. This new regulation, deposited May 16th, 2003 sets out the standards for water supply by public and private utilities in their supply of water to the residents of BC. The regulation 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 Drinking Water Officer's authority is delegated by the Province to the local health authorities and this responsibility lies with the Chief Medical Health Officer.

Requirements of the Drinking Water Protection Regulation include the following items:

- Operating Permits for all utilities with specific requirements for each;
- Qualification standards for personnel operating water systems;
- Emergency Response and Contingency Plans for utilities;
- Water Quality Monitoring requirements;
- Water Source and System Assessments, and;
- Drinking Water Protection Plans.

2.3 WATER QUALITY CRITERIA

The Trout Creek raw water supply does not currently meet water quality criteria standards for disinfection/inactivation of *Cryptosporidium*, trihalomethanes levels in the disinfected water, turbidity for much of the year, and occasionally colour. The new water treatment plant should correct these issues for flows up to 75 ML/day. The plan is to have all domestic water provided by the District of Summerland meet the IHA requirements at all times.

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:

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;

0 *Fecal Coliforms* in the distribution system.

From the Garnet Reservoir source, the levels of *Giardia* and *Cryptosporidium* occurrence are expected to be low however there is limited protection against *Cryptosporidium*. This plan provides projects that will address these protozoa.

For the development of additional water supply from Okanagan Lake, the Public Health Engineers have stated 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. This 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. This criteria is summarized in Table 2.1. For the analysis of future development areas, the recommended revised bylaw criteria set out below was utilized.

Condition	Bylaw	Recommended Bylaw Revision
Average Day Demand (ADD)	1,000 L/ca/day	900 L/ca/day
Maximum Day Demand (MDD)	3,000 L/ca/day	2,400 L/ca/day
Peak Hour Demand (PHD)	5,000 L/ca/day	1.5 x MDD flow rate

It is expected that the per capita (per person) water demand number will continue to be reduced in future years due to the increased cost for water, reduced availability, less water application to land, and increased inherent value of water. This trend is already occurring throughout the Okanagan Valley. Water distribution system existing design parameters and proposed revisions are presented in Table 2.1.

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 Central Okanagan has used an allocation of 675mm of annual water depth per area for several years with good success. Summerland is drier than the Central Okanagan and with an estimated normalized water demand of 8,649 ML for irrigation, the actual depth is in the range of 683mm for the land area. An allocated annual depth of 800 mm should be considered for the service area.

Table 2.1 Design Parameters

Criteria	Existing Condition (analysis of ex. areas)	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 CAPITAL PLAN DESIGN CRITERIA

Design criteria used within this report is generally consistent with the District's Subdivision Bylaw No. 99-004 and amendments, and good engineering practises. There are minor exceptions as noted in Table 2.1. Design criteria used in the estimation of long term water demand within this report is summarized in Table 2.1.

2.6 GROWTH PROJECTION CRITERIA

In planning for adequate future water supply, a 20 year horizon was used. Timeframes beyond 20 years were also reviewed for critical infrastructure components that would be in service for a longer period of time, i.e. transmission mains.

The District of Summerland Official Community Plan is the directional planning document that was followed in identifying future housing and development areas. From 1921 to the present, the growth rate in Summerland has been 2.07%. For financial forecasting, a lower rate was used and the reasons are explained within the report. The recent OCP forecasts a lower growth rate of 0.75% for Summerland.

2.7 FINANCIAL CRITERIA

Cost estimates are prepared in year 2008 dollars. The cost estimates include an engineering allowance of 10% on the estimated capital cost, and a contingency allowance of 15% 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.

TOTAL COST = (Estimated Capital Construction Cost + 10% engineering allowance) + 15% contingency allowance.

It is noted that costs have escalated substantially in the Okanagan Valley in the last five years. 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. Unsettled world energy markets will likely drive interest rates and the rate of inflation upwards. Criteria for detailed financial analyses are as follows:

- Long term Analysis period — 50 years
- Amortization rate — 6.00 %
- Return of Investment — 3.00 %
- Inflation rate (CPI) — 2.50 %
- 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 provide good guidance on issues for a 20 year horizon.

Table 2.2 Estimated Construction Cost Indices (CCI)

Year	CPI	Calc. %	CPI	CCI Est. %	CCI
1990	92.4		1.000		**1.000**
1991	97.4	5.13%	1.027	2.50%	**1.025**
1992	100	2.60%	1.082	2.50%	**1.051**
1993	103.5	3.38%	1.120	2.50%	**1.077**
1994	105.5	1.90%	1.142	2.50%	**1.104**
1995	107.9	2.22%	1.168	2.50%	**1.131**
1996	108.9	0.92%	1.179	2.50%	**1.160**
1997	109.7	0.73%	1.187	2.50%	**1.189**
1998	110	0.27%	1.190	2.50%	**1.218**
1999	111.2	1.08%	1.203	2.50%	**1.249**
2000	113.3	1.85%	1.226	2.50%	**1.280**
2001	115.2	1.65%	1.247	2.50%	**1.312**
2002	*117.5*	*2.00%*	1.272	3.00%	**1.351**
2003	*119.9*	*2.00%*	1.297	5.00%	**1.419**
2004	*122.3*	*2.00%*	1.323	12.00%	**1.589**
2005	*124.7*	*2.00%*	1.350	12.00%	**1.780**
2006	*127.2*	*2.00%*	1.377	8.00%	**1.922**
2007	*129.7*	*2.00%*	1.404	3.00%	**1.980**
2008	*132.3*	*2.00%*	1.432	3.00%	**2.039**

Figure 2.1 Okanagan Construction Cost Indices

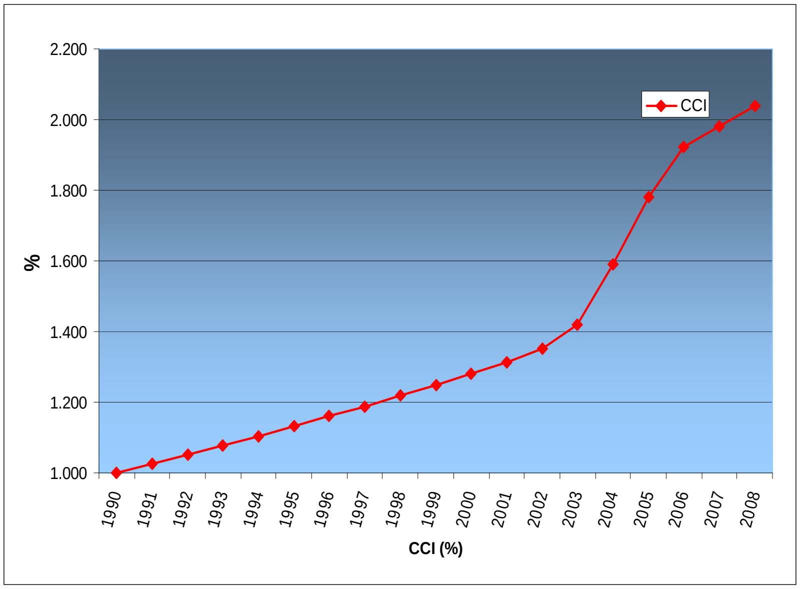


Table 2.2 summarizes the best available data that we have for construction prices in the Okanagan. The consumer price index and the construction cost indices (CCI) are listed in the table. The CCI is illustrated in Figure 2.1.

3. EXISTING WATER SUPPLY

3.1 INTRODUCTION

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

3.2 WATER SUPPLY HISTORY

Following is a condensed history of water supply in the Summerland region. Summerland holds some of the oldest water licenses in the Okanagan Valley. The evolution of Summerland is closely tied to the water system. We can expect that the future evolution of the community will also be tied to the water system. At the request of Council, the study team assembled a brief history of events that influenced the formation of the water system. in order to gain a better appreciation of how the community water supply system developed.

A historical account of the development of Summerland is available on the District website at www.summerland.ca . Key events in the evolution of the water supply for the community are provided in this section.

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

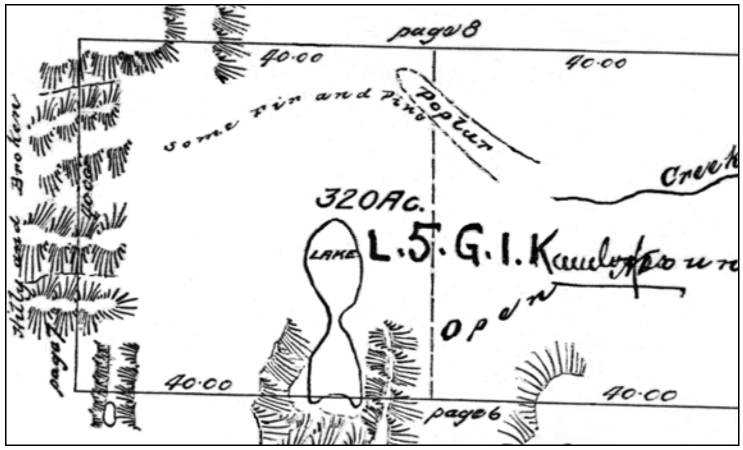
In **1887** the first commercial orchard, which was apple trees, was planted by James Gartrell and family. The first legal water rights were issued to Gartrell and Wood who were allowed to withdraw 300 acre-inches per year from lower Trout Creek (25 acre-feet). Early licensing was issued in acre-inches 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 3320 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 who 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. The project was substantial in comparison with any other projects in the region.



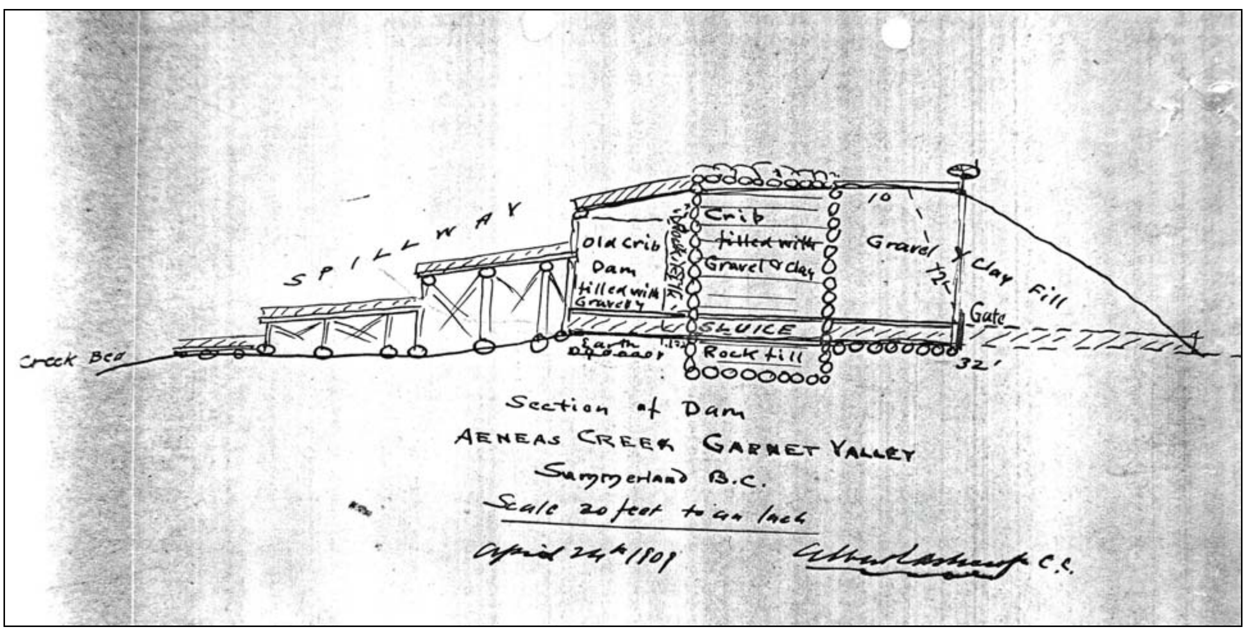
1889 Plan- Barclay Lake, now the Trout Creek Reservoir Site
Poplur Creek was originally referred to as Keremeous (Split) Creek

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.

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.

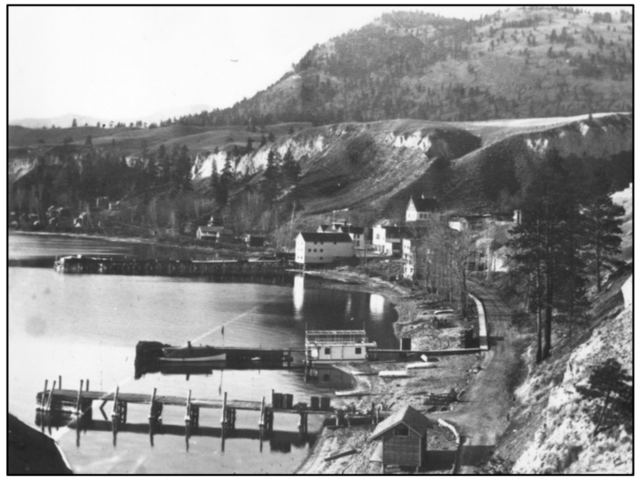
1906 - James Ritchie formed the Garnet Valley Land Company taking over most of the water licenses on Eneas Creek. A flume system was constructed to convey water from Garnet Dam to the lower valley to new subdivided lots. West Summerland town centre is formed on the upper flats at the north base of Giants Head Mountain.



James Ritchie Dam – Circa **1909**

1910 - The newly formed Municipality of Summerland took 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.

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 Farm was set up to help the orchard industry.

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 Improvement District (TCWID) was formed to service this area. A concrete dam existed at the mouth of the Trout Creek canyon and this diversion dam served the needs of Trout Creek.

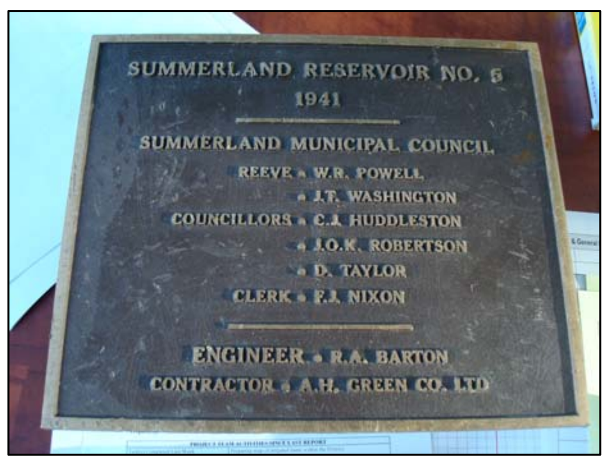
1924 - System demands increased with the demands from the Trout Creek, the Dominion Experimental Farm and the Municipality. Crescent Lake storage dam was completed.

Late **1920s** – early **1930s** – Drought and lack of water resulted in the loss of many orchards. Disputes occurred between the orchardists and utility.

In **1933**, the TCWID became the Trout Creek Irrigation District (TCID).

1940 – The lack of storage was noted and the Garnet Valley dam was reconstructed and raised.

1941 – The new Thirsk Dam (Summerland Reservoir No. 5) is located and constructed on Trout Creek 35 km upstream of the Trout Creek intake.



Late **1940's** – 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.

1948 – A chlorination system was installed by the Municipality for the domestic customers.

1950's - Highway 97 was re-routed above to the West benchlands.

1964 - Town Centre was moved to "West" Summerland and the "West" term was dropped.

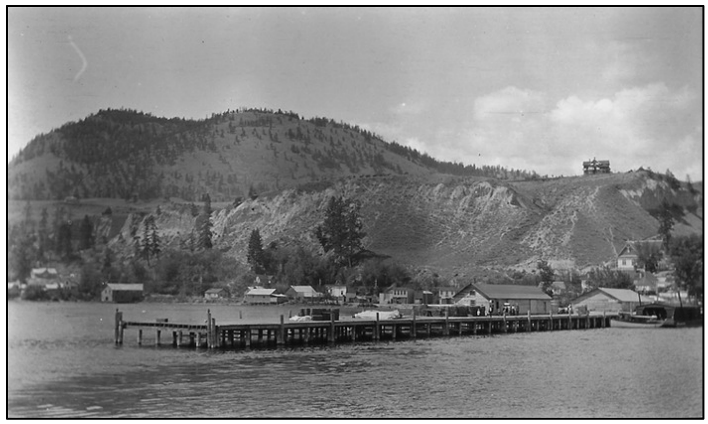
1968-69 - The water pump station and lake intake near the cannery in Lower Town were rebuilt to provide domestic water to the Lower Town area.

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 85 km of new watermain is installed throughout Summerland.

1976-77 – Garnet Reservoir was reconstructed approximately 100m downstream of the old 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 – A water treatment funding grant was received by the District of Summerland. Flow issues concerns within Trout Creek arose and a conflict occurs between the Department of Fisheries and Oceans and the District. Two emergency water wells are installed above Trout Creek Intake Reservoir on the Rodeo Grounds. Emergency water supply options are also investigated at that time.

2004 – Water Use Plan process was conducted by the town. It is the first water suppliers in the Province to do so. It is successfully administered by D. Sellars of Water Management Consultants.

2005 – The agricultural metering program begins. Summerland receives grant monies for the supply of agriculture meters. All larger parcels are to be metered within this program.

2005 - Reconstruction of Thirsk Dam began. The work was completed in 2007.

2006 - District 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.

2007 – WTP construction began. Construction was completed in the spring of 2008.

Historical Considerations and Future Direction

The previous history shows that the community is founded on agriculture with strong ties to their water supply. Inevitably society has changed and there is less economic value in local agriculture and globalization has brought in cheap 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 2002 and 2003 when there were issues related to the drought cycle and conflicting issues with the Provincial and Federal fisheries staff.

Within Summerland, the issues of water for agriculture, water quality, and differing needs of different user groups will 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 throughout the valley. 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 managed 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;*
- *Domestic water use should be minimized unless it is for beneficial uses such as growing food or public health benefits. Domestic users should respect the fact that the piped system was installed primarily for irrigation and that the urbanization of many areas accessed the pressurized irrigation pipes;*
- *Agricultural water use should continue to be as efficient as practical and accept that the domestic users provides a greater 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 truer goal for water sustainability would be to improve water use efficiencies to maximize its beneficial use. The largest beneficial use of water should be for drinking water and for growing food. The current practices to transport drinking water and food by vehicle to a community should be minimized.

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.

3.3 WATER LICENSING

The water for Summerland is obtained 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". The licenses issued to water suppliers are in one of three forms:

- **Storage:** 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 issued in the form of acre-feet (AF). It is a water volume equivalent to a one foot depth of water over an acre of land (1.0 AF= 1.233 ML);
- **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 issued in the form of Imperial Gallons per year (GY);
- **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 acre-feet (AF) per year. The irrigation license is typically assigned to a water supplier with a defined service area. The depth of irrigation can be assigned to a specific land area with usually 2.5 feet 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 of the licenses currently held by the District of Summerland. For the reasons of simplicity, all of the licenses in Table 3.1 have been converted to megaliters per year (ML/yr) which is equivalent to 1,000,000 litres per 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

Lic. No	Stream Name	Purpose	Quantity	Units	Storage	WWLA	Irrig.	Status	Priority	Issued
C014568	Trout Creek (Thirsk Reservoir)	Storage	2630	AF	3243			Current	19400626	0
C014569	Trout Creek	Waterworks Local Auth	91250000	GY		414		Current	19400626	0
C016412	Trout Creek	Irrigation Local Auth	3170	AF			3909	Current	18881218	0
C016413	Trout Creek	Irrigation Local Auth	6000	AF			7398	Current	19030711	0
C016414	Isintok Creek	Storage (1665 ML)	5500	AF				Current	19260326	0
"	Tsuh Creek	Storage (370 ML)	5500	AF				Current	19260326	0
"	Crescent Creek	Storage (617 ML)	5500	AF				Current	19260326	0
"	ZZ Creek (7819) (Whitehead)	Storage (432 ML)	5500	AF				Current	19260326	0
"	ZZ Creek (7824) (Headwaters)	Storage (3699 ML)	5500	AF				Current	19260326	0
"	ZZ Creek (7788)	Storage	5500	AF				Current	19260326	0
"	Trout Creek	Storage	5500	AF	6782			Current	19260326	0
C016415	Eneas Creek	Irrigation Local Auth	3000	AF			3699	Current	18890801	0
"	Eneas Creek	Irrigation Local Auth	3000	AF				Current	18890801	0
"	Latimer Creek	Irrigation Local Auth	3000	AF				Current	18890801	0
"	Eneas Creek	Irrigation Local Auth	3000	AF				Current	18890801	0
"	Eneas Creek	Irrigation Local Auth	3000	AF				Current	18890801	0
C016416	Eneas Creek (Garnet)	Storage	2000	AF	2466			Current	19130429	0
"	Finlay Creek (Garnet)	Storage	2000	AF				Current	19130429	0
C029847	Trout Creek (Headwaters 1)	Storage	750	AF	925			Current	19610518	0
C030786	ZZ Creek (7788) (Whitehead)	Storage	222	AF	274			Current	19650628	0
C030787	ZZ Creek (7819)	Storage	250	AF	308			Current	19650628	0
"	ZZ Creek (7824)	Storage	250	AF				Current	19650628	0
"	Trout Creek	Storage	250	AF				Current	19650628	0
C032615	Okanagan Lake	Waterworks Local Auth	584000000	GY		2651		Current	19670606	0
C034398	Crescent Creek	Storage	255	AF	314			Current	19670606	0
C034399	Crescent Creek (Headwaters)	Storage	1000	AF	1233			Current	19670606	0
C034400	ZZ Creek (7788) (Whitehead)	Storage	348	AF	429			Current	19670717	0
C056161	Eneas Creek	Irrigation Local Auth	25	AF			31	Current	19480318	0
C056869	Eneas Creek	Storage	360	AF	444			Current	19800624	0
C060898	Trout Creek	Irrigation Local Auth	1500	AF			1850	Current	19730803	0
"	Trout Creek	Waterworks Local Auth	213000130	GY		967		Current	19730803	0
C066455	Trout Creek	Irrigation Local Auth	2500	AF			3083	Current	19880602	0
C066491	Trout Creek	Irrigation Local Auth	75	AF			92	Current	19410526	0
C106027	Thirsk Lake	Storage	2000	AF	2466			Current	19930122	20000317
C106243	Prairie Creek	Land Improve	0	TF				Current	19930217	19941102
C106464	Eneas Creek	Land Improve	0	TF				Current	19940421	19941027
C118910	Okanagan Lake	Waterworks Local Auth	760000000	GY		3450		Current	20031022	20040212
F066492	Trout Creek	Irrigation Local Auth	697	AF			859	Current	18881218	0
"	Trout Creek	Waterworks Local Auth	1825000	GY		8		Current	18881218	0
F066493	Trout Creek	Irrigation Local Auth	5	AF			6	Current	18901220	0
Okanagan Lake Licenses						6,102				
Trout Creek Licenses					15,974	1,390	17,197			
Garnet Valley Licenses					2,910	0	3,730			
TOTAL WATER LICENSING IN ML / YEAR					18,883	7,491	20,926			
Total number of Licences and/or Applications found is 25										

RESIDUAL WATERSHED LICENSES

The remainder of the Trout Creek and Eneas Creek watersheds was reviewed to determine the total number of licenses and volumes that were held.

- **Storage:** Excluding the District of Summerland, 1,425 ML of storage licensing was held in the Trout and Eneas Creek watersheds with the majority of the licensing of 1,264 ML being held by the Meadow Valley Irrigation District who operate within the Darke Creek Valley and utilize Darke Lake as a storage reservoir.
- **Irrigation:** A total of 2,351 ML/year of irrigation licensing is held in the region by other water suppliers. The majority of irrigation licensing was also held by the Meadow Valley Irrigation District with 1,660 ML. That district utilizes storage in Darke Lake.
- **WWLA:** In addition, there is also 88.1 ML/year of licensing held for WWLA by many private licenses.

RECOMMENDED LICENSE ADJUSTMENTS

Adjustments in the licensing for Summerland should be considered for the following areas:

- **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 of approximately 781 ML. Headwaters Reservoirs holds 4,640 ML of storage while there is 5,857 ML of licensed storage at these four reservoirs. Rationalization/adjustment of licensed volumes at these two sites would allow the allocations to be closer to actual numbers;
- **Okanagan Lake:** WWLA licensing on OK Lake at existing Lower Town site is larger than required for that intake. The simplest adjustment may be to add an alternate PD (point of diversion) for the older Okanagan Lake license to the site of the proposed lake intake, when the site is further in development.

  If a new intake is developed at Wharf Street or Powell Beach as discussed later in this report, a PD of License No. C042615 should be considered for that site. That would allow a maximum withdrawal at the new intake of 6,102 ML. It is noted that if the withdrawals from Okanagan Lake are supported by existing reservoir storage, then any of the Irrigation or WWLA licenses held by Summerland within Trout Creek could also make application for an alternate PD at the site of the new lake intake;
- **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.

3.4 WATERSHED SOURCES

Although Summerland has groundwater wells at the west limits of the district and a pump station at Lower Town on Okanagan Lake, over 95% of water currently used is obtained from two watersheds. This section provides a summary of the Trout Creek and Eneas Creek watershed characteristics, including the storage reservoirs, dams, catchment areas, capacity and reliability.

There have been numerous reports on the hydrology of the basin including Reksten (1973), Weiss (1981), Letvak (1989), Northwest Hydraulics (2001) and Water Management Consultants (2004). The data in this report is based on the Water Management Consultant work to date and modifications to that work.
The definitive work to date related to the watershed is the 2004 work by Water Management Consultants related to the Trout Creek Water Use Plan. A *Watershed Reservoir Model* was assembled by WMC to set out the best available science for making decisions on the operation of storage facilities in the Trout Creek watershed. Areas, runoff flows and data derived in that report is carried forward to this watershed summary. Figure 3.1 provides an illustration of the existing Trout Creek and Eneas Creek watersheds and storage reservoir lakes.

Reservoir-Lakes

Please note that for this report, all storage reservoir-lakes are referred to as "reservoirs". The lake terminology is not utilized and we would recommend that Summerland refer to all of their reservoirs as such so that the public, Ministry of Agriculture and Lands, and lessees that operate facilities on these reservoirs are continually reminded that these water bodies are not natural lakes but rather managed reservoirs that are licensed by the Province of BC for beneficial use.

Eneas Creek Watershed

Eneas Creek is the second surface water source for the District of Summerland, and has a catchment area of approximately 91 km^2. The Eneas Creek watershed extends northwards up Lapsley Creek and the reservoir is influenced by groundwater springs that appear to originate to the west in the Darke Creek watershed. The water quality from this watershed is considered good for most of the year. Algae blooms can occur in the late summer months due to daytime heating however, an aeration system located near the intake has been successful at minimizing the potential for anaerobic water and algae growth.

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. Local wildlife within the watershed area also present a health risk for Eneas Creek.

Trout Creek Watershed

With a catchment area of 759 km^2 at the mouth, Trout Creek is the second largest creek feeding into Okanagan Lake. The area of watershed accessible to Summerland above its intake is 713 km^2. Trout Creek is the primary water source for Summerland who operates 9 storage reservoirs within the upper elevations of the Trout Creek watershed. The upper level reservoirs include Headwaters (4), Crescent, Whitehead, Tsuh, Isintok and Thirsk. The watershed is unprotected and is of considerable size with agriculture, septic tanks, forestry and cattle grazing activities in addition to the local wildlife.

Thirsk Reservoir, Raised Dam and Spillway
2008 photo c/o MOE/Dobson Eng.

The total average annual volume of water estimated to flow immediately above the intake each year is 83,370 ML with the lowest year recorded being 1929 when only 28,500 ML was available (34% of normal).

Table 3.2 - Trout Creek Watershed – Area - Elevation Summary

SUB-BASINS	AREAS FOR SHOWN ELEVATION RANGE (km^2)						Local Area (km2)	Total Area (km2)
	Below 600	600 900	900 1200	1200 1500	1500 1800	Above 1800		
Headwaters Reservoirs	0	0	0	14.23	1.15	3.08	19.18	19.18
Crescent Reservoir	0	0	0	4.14	9.05	2.20	15.39	15.39
Whitehead Reservoir	0	0	0	6.71	0	0	6.71	6.71
Thirsk Reservoir	0	0	15.36	99.66	74.52	5.90	195.44	236.72
Tsuh Reservoir	0	0	0	0	2.22	0	2.22	2.22
Isintok Reservoir	0	0	0	0	10.42	5.89	16.31	16.31
Darke Creek Watershed	0	20.83	26.65	18.26	10.94	0	76.68	76.68
Trout Creek @ Intake	0	33.7	92.81	131.30	114.52	9.7	422.87	713.24
Trout Creek @ Mouth	12.59	24.24	8.46	0.24	0	0	45.52	758.77
Trout Creek Total	**12.59**	**78.77**	**143.28**	**274.54**	**222.82**	**26.77**		**758.77**

(Adapted from Water Management Consultants WUP Technical Brief)

Table 3.2 provides a summary of the elevation of various sub-basins of the reservoirs. The higher the watershed elevation, the higher the annual precipitation and resulting runoff volumes. Table 3.2 includes all District of Summerland reservoirs in Trout Creek. The local area includes all areas above a location excluding areas that may be collected in reservoirs that are above the local site. The total area includes all area above each reservoir at its outlet.

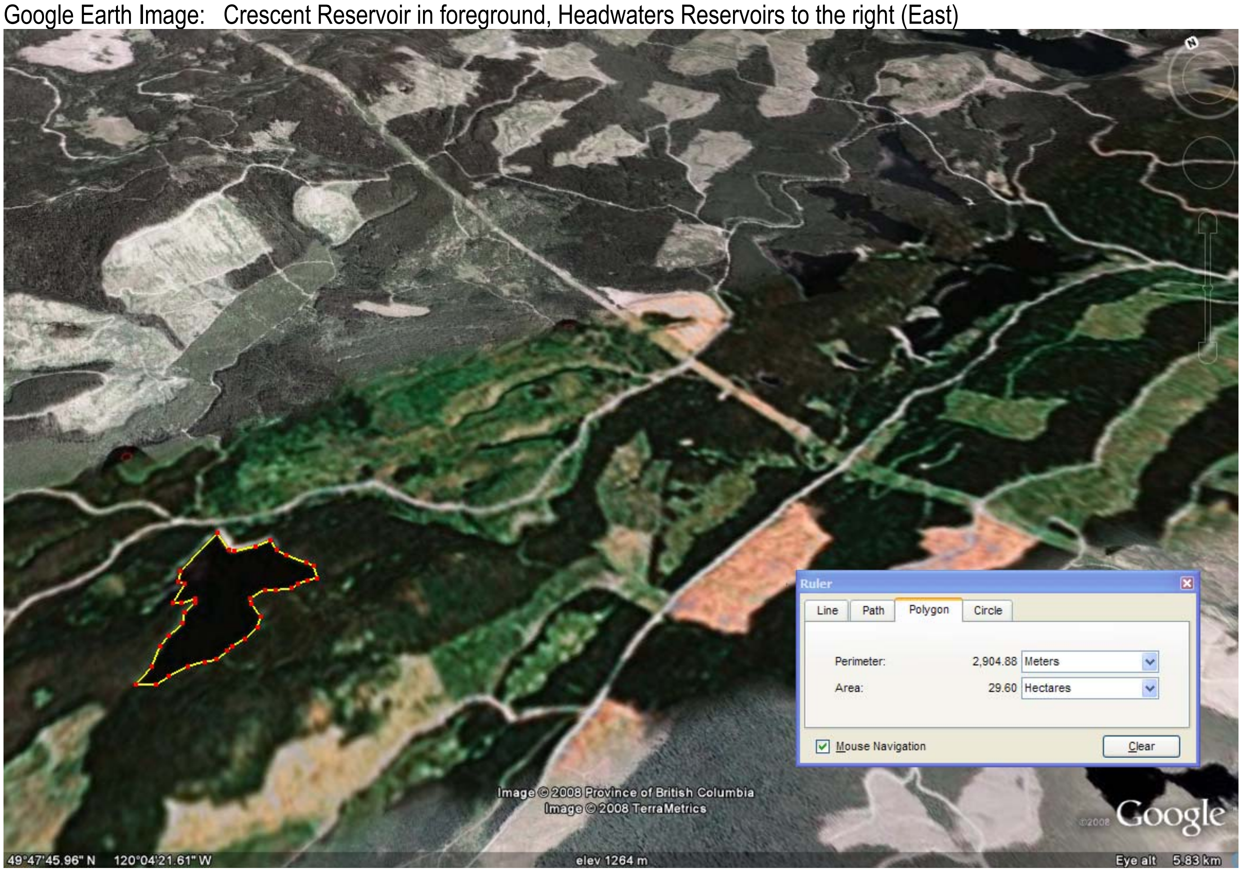
CRESCENT RESERVOIR

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 is 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.

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	2300 ML
Average Annual Runoff Depth	0.149 m
Average Year Ability to Fill	**301%**
Evaporation Losses	**547 mm**
	162 ML
1:100 year Drought Runoff	800 ML
1:100 year Drought Runoff Depth	0.052 m
1:100 year Ability to Fill	**105%**

Google Earth Image: Crescent Reservoir in foreground, Headwaters Reservoirs to the right (East)



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 11 kms up the Brenda Mines Road and then another 14 km up the Headwaters Road to the lake sites. A breakdown in lake storage is listed below:

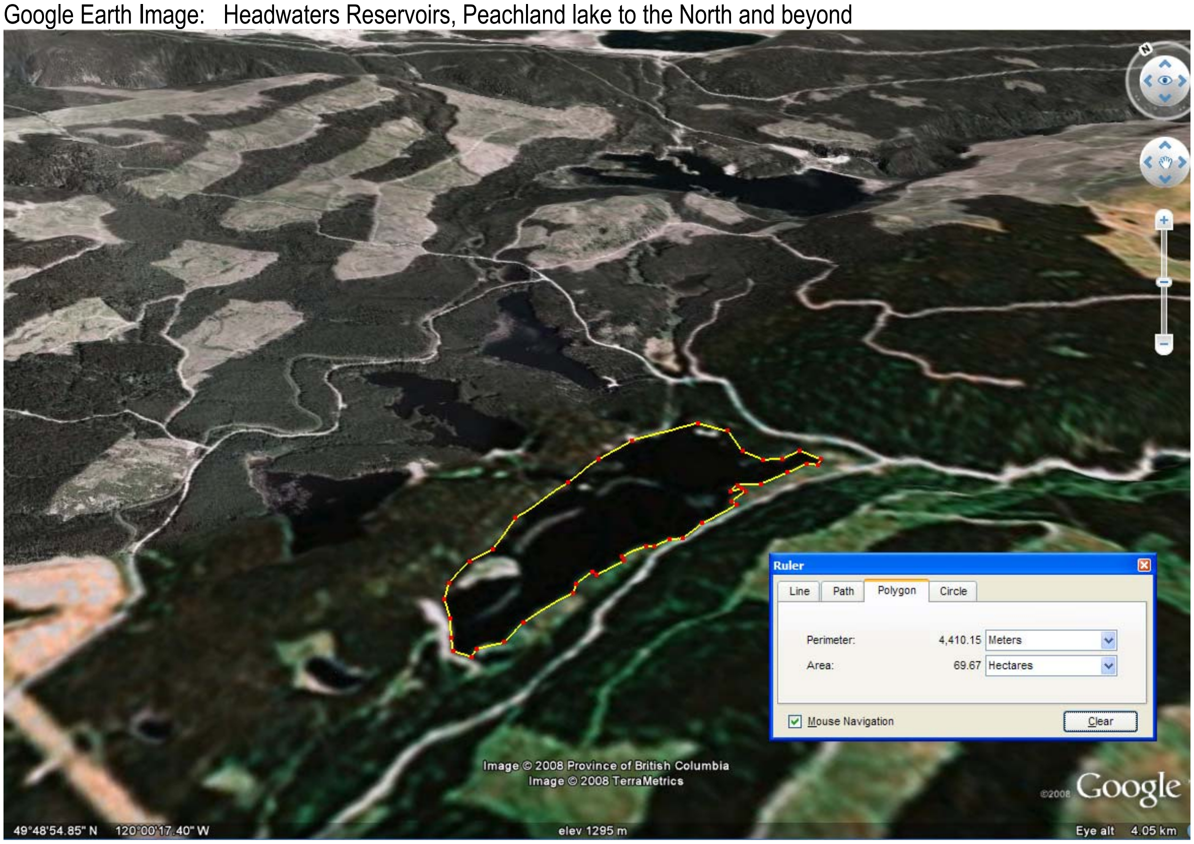
Reservoir	Storage (ML)	Area (ha.)	Ave.Depth (m)
Headwaters 1	2613	69.7	3.75
Headwaters 2	738	21.0	3.51
Headwaters 3	617	21.0	2.93
Headwaters 4	504	15.9	3.17

Headwaters Reservoirs		
Subcatchment area	1917.7	ha.
Reservoir Surface Area	127.6	ha.
Reservoir Elevation	1289	m
Mean Subcatchment Elevation	1335	m
Live Storage	1384	ML
Ave. Reservoir Depth	1.084	m
Average Annual Runoff	2460	ML
Average Annual Runoff Depth	0.128	m
Average Year Ability to Fill	**178%**	
Evaporation Losses	**527**	**mm**
	673	**ML**
1:100 year Drought Runoff	820	ML
1:100 year Drought Runoff Depth	0.043	m
1:100 year Ability to Fill	**59%**	

The lakes have multiple uses around the area. Of concern is the issue of the potential sale of lease lots to the lessees. This reduces the abilities of the Province to eliminate these leases at some time in the future.

Presently there are 10 cabins and 14 campsites situated around Headwaters 1. Headwaters 2 has 33 leased cabins within 7 lots. There are another 7 leases on 3 lots along Headwaters 3. No leases exist on Headwaters 4.

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



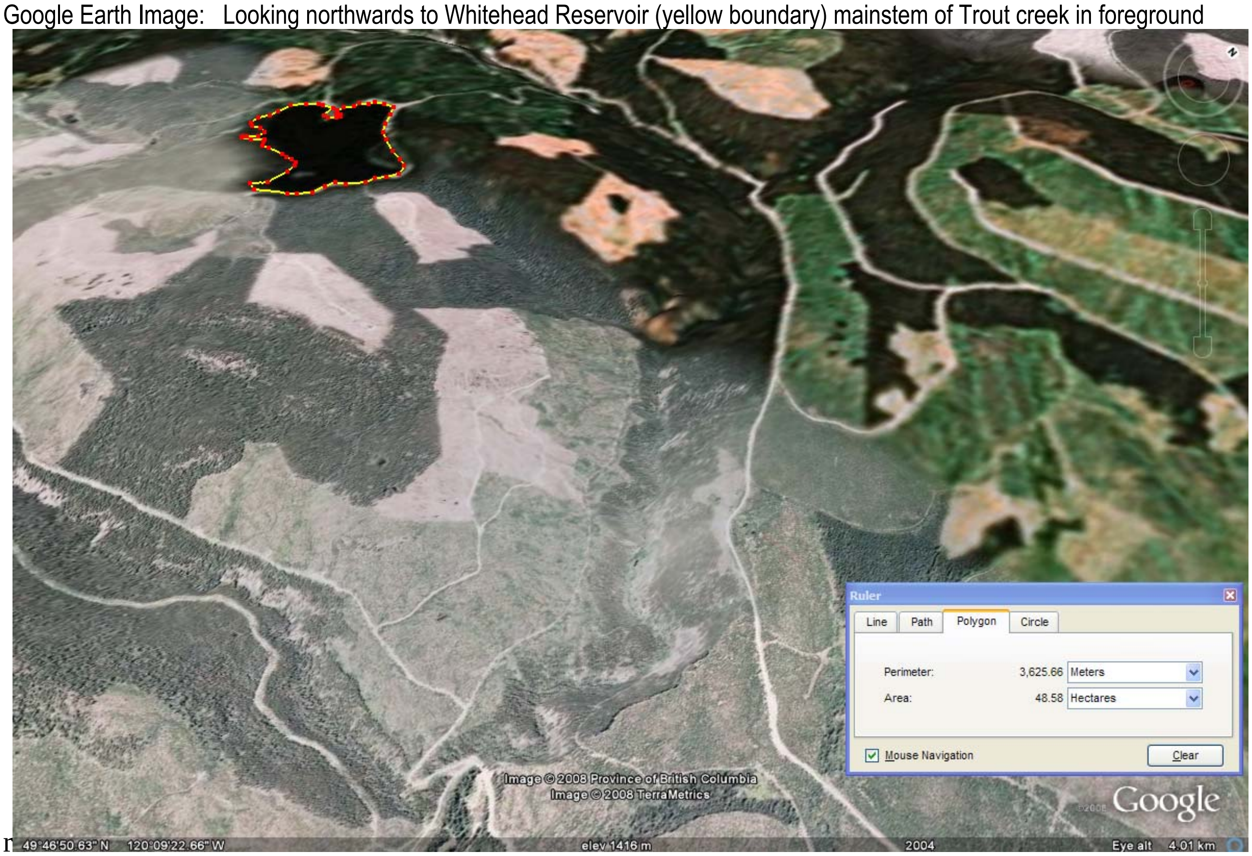
WHITEHEAD RESERVOIR

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.

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 subcatchment area. The ability to fill the lake on an annual basis is only 81%. Management of water sources to allow use of this water in the latter years of a multi-year drought cycle is very important. Expansion of reservoir storage at this site is not a viable option.

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	980 ML
Average Annual Runoff Depth	0.146 m
Average Year Ability to Fill	**81%**
Evaporation Losses	**508 mm**
	247 ML
1:100 year Drought Runoff	400 ML
1:100 year Drought Runoff Depth	0.060 m
1:100 year Ability to Fill	**33%**

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



THIRSK RESERVOIR

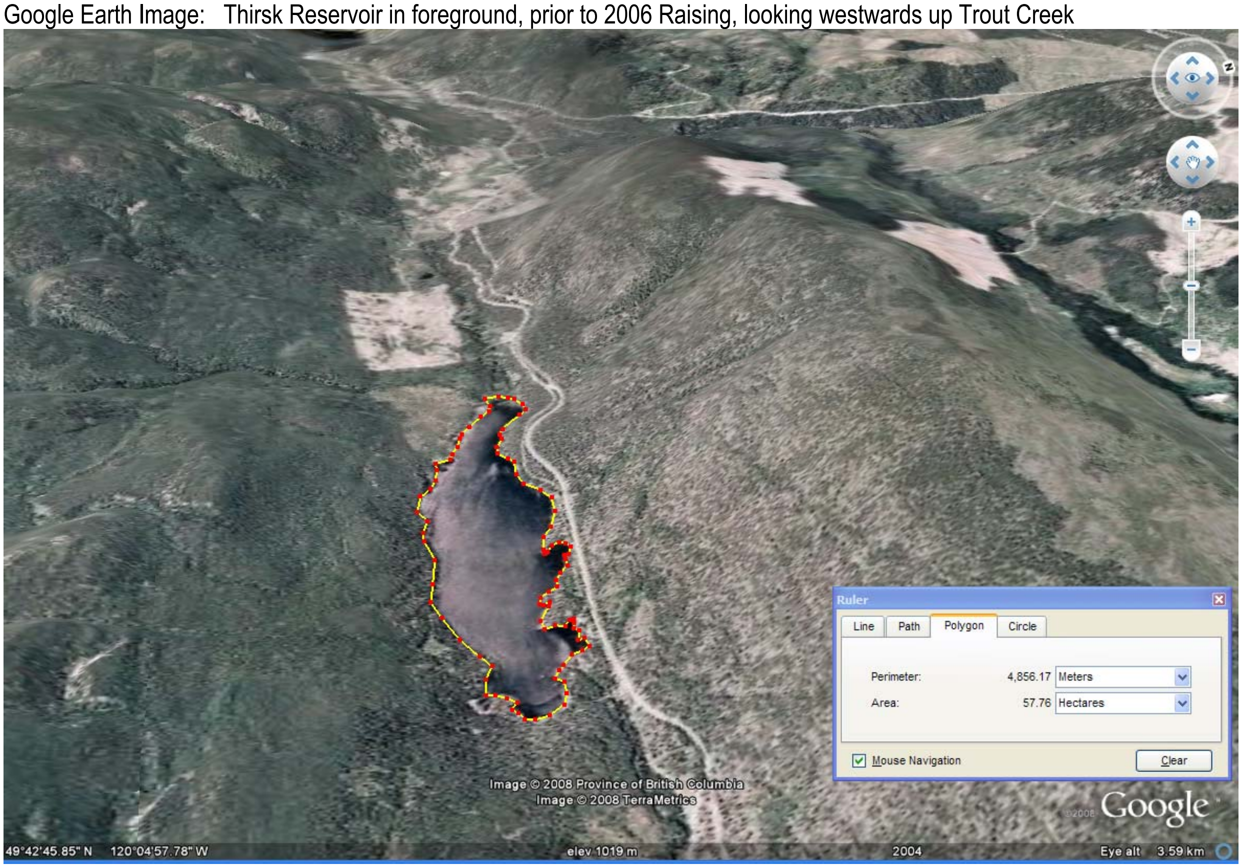
Thirsk Reservoir is the primary control reservoir for flow in lower Trout Creek. The reservoir is located 34 km upstream of the existing District of Summerland intake. Travel time for releases from this reservoir to reach the district intake is 18 hours during summer flows. The average stream velocity is 1.9 km/hr or 0.50m/s. There is one remote gate installed that can be controlled with the Summerland SCADA system.

Thirsk provides on-line storage on Trout Creek, effectively collecting and storing all upstream water in the watershed. The reservoir concrete dam was recently upgraded and the entire structure was raised by 4.6 metres. Thirsk Reservoir is the largest and most critical reservoir owned and operated by the District. Radio controlled monitoring of the reservoir for flows and water level is recommended to collect more reliable data on Trout Creek.

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	27520	ML
Average Annual Runoff Depth	0.141	m
Average Year Ability to Fill	**424%**	
Evaporation Losses	**588**	**mm**
	340	**ML**
1:100 year Drought Runoff	6790	ML
1:100 year Drought Runoff Depth	0.035	m
1:100 year Ability to Fill	**105%**	
* 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



TSUH (DEER) RESERVOIR

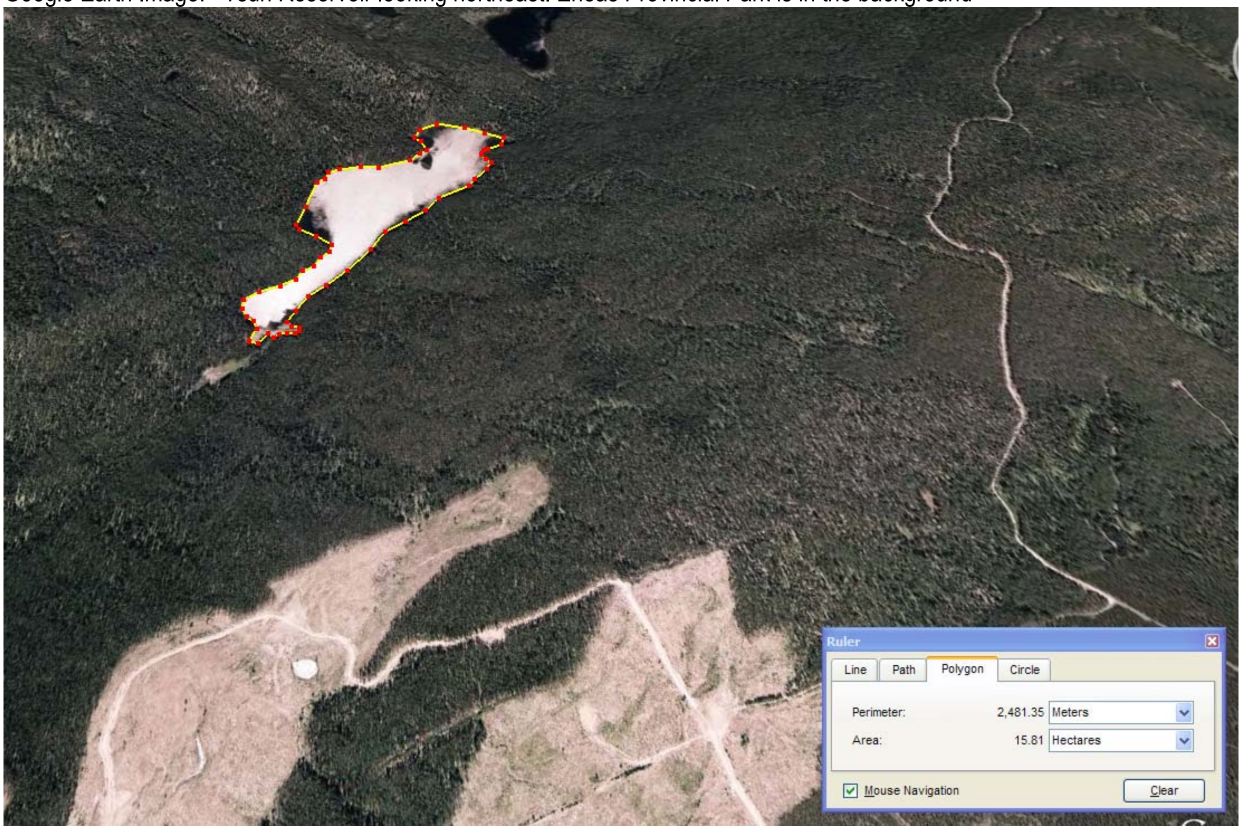
Tsuh Reservoir is a very small reservoir located at the divide between the Eneas and Trout Creek watersheds. The reservoir is 7 km north of Trout Creek mainstem approximately 26 km upstream of the District intake. Tsuh Reservoir and creek is located below Thirsk Reservoir. The reservoir is very small 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 so remote and storage volume so small that the reservoir has not been used for several years.

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 from where the reservoir can be accessed.

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	486 ML
Average Annual Runoff Depth	0.219 m
Average Year Ability to Fill	**158%**
Evaporation Losses	**373 mm**
	59 ML
1:100 year Drought Runoff	173 ML
1:100 year Drought Runoff Depth	0.078 m
1:100 year Ability to Fill	**56%**

Google Earth Image: Tsuh Reservoir looking northeast. Eneas Provincial Park is in the background



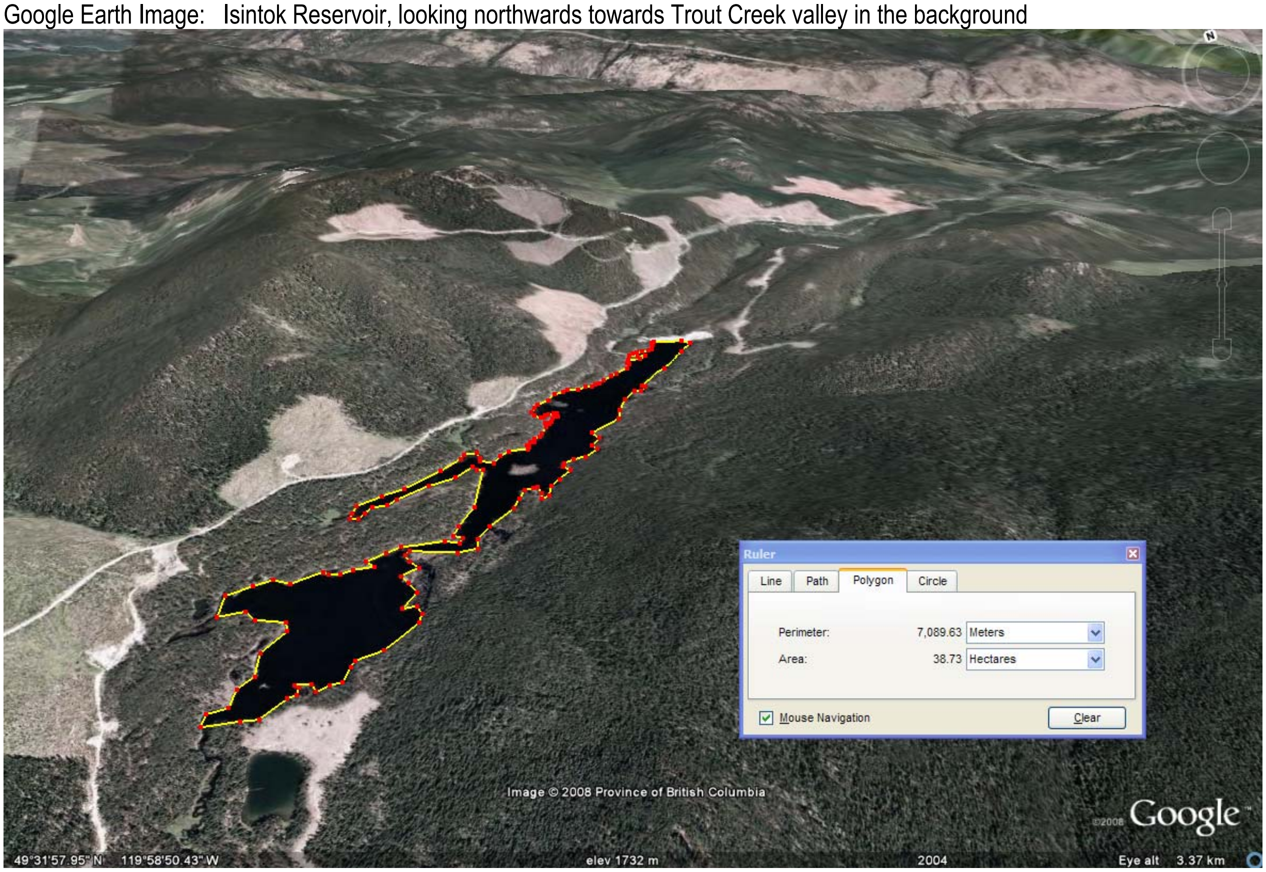
ISINTOK RESERVOIR

Isintok Reservoir is a moderately sized reservoir located up Isintok Creek a distance of 12 km up from Trout Creek mainstem. Isintok Creek intersects Trout Creek approximately 12 km upstream of the District intake. At a distance of 24 km from the intake, Isintok is the closest reservoir to the District. It is located below Thirsk Reservoir and has reasonable access. The lake reliably fills from snowmelt each year.

The dam is located at the north end of the lake.

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	2460	ML
Average Annual Runoff Depth	0.151	m
Average Year Ability to Fill	**178%**	
Evaporation Losses	**511**	**mm**
	198	**ML**
1:100 year Drought Runoff	820	ML
1:100 year Drought Runoff Depth	0.050	m
1:100 year Ability to Fill	**59%**	

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



TROUT CREEK INTAKE RESERVOIR

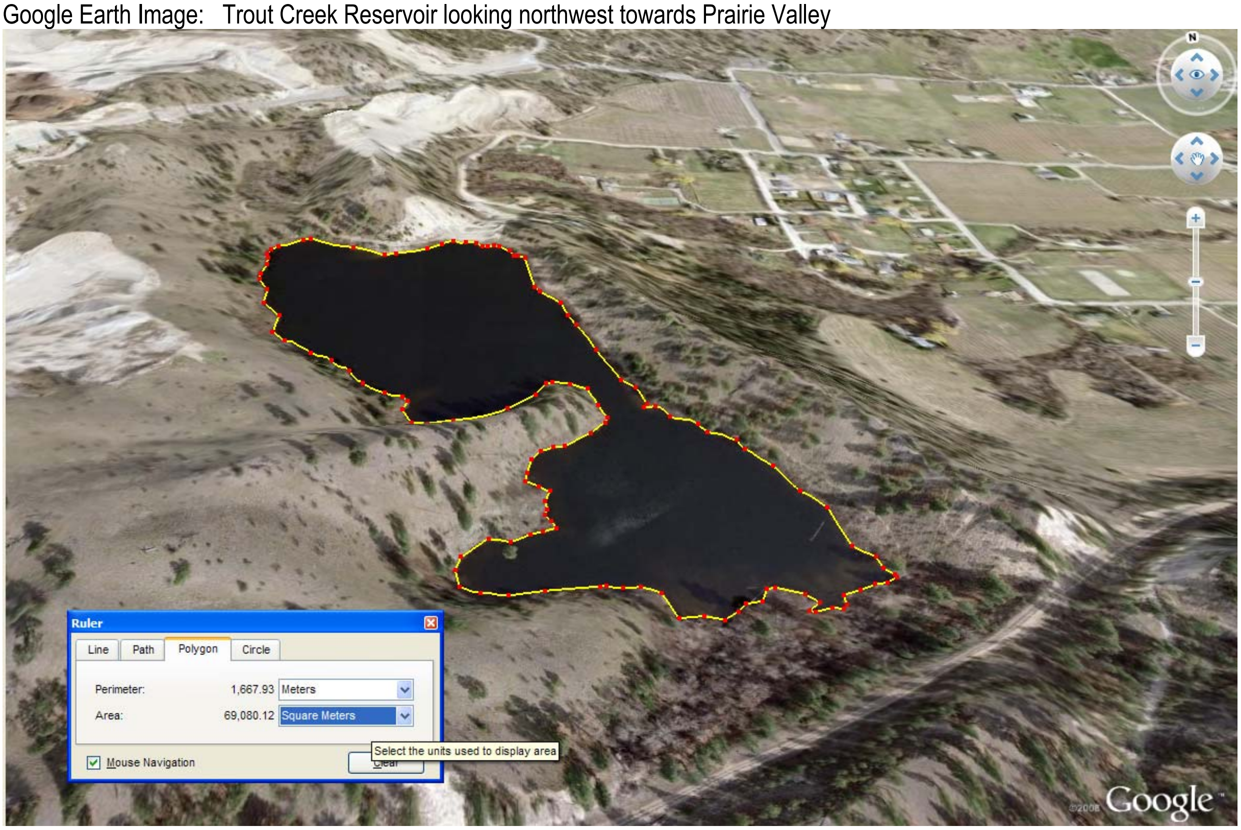
Trout Creek intake reservoir is located within the watershed boundary but is considered balancing storage rather than watershed storage. This reservoir allows balancing of daily water demands so that Summerland releases from Thirsk Dam can be reduced to the daily average flow rather than the peak hourly demand.

The area of Trout Creek upstream of the intake is approximately 689 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.

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.

Trout Creek Intake		
Subcatchment area *	68209.1	ha.
Reservoir Surface Area	6.9	ha.
Reservoir Elevation	623	m
Mean Subcatchment Elevation*	n/a	m
Live Storage	69	ML
Usable Reservoir Depth	0.999	m
Average Annual Runoff	83370	ML
Average Annual Runoff Depth	0.122	m
Average Year Ability to Fill		
Evaporation Losses	**593**	**mm**
	41	**ML**
1:100 year Drought Runoff	22360	ML
1:100 year Drought Runoff Depth	0.033	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

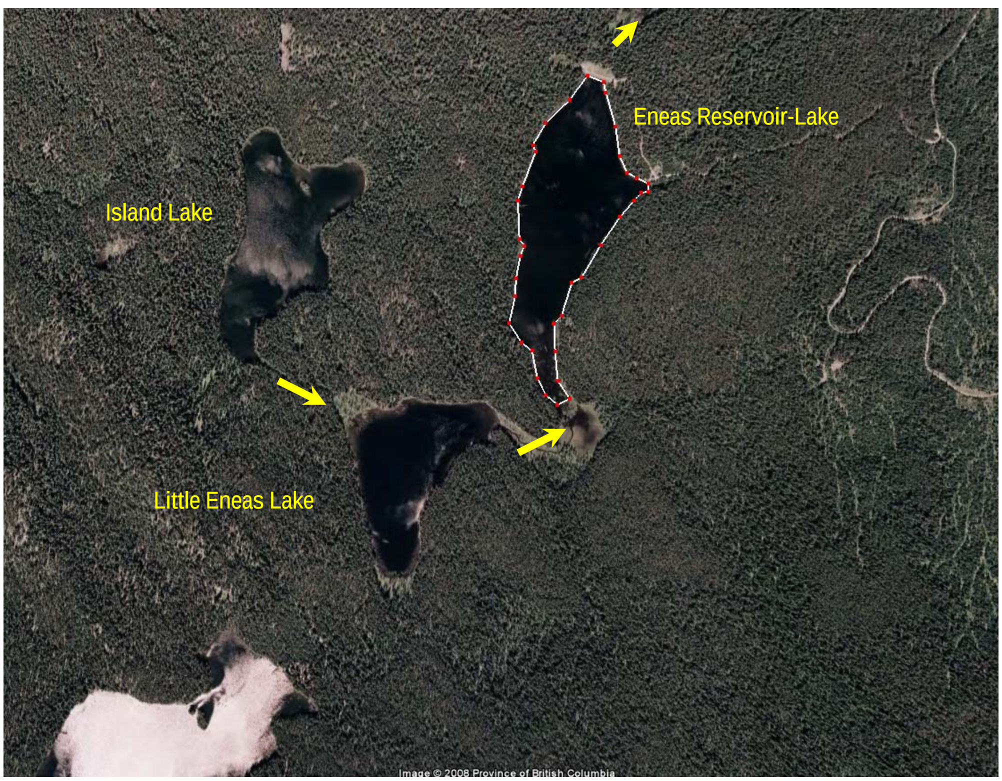
Eneas Reservoir-Lake is the headwaters for Eneas Creek. The reservoir is located within Eneas Provincial Park 14 km upstream of Garnet Reservoir. The original dam was constructed prior to 1941 and the reservoir dam was reconstructed in 1975. The high water level is 1561 m. The reservoir is not actively used for storage as all overflows from the reservoir spillway is collected by Garnet Reservoir downstream. 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.

Eneas Reservoirs		
Subcatchment area	3108.0	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	n/a	ML
Average Annual Runoff Depth	n/a	m
Average Year Ability to Fill	**n/a**	
Evaporation Losses	**373**	**mm**
	214	**ML**
1:100 year Drought Runoff	n/a	ML
1:100 year Drought Runoff Depth	n/a	m
1:100 year Ability to Fill	**n/a**	

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

* 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.

Because the storage volume is very small, it is not utilized by the District and therefore, the storage volume from Eneas Reservoir was not included in the drought calculations or reservoir model.

GARNET RESERVOIR

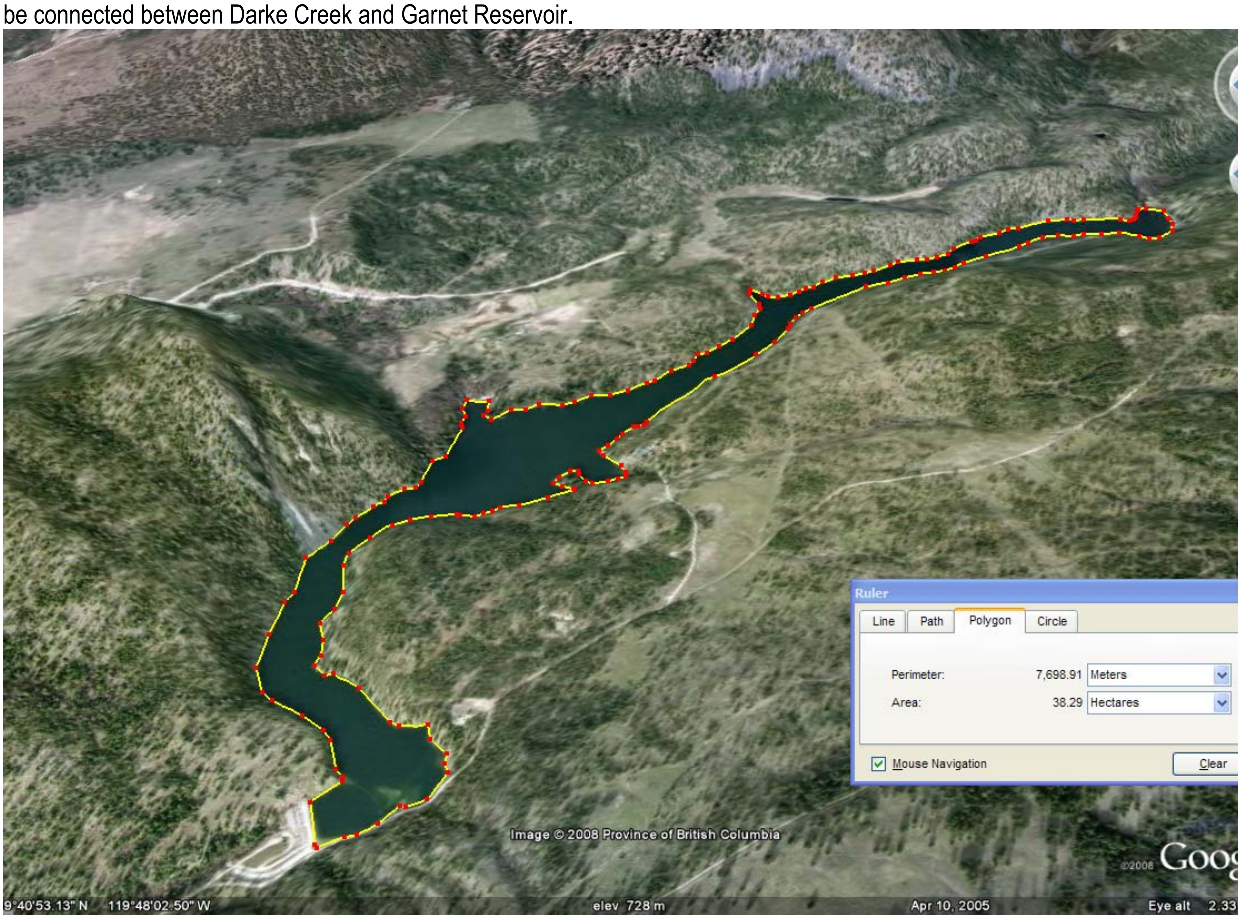
Garnet Reservoir is the terminal location for water from Eneas Creek. The headwaters are located at Eneas Provincial Park 14 km upstream of the dam. There are several creeks and diversions that influence the flows into Garnet Reservoir including Eneas Creek, Lapsley Creek and Findlay Creek which also supplies Darke Creek and Darke Lake.

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 confirmed that there is a substantial percentage of groundwater-influenced flow into the reservoir, likely from the west.

Garnet Reservoir		
Subcatchment area	9100.0	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	5690	ML
Average Annual Runoff Depth	0.063	m
Average Year Ability to Fill	**241%**	
Evaporation Losses	**559**	**mm**
	214	**ML**
1:100 year Drought Runoff	2180	ML
1:100 year Drought Runoff Depth	0.024	m
1:100 year Ability to Fill	**92%**	

Google Earth Image: Garnet Reservoir looking northwest. Meadow Valley is in upper left corner of image. Aquifer appears to be connected between Darke Creek and Garnet Reservoir.



RESERVOIR DRAWDOWN OPERATING RULES

The Water Management Consultants' *Water Use Plan – Technical Background Document on Hydrology, Water Usage and Reservoir Operations* was used as the basis for defining reservoir capacity, operations and operating rules. The operating rules for the mouth of Trout Creek were as follows:

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

The overriding concept in setting the reservoir drawdown procedure is that the reservoir storage volume that can most reliably be filled be first utilized. Once that volume of water is used, the next most reliable source water is utilized. This process continues and adjustments are made considering storage remaining, water demands, time of year and drought stage condition.

The operating rules for release from the reservoirs were in the following order:

1. Withdraw water from storage in Thirsk to the specified level above the intake. Begin releasing makeup water from other reservoirs when 80% of the Thirsk storage capacity has been depleted;
2. Withdraw water available from Crescent Reservoir first. In the model, this water was routed through Headwaters Reservoirs. Until the Headwaters Reservoirs were filled, Crescent was held at the specified level above the intake;
3. Withdraw the top 432 ML of water from Whitehead Reservoir and hold at that level until the next drawdown of this reservoir or the next time when the demand is not required;
4. Withdraw 2,339 ML of water from Headwaters and hold at that level until the next drawdown or when the demand is not required;
5. Drawdown Isintok Reservoir to the specified level above the intake and pass any additional inflow until the demand is not required;
6. Draw down the remainder of Headwaters Reservoirs to the specified level above the intake and pass any additional inflow until the demand is not required;
7. Draw down the remainder of Whitehead Reservoir to the specified level above the intake and pass any additional inflow until the demand is not required.

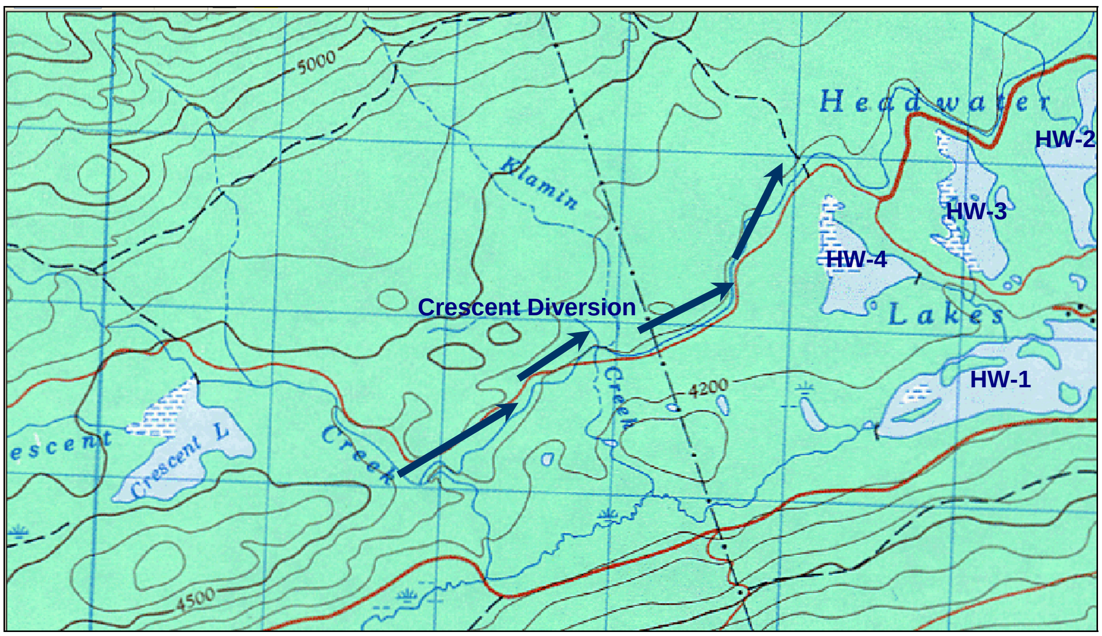
It is noted that in the WUP, all reservoirs are allowed to be drawn down to a minimum level of 1.8m above the bottom outlet pipe of the reservoir. The reservoirs are not drawn down lower so as not to draw off reservoir bottom sediments.

HEADWATERS RESERVOIR-LAKES OPERATIONS

Operations of the Headwaters Reservoir-Lakes is described on this page. As illustrated in Figure 3.2, 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 water 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 3.2 - Headwaters Reservoir-Lakes Operations



Headwaters No. 4 fills and then overflows into Headwaters No. 3 which then subsequently fills. Crescent Lake is one of the most reliable water reservoirs for the District.

3.5 WATERSHED RELIABILITY ANALYSIS

A hydrologic analysis was carried out for the upper watershed reservoirs for the Trout Creek and Garnet Creek systems using the Water Management Consultants Watershed model. The primary flow gauge used to calibrate the model was the WSC gauge on Camp Creek. Records of reservoir levels from 1993 to 2003 were also used to calibrate the model plus intermittent flow records for Trout Creek at the mouth. Historical data, extending from 1937 to 2003 were utilized within the model to estimate the annual flow rates for the following return periods and runoff conditions;

- 10 year wet
- 10 year average
- 10 year dry
- 50 year dry
- 100 year dry

The frequency analysis program FFAME, developed by BC Environment was used for the frequency analysis. The following table presents a summary of the live storage above the intake level for each reservoir, and includes the newly expanded storage of 3,082 ML within the Thirsk reservoir. 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 catchment area, average annual depth of runoff, average watershed elevation, elevation of the reservoir, annual average runoff, licensed and actual storage volumes.

Table 3.3 - Summerland Reservoir Characteristics

Reservoirs	Unregulated Catchment Area (km2)	Ave runoff Depth (m)	Watershed Elevation (m)	Reservoir Elevation (m)	Ave. Runoff (ML)	Licensed Storage (ML)	Ex. Actual Storage (ML)
Isintok Reservoir	16.31	0.151	1780	1649	2460	1665	**1384**
Crescent Reservoir	15.39	0.149	1661	1363	2300	931	**765**
Tsuh Reservoir **	2.22	0.219	1624	1555	486	370	**308**
Whitehead Reservoir	6.71	0.146	1472	1447	980	1442	**1216**
Headwaters Reservoirs	19.18	0.128	1335	1289	4640	5857	**4472**
Thirsk Reservoir	195.44	0.141	1335	1026	27520	5709	**6490**
Trout Creek @ Intake	682.09	0.122	n/a	623	83370		**260**
Garnet & Eneas Reservoirs	91.00	0.063	1200	629	5690	2910	**2360**
TOTALS						**18884**	**17255**

** Data Source is 1989 Letvak Report

Table 3.4 - Summerland Reservoir Inflows

Reservoirs	Licensed Storage (ML)	Ex. Actual Storage (ML)	1:10 Wet Runoff (ML)	Ave. Runoff (ML)	Drought Runoff (ML)	1:50 Drought Runoff (ML)	1:100 Drought Runoff (ML)
Thirsk Reservoir	5709	6490	47340	**27520**	12840	8160	**6790**
Headwaters Reservoirs	5857	4472	7190	**4640**	2500	1700	**1480**
Isintok Reservoir	1665	1384	3910	**2460**	1280	920	**820**
Crescent Reservoir	931	765	3580	**2300**	1250	900	**800**
Whitehead Reservoir	1442	1216	1430	**980**	590	440	**400**
Tsuh Reservoir	370	308		**486**			**173**
Trout Creek @ Intake		260	137690	**83370**	39980	26140	**22360**
Estimated fish flows as per WUP			30461	**20695**	12449	9485	**8618**
Garnet & Eneas Reservoirs	2910	2360	8870	**5690**	3120	2390	**2180**
TOTALS	**18884**	**17255**					

Table 3.4 provides the summary of the frequency analysis carried out by Water Management Consultants 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 Garnet Reservoir would be expected to fill in all years, even starting empty, except for the 100-year dry year. 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 and Tsuh Reservoirs 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 drought 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 dry years.

UNAVAILABLE WATER

From the Trout Creek and Eneas Creek watersheds, there is water that will not be available to the District. These volumes include:

- Darke Creek and Darke Reservoir-Lake water is licensed to the Meadow Valley Irrigation District. It is assumed that this water will be fully allocated and utilized by that Improvement District;
- There are evaporative losses from all of the reservoir surface waters. An estimate of these losses is 1,928 ML/year as summarized in Table 3.5;
- There is naturalized base flow in the creek that is to be allowed to pass to support conservation and habitat requirements downstream of the Trout Creek intake. An estimate of the total annual flow for conservation in accordance with the Water Use Plan is summarized in Table 3.4. This amount varies, based on the 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 WUP 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 made;

- 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.

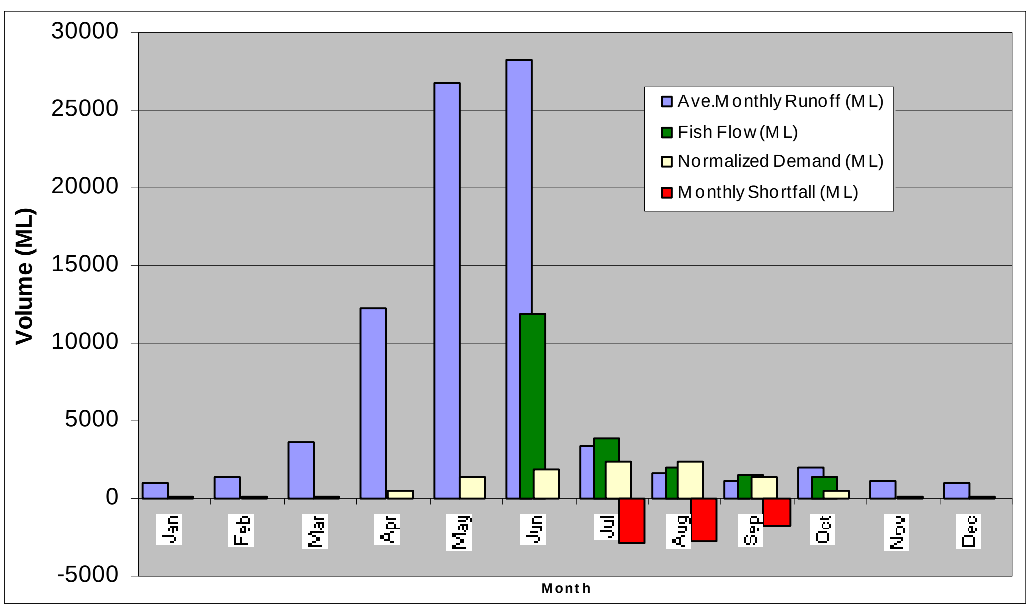
Table 3.5 - Summerland Drought Year Storage

Reservoirs	Licensed Storage (ML)	Ex. Actual Storage (ML)	Ability to Fill (Ave.Yr)	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	**424%**	105%	6790	340	**6450**
Crescent Reservoir	931	765	**301%**	105%	765	162	**603**
Isintok Reservoir	1665	1384	**178%**	59%	820	198	**622**
Headwaters Reservoirs	5857	4472	**178%**	59%	1480	673	**807**
Tsuh Reservoir	370	308	**158%**	56%	173	59	**0**
Whitehead Reservoir	1442	1216	**81%**	33%	400	247	**153**
Trout Creek @ Intake		260	**n/a**	n/a	n/a	35	**n/a**
Garnet & Eneas Reservoirs	2910	2360	**241%**	92%	2180	214	**1966**
TOTALS	**18884**	**17255**			**12608**	**1928**	**10601**

* Calculated by WMC weekly reservoir watershed model

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, 10,601 ML of reservoir storage is estimated to be required within the watershed.

Figure 3.3a - Trout Creek – Average Year Monthly Water Shortfall



In an average water use year, Summerland utilizes 11,200 ML of water from Trout Creek. The charts in Figures 3.3a and 3.3b provide the estimated monthly water demand from the watershed for an average year and a 1:100 year event respectively.

The columns in the charts are described below.

- The **blue** columns provide the average monthly flow available in Trout Creek. Approximately 80% of the total annual flow in the creek occurs during the months of April, May and June. The majority of precipitation occurs and accumulates during the winter months as snowfall;
- The **green** columns represent fish habitat requirements as set out in the Summerland Water Use Plan agreement with the Department of Fisheries and Ministry of Environment. The fish flow is required between June and October annually;
- The monthly *Normalized Water Demand* shown in the **white** columns is the water demand by Summerland that occurs on a year of average temperature and moisture conditions. This demand number is obtained by trending the water use in previous years to the present year to account for population growth and land use changes and previous water demand trends. The variance from normalized water demand can be as much as 10% higher or lower for a dry or wet year;
- The **red** columns show the average annual shortfall when accounting for water demand and in-stream flow requirements. In dry years, the annual average shortfall increases unless there are allowances and agreements made by the stakeholders through the means of a water use plan. Reservoir storage must be in place to account for this shortfall.

The corresponding numbers to Figures 3.3a and 3.3b are in Table 3.6 on the following page.

Figure 3.3b - Trout Creek – 1:100 Year Monthly Water Shortfall

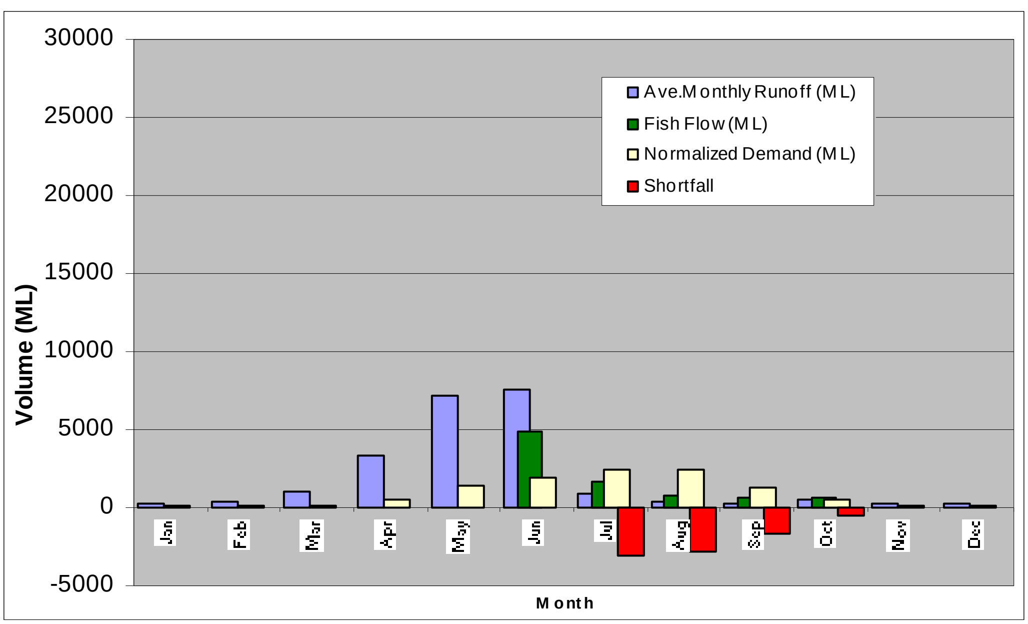


Table 3.6 - Trout Creek Available Water – Average and Drought Year

Month	Ave. Runoff (ML)	Fish Flow % of Runoff	Normalized Demand	Ave. Yr Fish Flow	Ave. Year Req'd Storage Volume	1:100 Drought Runoff (ML)	1:100 Yr Fish Flow	1:100 Yr Req'd Storage Volume
Jan	1004	0	161			269		
Feb	1327	0	152			356		
Mar	3623	0	170			972		
Apr	12203	0	469			3273		
May	26761	0	1364			7177		
Jun	28220	57.2	1905	11838		7569	4929	
Jul	3354	18.8	2395	3891	-2932	900	1620	-3116
Aug	1567	9.6	2373	1987	-2793	420	827	-2780
Sep	1185	7.5	1342	1552	-1709	318	646	-1671
Oct	2057	6.9	490	1428		552	595	-533
Nov	1066	0	172			286		
Dec	1004	0	162			269		
TOTAL	83370	100.0	11156	20695	-7434	22360	8618	-8100

Table 3.6 provides a numerical summary of the estimated monthly volumes of water that runoff (blue column), are required for fish flows (brown column) are used by Summerland (blue column) for an average year and a 1:100 year drought. The table shows that the 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.

3.6 WATER USE PLAN UPDATE

The Trout Creek Water Use Plan from 2004 relied on watershed modeling carried out by Water Management Consultants Inc (WMC). The watershed model developed by WMC is the primary tool utilized to analyze the capacity and reliability of the Trout Creek watershed. As part of the Water Master Plan, Water Management Consultants were requested to update the reservoir model and trigger graphs for Summerland. The existing trigger graph and trigger graph with expanded storage at Thirsk Reservoir are illustrated on the next page. Details and several scenarios are presented in a document prepared by Water Management Consultants (WMC) included as part of this report in Appendix F.

With the additional storage at Thirsk Reservoir, the reliability of water supply for the community significantly improves. Drought restrictions would not normally be triggered except in extreme drought years. If irrigation remains constant, residential demand could be increased a factor of 3.75 from present levels. If residential consumption remains constant, irrigation demands could be factored up 1.42 times from present levels. Eight scenarios are presented in Appendix F.

Figures 3.4 and 3.5 show the trigger levels in place before and after the raising of Thirsk Reservoir.

Figure 3.4 - Existing Trigger Graph for Demand Reductions

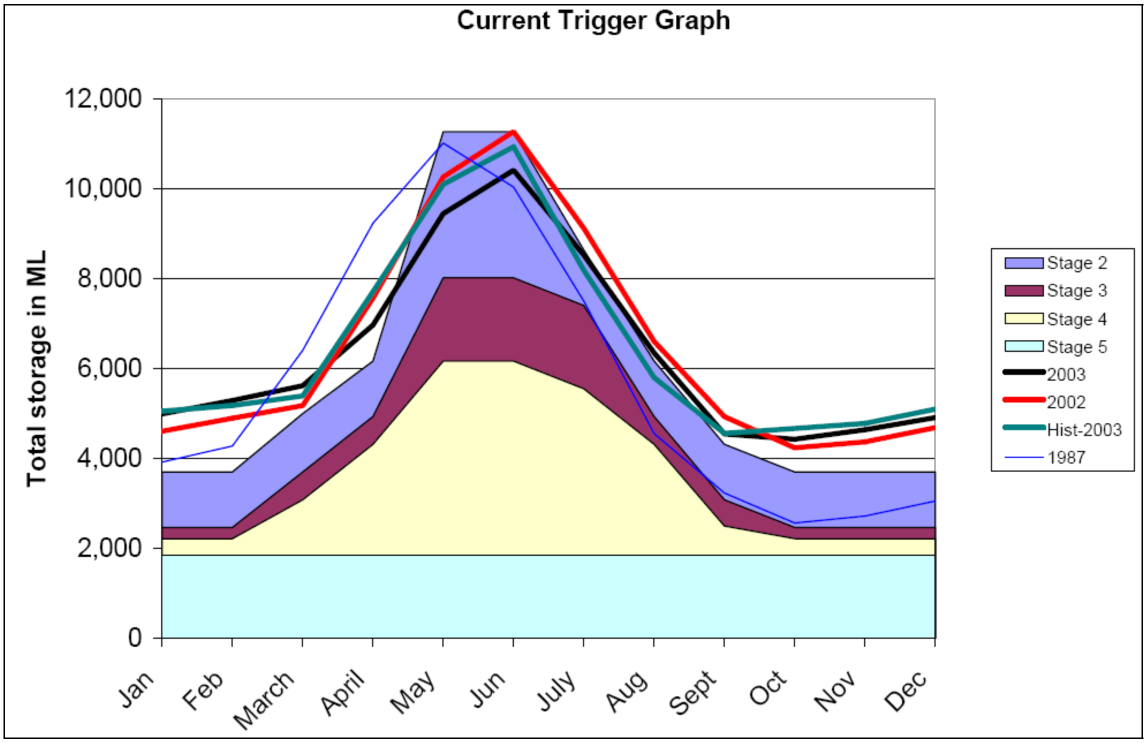
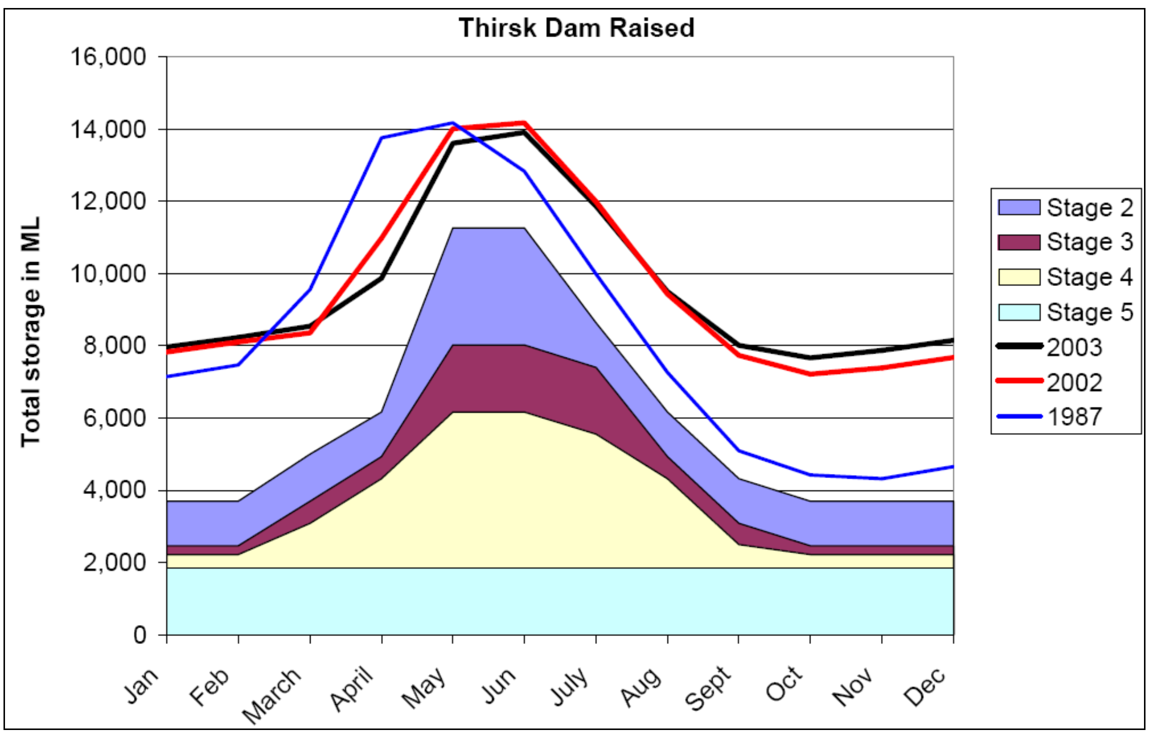


Figure 3.5 - Trigger Graph for Demand Reduction with Thirsk Dam Raised



3.7 OKANAGAN LAKE SOURCES

This section presents information on the existing water supply system on Okanagan Lake. The benefits of developing additional water supply from Okanagan Lake are that there would be multiple sources available to the District in the event that something damaged the water in the Trout Creek or Eneas Creek watersheds to the point where they are unusable.

The District of Summerland holds licenses at two locations on Okanagan Lake. The oldest license is from 1967 for the Lower Town Pump Station at the Marina. The license allows the withdrawal of 2,650 ML of water per year however the station capacity is undersized to provide this volume. A second location for water withdrawal is in Trout Creek and this license was applied for in 2004 after the 2003 drought.

LOWER TOWN PUMP STATION

The Lower Town Pump Station still exists and is located very near to the shoreline at the marina. This station has a 30 hp, 3 phase, 440V pump with a capacity rated at 25.2 L/s @ 54.8 m TDH. It was originally designed in Feb. 1968. Capacity is limited by water intake main size which is 200mm diameter. The line up to the reservoir is also limited at 150mm diameter. A small hypochlorite pump is capable of feeding sodium hypochlorite into the water leaving the pump station.

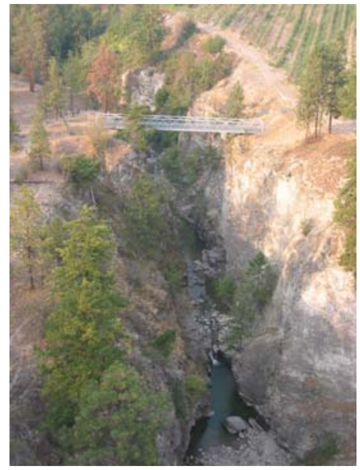
Although the water quality will be good most of the year, there are drinking water risks for this water supply including inadequate disinfection contact time, high boat traffic, high human activity, warm water temperatures, and a relatively shallow intake depth of only 5.2 m. The pump station was briefly used in 2003 however, the IHA informed the District that the intake would not be allowed without major upgrades to the point of withdrawal and treatment technologies utilized.

50,000 US gallon Reservoir located at elevation 384.10 (slab). HWL = 387.08 m (Yellow line denotes watermain)
Emergency use only. Capacity in the course of a year with 400 USgpm running for 4 months, 265 ML

The existing station capacity is only approximately 10% of the licensed amount from this location.

SUMMERLAND AGRICULTURE RESEARCH STATION LAKE PUMP STATION

The Summerland Agriculture Research Station is located within the southeast boundaries of the District of Summerland. Summerland provides potable water to the Research station through a 200 mm diameter watermain that crosses Trout Creek via a bridge 80 metres upstream of the Kettle Valley Railroad trestle. For irrigation water, the Research Station has its own dedicated pumping system from Okanagan Lake that provides irrigation water to the Research Station lands.



Walking Trestle over Trout Creek where watermain is located

The pump station, located along Sun-Oka Beach, houses three (3) 200 hp pumps that convey water through 1,825m of watermain to a reservoir at the 522 metre elevation west of the Research Station grounds. Approximately 96 L/s can be pumped up to this reservoir with two pumps running. Three pumps cannot run at one time due to electrical service restrictions in the station. There is approximately 85 ha. of land at the research station that is irrigated.

Figure 3.6 - Summerland Research Station Water System

Modeling showed that if the connections were made between the systems, it would be possible to access up to 63 L/s of water from the Research Station water system in the event of an emergency. Watermain installation **(red-line)** from the irrigation system to the Double Check Valve (DCV) vault would be required as would be pumping to lift water from the 523m hydraulic grade line of the Research Station into town at the 586m hydraulic grade line. The issue of compromising water to the Research Station makes this option problematic except during the irrigation off-season.

3.8 GROUNDWATER SOURCES

Groundwater is considered to be a supplemental source for the District of Summerland. Expanding the capacity of the groundwater to supply the District is important with regards to having a safe emergency alternative in the event that there are problems with the surface water supply.

This section first presents the aquifers that are known within the District municipal boundaries, the characteristics of those aquifers and the known wells in the area. The section then presents the existing District wells, their capacity and how they are normally utilized.

Comments are provided on the risks of groundwater seepage from the landfill to the existing Trout Creek Reservoir, and finally recommendations are made as to how and where to expand groundwater supply

HYDROGEOLOGY

Figure 3.7 illustrates the three existing defined aquifers in the Summerland area of service. The location of groundwater wells in the region and mapping is available on the internet at the Ministry of Environment, BC Water Resources Atlas at the website address. http://srmapps.gov.bc.ca/apps/wrbc/

Although the aquifer mapping is incomplete, it 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. The productivity, vulnerability and sensitivity of the aquifers are noted in Table 3.8. The sensitivity rating is no longer available on the Ministry website.

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

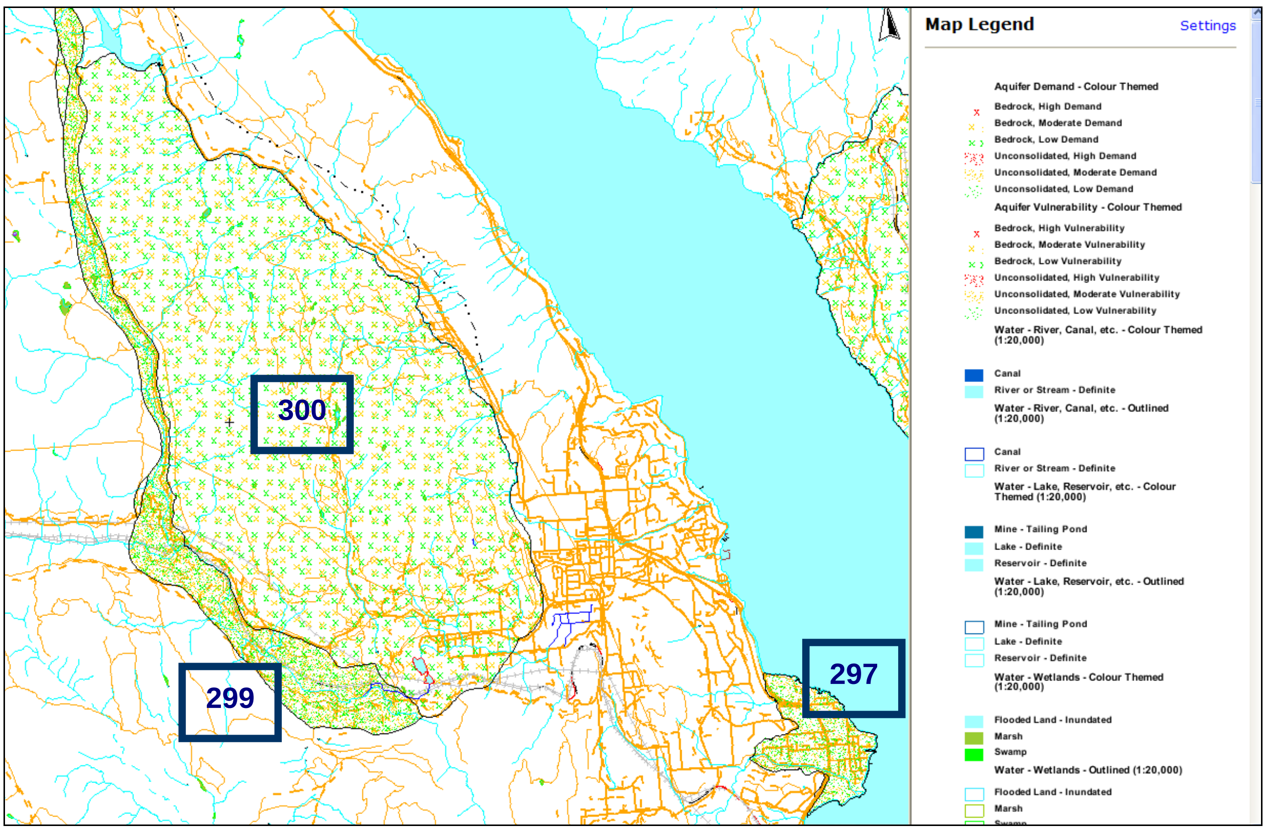
The sensitivity ranking indicates the priority of the aquifer required for proper management of the resource:

- 21 Highest number, requires highest attention
- 13 Moderate number for ranking in relation to scale
- 5 Lowest ranking number, requiring lowest attention for aquifer management

Table 3.7 - Summary of Groundwater Aquifers

Aquifer No.	Location	Aquifer Characteristics	Productivity	Vulnerability	Sensitivity
297	Trout Creek Fan	Unconfined, Sand and Gravel, loose to compact. No. of wells = 10 (approx.) Ave. well depth = 14m Average Yield – One reported yield of 11 L/s Ave. depth to Water Table = 4m	III	B	11
299	Meadow Valley (Faulder)	Unconfined, Sand and Gravel, loose to compact. No. of wells = 18 (approx.) Ave. well depth = 44m (range of 12 to 122 m) Average Yield – 10 L/s (range 0.4 to 139 L/s) Ave. depth to Water Table < 1 m to 52 m	III	C	10
300	Summerland	Unconfined, Fractured Bedrock No. of wells = unconfirmed Ave. well depth = 95m Average Yield = Low 0.11 L/s Ave. depth to Water Table = 21m (range 8m to 52m)	II	C	12

Figure 3.7 - Provincially Defined Groundwater Aquifers



Summerland Trout Hatchery

The Summerland Trout Hatchery, at the base of Lakeshore Drive, is one of five hatcheries operated by the Freshwater Fisheries Society of BC (FFSBC). It is the oldest fish hatchery in the Province, having been in continuous operation since 1928. It holds a water license on Shaughnessy Creek, a groundwater fed creek originating from several springs located upslope of the hatchery. The existence of this stable water supply is the primary reason the Summerland Trout Hatchery was constructed in its current location on Lakeshore Drive. Without this critical water supply, this 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 Trout and Eneas Creeks. The lining of Trout Creek Reservoir may negatively impact flow regimes of Shaughnessy Spring placing the lives of several million eggs and fish at risk. Therefore, all future groundwater projects must consider the potential impact to the Summerland Trout Hatchery water supply and to other groundwater users in the District.

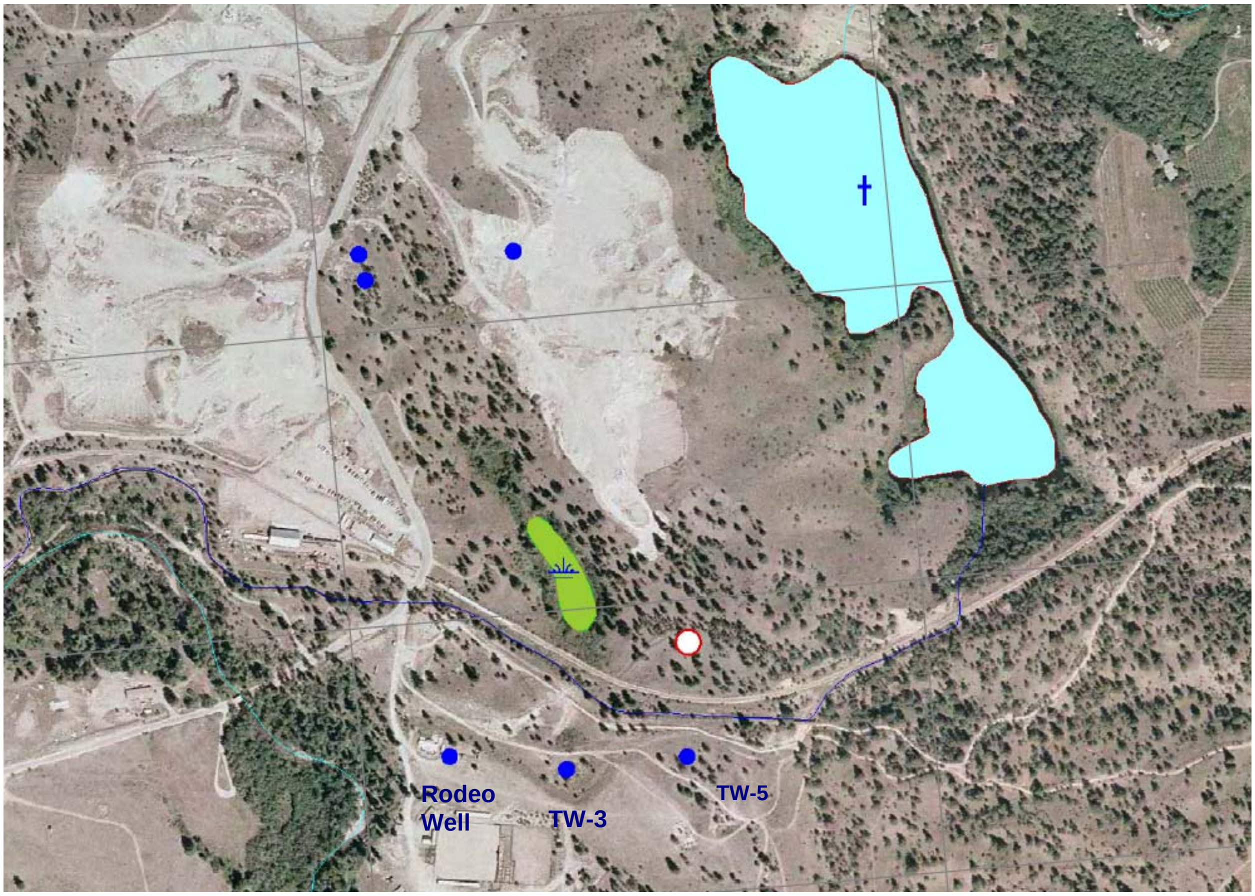
EXISTING GROUNDWATER WELLS

The District of Summerland operates three groundwater wells, all located above the Trout Creek intake reservoir as shown on Figure 3.8.

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 are used only during times of drought and are regularly maintained. 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 3.8 - Existing Groundwater Well Locations



To reduce demands on the water treatment plant, the well water could be pumped directly into the water distribution system. To accomplish this, approximately 1,340 metres of 250 mm main would be required, however this is not recommended due to the quality of wells and cost of the watermain.

3.9 CENSUS DATA - POPULATION

Population data is summarized in this section to provide some context as to the historic growth that has occurred within Summerland. Data going back to 1921 was found to be available from the province. The long term growth rate is 2.07%.

Census data shows that from 1921 to 2006, the population of Summerland grew from 1,892 persons to 10,828. The growth was relatively steady. The data is tabulated on Table 3.8 and illustrated on Figure 3.9.

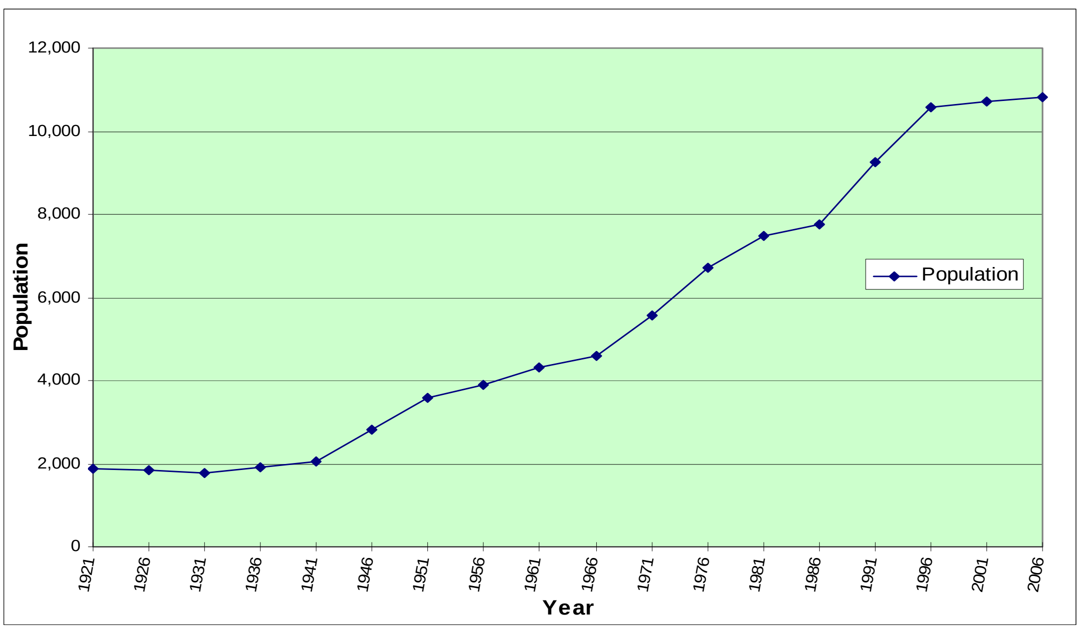
The agricultural base was the core industry for the community. The growth rates in the District were highest between 1941-51, 1966-76, and from 1986-1991.

The historic rates presented here will be considered when projecting forwards with population growth and forecasting future water demands.

Table 3.8 - 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%

Figure 3.9 District of Summerland – Population Growth (1921 – 2006)

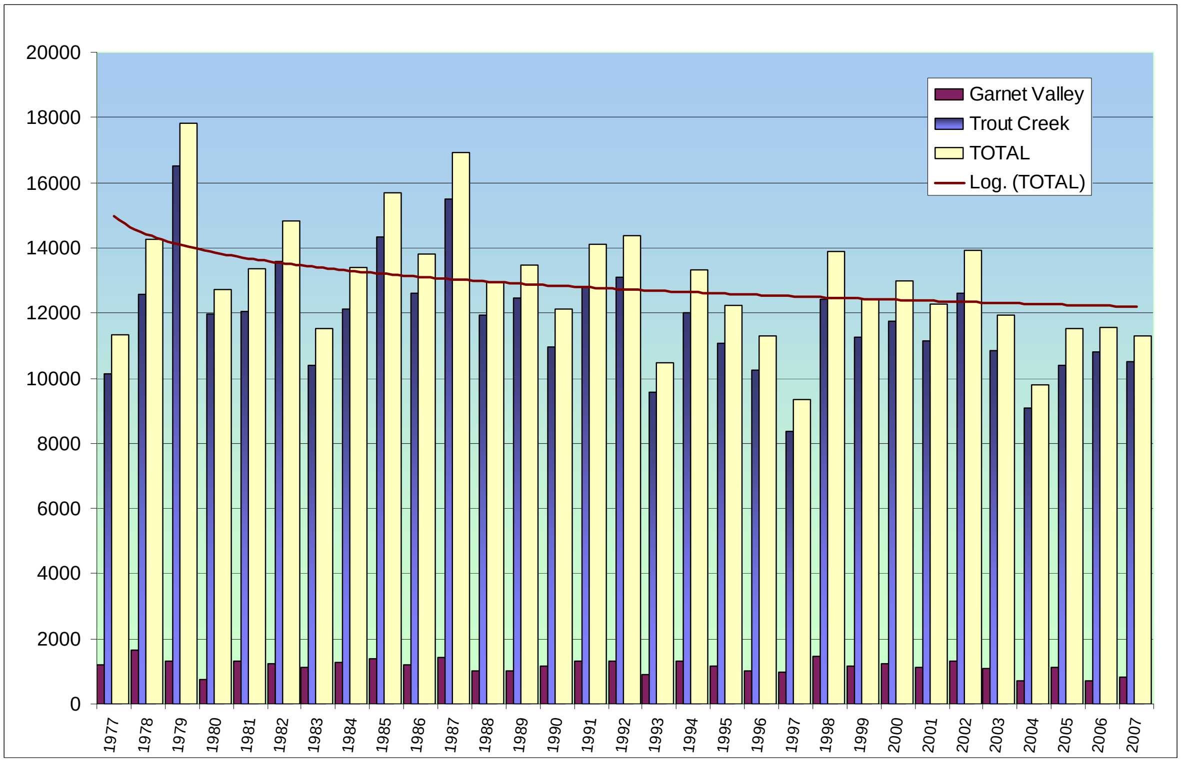


3.10 HISTORIC WATER CONSUMPTION

This section presents historical records since 1977. The data is useful to understand the consumption evolution within the district and allows establishing demand trends. Forecast of future water demands can be obtained from the identified trends. The years of highest water use were 1979 and 1987 where 17,900 and 16,806 ML of water was used respectively. The year 1987 is known to be one of the highest water use years on record for most utilities in the Okanagan.

Figure 3.10 summarizes the domestic, irrigation and total water consumption within Summerland from 1977 to 2007. The critical factor to note is that although the land base has remained relatively constant and there has been relatively consistent population growth, the drier years such as 1979, 1987, 1994, 1998 and 2002 represent the highest years for water use.

Figure 3.10 - Historic Water Consumption Summary Chart (1977 – 2007)



The trend presented in Figure 3.10 may be surprising to some people. The reasons for the decline in water demand are numerous. The probable reasons include the reduction of land in agricultural production, the changing of crop types to those requiring lower annual water use (vineyards), a strong effort placed towards water scheduling, education, and increased irrigation efficiencies. Metering will likely see the current lower levels maintained. The impact from all of these factors has resulted in a reduced water demand of approximately 10%. Current trends of housing densification have resulted in less water being used per new connection. It is expected that this trend will continue, however the trend line shown in Figure 3.10 will inevitably start to climb as expansion into new areas and population growth continues.

3.11 WATER DISTRIBUTION SYSTEM REVIEW

This section provides a review of the District of Summerland water distribution system. The District of Summerland has two relatively independent distribution areas, the Summerland (Trout Creek) water distribution system and the Garnet Valley water system.

The water distribution system review was completed utilizing the updated water model and considering various water demand scenarios including fire protection. The key factor during the system review is the identification of low residual pressures during normal operation and also during critical conditions such as Peak Hour Demand and Maximum Day Demand plus fire flow requirements.

COMPUTER WATER MODEL UPDATE

The water distribution model is the primary tool used to analyze the capacity of the water distribution system. The existing Summerland computer model was upgraded for this plan. Pump controls, pump curves and reservoir data were added to the model. All of the PRV settings were verified. A summary of the modeling work carried out is listed in Appendix C.

The computer model for the water distribution system provides the ability to analyze the water system on a daily basis in terms of daily or weekly flows. The model is set up in the program EPANET which is a public domain program developed by the USEPA. It is used by water utilities across North America for the analysis of water distribution systems. 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 items of use for Summerland is that all of the watermains were tagged for material type and year installed. This will form a database of pipe materials in the ground for the purposes of determining funds that should be set aside for system renewal, and it should also be useful for the Tangible Capital Asset reporting that is required by the Province for all utilities in 2009.

The EPANET model does not have the capability to assess seasonal water demands or upper watershed reservoir storage requirements. That assessment is done with the use of the watershed model that was used in the review of the Water Use Plan.

Future 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 analysis of chlorine levels throughout the water distribution system.

Existing Pressure Zones

The Summerland water distribution system is comprised of 23 pressure zones. Within this report, each pressure zone is designated by the hydraulic grade line (HGL) in metres of elevation. Figures 3.11(S) and 3.11(N) show the pressure zones in the south and north halves of the Summerland water distribution system respectively. Table 3.9 summarizes the estimated water demand within each pressure zone during the current maximum daily demand condition in litres per second.

Table 3.9 Water Demand per Pressure Zone

Pressure Zone ID	Local PZ Demand (L/s) Dom+ICI	Local PZ Demand (L/s) Irrig	Total Through Demand (L/s) Dom+ICI	Total Through Demand (L/s) Irrig
Trout Creek System	**MAX DAY SUMMER DEMANDS**			
PZ 668 Golf Course	1.62	65.06	1.62	65.06
PZ 638 Simpson Road	0.85	33.63	2.47	98.69
PZ 730 Hermiston	0.77	0.00	0.77	0.00
PZ 667 Morrow Road	1.62	9.04	2.38	9.04
PZ 636 Upper Dale Meadows	0.03	9.92	0.03	9.92
PZ 649 South Prairie Valley	0.38	8.16	0.38	8.16
PZ 647 Upper Trout Creek Reservoir	2.03	62.76	2.03	62.76
PZ 594 Prairie Valley	42.58	264.58	128.87	981.56
PZ 499 Canyon View	1.44	44.66	13.44	147.42
PZ 417 Lower Trout Creek	11.99	102.76	11.99	102.76
PZ 563 Downtown Core	42.00	239.05	53.55	372.37
PZ 498 Okanagan Lake N	0.35	18.36	0.35	18.36
PZ 533 Happy Valley Rd	4.56	61.78	4.94	62.67
PZ 464 Lower Gartrell	0.38	0.89	0.38	0.89
PZ 518 Hespeller Road	1.99	8.58	3.78	34.23
PZ 479 Front Beach Rd	1.80	25.66	1.80	25.66
PZ 487 Whitfield Road	0.41	17.41	2.47	18.06
PZ 434 Crescent Beach	2.06	0.65	2.06	0.65
PZ 502 Bristow Road	1.68	4.69	12.01	8.62
PZ 464 Peach Orchard	6.55	3.93	6.55	3.93
PZ 387 Lower Town	3.78	0.00	3.78	0.00
Garnet Valley System				
PZ 625 Upper Garnet Valley	6.1	40.7	10.5	65.8
PZ 600 Lower Garnet Valley	4.4	25.1	4.4	25.1

Gravity supplied pressure zone (orange) — Pumped supply pressure zone (cyan)

Table 3.10 and Figure 3.12 on the following page present the estimated average monthly and annual water demand per user group for Summerland. The data is useful in assessing how much water to allocate for various future uses.

Table 3.10 Monthly Usage per User Group

DISTRIBUTION PATTERNS FOR MONTHLY WATER USAGE																	
			ML/yr/unit	Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ML/yr	
Grade A Land	1249	ha.	0.693	0	0	0	0.020	0.081	0.135	0.178	0.169	0.085	0.025	0	0	8649	m depth of water irrig. /.mo.
Single Family Lots	3717	lots	0.647	0.031	0.028	0.031	0.05	0.07	0.082	0.097	0.088	0.077	0.032	0.03	0.031	2405	ML per connection per mo.
MF / Townhouses	626	Units	0.388	0.019	0.017	0.019	0.030	0.042	0.049	0.058	0.053	0.046	0.019	0.018	0.019	243	ML per connection per mo.
ICI	261	Units	0.970	0.046	0.042	0.046	0.075	0.105	0.123	0.145	0.132	0.115	0.048	0.045	0.046	253	ML per connection per mo.
Leakage	728.0	ML/yr	0.000	61.8	55.8	61.8	59.8	61.8	59.8	61.8	61.8	59.8	61.8	59.8	61.8	728	ML of UFW / mo.
TOTAL ANNUAL WATER DEMAND																12278	
WATER USAGE PER MONTH (ML)																	
LAND USE				Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	
Grade A Land	1249	ha.		0	0	0	250	1005	1686	2223	2111	1062	312	0	0	8649	
Single Family Lots	3717	Lots		115	104	115	186	260	305	361	327	286	119	112	115	2405	
MF / Townhouses	626	Units		12	11	12	19	26	31	36	33	29	12	11	12	243	
ICI	261	Units		12	11	12	20	27	32	38	34	30	13	12	12	253	
Leakage	728	ML/yr		62	56	62	60	62	60	62	62	60	62	60	62	728	
TOTAL DEMAND PER MONTH				201	181	201	534	1381	2114	2720	2567	1467	518	194	201	12278	

Figure 3.12 Average Monthly Water Demand per User Group

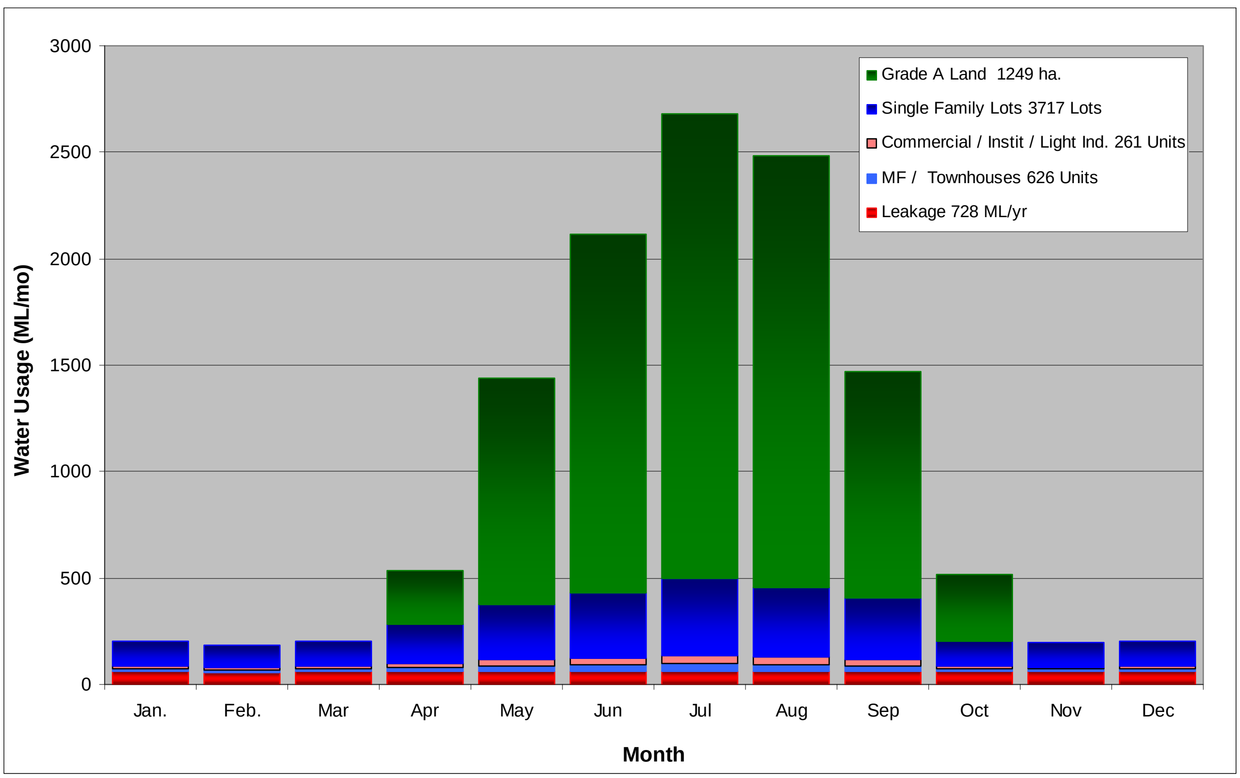


Table 3.11 provides a listing of the key infrastructure components within the Summerland water distributions system. The list includes the water sources, balancing reservoir, booster stations and PRVs. The location of the key infrastructure components is shown on Figures 3.13(S) and 3.13(N). Key components of infrastructure are reviewed in this section including the reservoir storage tanks, the water pump stations, pressure reducing stations, the hydrant coverage, and the water distribution system conveyance capacity.

Table 3.11 Key Infrastructure Components (refer to Figures 3.13(S) and 3.13(N))

I.D.	Location	Description
Sources		
S-1	Trout Creek Intake	Elevation 594 m
S-2	Garnet Lake	Elevation 6
W-		60 hp, vertical turbine, 31 L/s, WL drawdown to 320 elev. Grd…420 m
W-		75 hp submersible, 31 L/s WL drawdown to 404 m elev. Grd 435.7m
Water Treatment Plant		
WTP	Prairie Valley Road	Capacity 75 MLD
Reservoir Storage Tanks		
R-1	Deer Ridge	423 m³, Concrete Reservoir. HWL 726.0 m
R-2	Trout Creek	430 m³, Concrete 2 cell reservoir HWL 470.5 m
R-3	Lower Town	190 m³, Concrete 2 cell reservoir HWL 386.9 m
Pump Stations		No. Hp Flow and TDH, Pump Model Voltage and rpm
PS-1	Prairie Valley Road	2 – 20 hp (16.7 L/s @ 54.6 m) Aurora Model 411, 460V, 3600 rpm
PS-2	Dale Meadows Road	2 – 50 hp (41.4 L/s @ 56.9 m) Aurora Model 411, 460V, 1770 rpm. One pump is VFD equipped.
PS-2A	Morrow Avenue	2 – 25 hp (37.9 L/s @ 36.6 m) Peerless Pump 4X4X8A PV, 208V. One pump is VFD equipped.
PS-2B	Hermiston Drive	2 – 15 hp Berkeley B1 - 1 1/2 ZPL
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	Pollock Terrace	1 – 5 hp *operated without reservoir, planned to be decommissioned
PS-8	Lakeshore	1 – 30 hp (30.3 L/s @ 54.9m TDH) Oliver Pump, 208V
PRV Stations		Main Valve Size/Type Bypass Valve Type Inlet Pressure m (psi) Outlet Pressure m (psi)
PRV-01	Garnet Valley Road	150mm Clayton 38mm Clayton 88m (125 psi) 63m (90 psi)
PRV-03	Trout Creek Tank	2-150mm Singers 38mm Singer 98.5m (140 psi) Tank Level
PRV -04	McDougal Road	100mm 38mm Clayton 105m (150 psi) 38m (54 psi)
PRV-05	Whitfield Road	150mm 38mm Clayton 119.6m (170 psi) 47.9m (68 psi)
PRV-06	Slater Road	200x150mm Cla- Reduced Port, 75x50mm Cla Red. Port 108.4m (154 psi) 43.6m (62 psi)
PRV-07	Solly Road	200mm Clayton 75mm Clayton 91.5m (130 psi) 52.8m (75 psi)
PRV-08	Solly Road	200mm Clayton 75mm Clayton 123m (175 psi) 56.3m (80 psi)
PRV-09	Lower Town Tank	100mm Clayton 91.5m (130 psi) Tank Level.
PRV-10	Prairie Valley Road	3-300mm Claytons 100mm Clayton 105.6m (150 psi) 70.4m (100 psi)
PRV-12	Hespeler Road	150mm Clayton 38mm Clayton 98.5m (140 psi) 52.8m (75 psi)
PRV-13	Clark Street	100mm Clayton 38mm Clayton 98.5m (140 psi) 56.3m (80 psi)
PRV-14	Harris Road	150mm Clayton 50mm Clayton 95m (135 psi) 56.3m (80 psi)
PRV-15	Hillborne Avenue	250mm Clayton 75mm Clayton 98.5m (140 psi) 49.3m (70 psi)
PRV-16	Gartrell Road	150mm Clayton 38mm Clayton 126.7m (180 psi) 56.3m (80 psi)
PRV-17	Morgan Street	200mm Clayton 63mm Clayton 112.6m (160 psi) 63.3m (90 psi)

RESERVOIR STORAGE TANK REVIEW

Through the upgrading of the computer model, a greater understanding of the water distribution system, pump stations and reservoirs was gained and the existing system was then reviewed. A component of the review is an assessment of the existing reservoir storage to determine whether or not the existing reservoir storage tanks are of adequate capacity.

Table 3.12 provides both a numerical and graphical presentation of the gravity and pumped pressure zones. Each zone is supplied from the zone to the left. The reservoir storage was reviewed based on providing balancing storage, the required fire storage to FUS requirements, and an additional 25% volume for emergency conditions.

Table 3.12 Reservoir Storage Tank Assessment

Pressure Zone ID	MDD for Dom+ICI Local	MDD for Dom+ICI Total	Balancing (m^3)	Fire (m^3)	Emergency (m^3)	Total Req. (m^3)	Existing (m^3)	Spare (m^3)
Trout Creek System								
PZ 677 Golf Course	1.62	2.47	53.4	456.9	127.6	638	0	-637.9
PZ 641 Simpson Road	0.85							
PZ 730 Hermiston Drive	0.77	2.38	51.5	456.9	127.1	636	423	-212.5
PZ 690 Morrow Avenue	1.62							
PZ 628 Upper Dale Meadow	0.03	0.03	0.6	456.9	114.4	572	0	-571.9
PZ 667 Fyffe Road	0.38	0.38	8.3	456.9	116.3	581	0	-581.5
PZ 642 Trout Creek Reservoir	2.03	2.03	43.9	456.9	125.2	626	0	-626.0
PZ 586 Prairie Valley	42.58	121.57	2626.0	2328.8	1238.7	6193	6020	-173.4
PZ 548 Canyon View Road	1.44							
PZ 417 Trout Creek	11.99							
PZ 563 Downtown	42.00		all gravity fed from WTP clearwell					
PZ 498 Okanagan Lake North	0.35							
PZ 533 Happy Valley Road	4.56							
PZ 464 Lower Gartrell	0.38							
PZ 518 Hespeler Road	1.99							
PZ 479 Front Beach	1.80							
PZ 487 Wheatfield Road	0.41							
PZ 434 Crescent Beach	2.06							
PZ 502 Bristow Road	1.68							
PZ 464 Peach Orchard	6.55							
PZ 387 Lower Town	3.78							
Garnet Valley System								
PZ 625 Upper Garnet Valley	10.91	18.9	408.0	456.9	216.2	1081	2360000	2358919
PZ 600 Lower Garnet Valley	7.97							

PZ 641 Pumped Pressure Zone; PZ 625 Gravity Fed Pressure Zone; Area of Concern

Fire storage forms a large component of reservoir storage. New development that will be occurring will require fire flows in the range of 150 to 250 L/s for a duration in conformance with FUS standards. Increased fire storage can be covered by either new development, building fire storage above the existing service pressure zones. Costs for storage should be covered through DCC contribution.

For the existing high density areas, a maximum fire flow of 225 L/s for a duration of 2.875 hrs was included in the calculations. The FUS guidelines do not require a 25% emergency storage component however, this component provides the supplier with the buffer necessary to accommodate changes in the water supply system. Distribution system improvements are presented at the end of this section.

HYDRANT COVERAGE

In addition to the water system review, a hydrant coverage review was conducted. The coverage required by hydrants is determined based on fire flow requirements and zoning. Figures 3.14(S) and 3.14(N) illustrate current fire coverage throughout the District as well as proposed locations for additional hydrants.

The hydrant radius presented for all single family areas is 150m. The District subdivision bylaw requires a minimum hydrant spacing of 180m however, the FUS calculation for large new single family homes typically works out to a hydrant spacing of 138m. A minimum spacing of 150m is recommended for all existing and new development areas. The hydrant radius is smaller (100 m) in high fire flow zones such as commercial or industrial areas.

Based on the water distribution system mapping, there are 419 existing hydrants and 9 standpipes within the water distribution system. Based on the mapping and hydrant coverage analysis, there are several areas where hydrant coverage is deficient. As illustrated in Figures 3.14(S) and 3.14(N), it is estimated that a total of 64 additional hydrants are required in the distribution system. The drawings should be forwarded to the fire department to determine where the highest priority locations are for hydrant installations. This will help to manage and reduce the risk of inadequate hydrant coverage. Hydrants are included as an on-going project for the District and are listed as Project 30 in Appendix A.

Table 3.13 - Fire Flow Table – Storage and Hydrant Radius

Flow (L/s)	Flow (L/min)	Std Hydrant Coverage (m2)	Req'd Hydrant Radius (m)	Hydrant Diameter	Duration (hr)	FF Storage Vol + 25% emerg. (m3)	Flow No. of Hydrants
60	3600	15200	69.6	139.1	1.400	378	
75	4500	14750	68.5	137.0	1.670	564	80 L/s 1 hydrant
90	5400	14300	67.5	134.9	1.870	757	150 L/s 2 hydrants
125	7500	13250	64.9	129.9	2.000	1125	225 L/s 3 hydrants
150	9000	12500	63.1	126.2	2.000	1350	280 L/s 4 hydrant
175	10500	11750	61.2	122.3	2.130	1677	
200	12000	11000	59.2	118.3	2.500	2250	
225	13500	10375	57.5	114.9	2.875	2911	**Max. Recommended**
250	15000	9750	55.7	111.4	3.250	3656	
275	16500	9375	54.6	109.3	3.625	4486	
300	18000	9000	53.5	107.0	4.000	5400	
325	19500	8625	52.4	104.8	4.375	6398	
350	21000	8250	51.2	102.5	4.750	7481	

PRV STATION REVIEW

The PRV stations were reviewed and inspected as part of the works. The stations are a key transfer location for the flow of water across pressure zones. It was noted that not all of the PRVs have ventilation fans. Fans would improve the operational safety and would help to meet the requirements of WCB.

An assessment of the MDD and PHD conditions was carried out in the review of these stations. A maximum normal operating velocity of 5 m/s is recommended by the manufacturers of Clayton and Singer PRVs. A maximum continuous velocity of 6 m/s is permitted, however this should not be a normal operating condition.

Table 3.14 PRV Capacity Review

PRV ID	Upper PZ	Lower PZ	Local Demand MDD (L/s)	Local Demand PHD (L/s)	Through Flow MDD (L/s)	Through Flow PHD (L/s)	Main Valve Valves	Main Valve Diam (mm)	By-pass Valves	By-pass Diam (mm)	Velocity (m/s) Under MDD	Velocity (m/s) Under PHD	Max Flow based on 5 m/s (L/s) Main Valve	Max Flow By-pass	Max Flow Total	Max Flow FF Available
1	625	600	34.7	39.4	34.7	39.4	1	150	1	38	1.8	2.1	88.4	5.7	94.0	59.4
4	563	498	18.9	21.6	18.9	21.6	1	100	1	38	2.1	2.4	39.3	5.7	44.9	26.0
5	563	487	18.0	20.6	20.9	23.9	1	150	1	38	1.1	1.3	88.4	5.7	94.0	73.1
6	487	434	2.9	3.4	2.9	3.4	1	150	1	50	0.1	0.2	88.4	9.8	98.2	95.2
7	502	464	11.5	13.1	11.5	13.1	1	200	1	75	0.3	0.4	157.1	22.1	179.2	167.7
8	594	502	6.8	7.7	18.2	20.8	1	200	1	75	0.5	0.6	157.1	22.1	179.2	160.9
10	594	563	287.0	327.9	423.5	483.8	3	300	1	100	1.9	2.2	1060.3	39.3	1099.6	676.1
12	563	518	11.1	12.7	38.9	44.5	1	150	1	38	2.1	2.4	88.4	5.7	94.0	55.1
13	518	479	27.8	31.8	27.8	31.8	1	100	1	38	3.1	3.5	39.3	5.7	44.9	17.1
14	563	533	67.4	77.0	68.8	78.6	1	150	1	50	3.5	4.0	88.4	9.8	98.2	29.4
15	594	499	46.6	53.2	163.2	186.4	1	250	1	75	3.1	3.5	245.4	22.1	267.5	104.3
16	533	464	1.4	1.6	1.4	1.6	1	150	1	38	0.1	0.1	88.4	5.7	94.0	92.6
17	499	417	116.6	133.2	116.6	133.2	1	200	1	63	3.4	3.9	157.1	15.6	172.7	56.1

Consider PRV upgrade (shaded: FF Available for PRV 1, 4, 12, 13, 14, 17)

Under normal maximum daily demand and under peak hour demands, the PRV stations are adequate to provide flows to the service areas. Under fire flow conditions, the smaller stations may be subjected to high velocities. Some of the stations should perform adequately under a slightly higher velocity such as 6.0 m/s however, there are three stations that require further review. PRVs that require upgrades in order of priority are PRV 13, 4, and 14. Lower priority upgrades are required at PRV 12, 17 and 1.

For some stations, it may be possible to upgrade the largest pressure reducing valve in the station. Major process piping modifications may be required at other stations. It is recommended that the simpler upgrades be carried out by the District staff within their Capital Projects budget.

The only station that appears to have potential for hydro-electric generation potential is PRV 10 as it has the highest flow-through of water year-round. More detailed analysis of the flow characteristics of the station should be conducted to determine the viability of hydro-electric generation.

PUMP STATION CAPACITY REVIEW

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

Table 3.15 provides a graphical summary of the primary, secondary and tertiary 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 3.15 provides a summary of the MDD to be supplied to each pressure zone.

Table 3.15 Pump Station Capacity Assessment

Pressure Zone ID	MDD (L/s) Local	MDD (L/s) Total	Elevation Gain (m)	10% Headloss	TDH (m)	Required (hp)	Existing (hp)	Spare (hp)
Trout Creek System								
PZ 677 Golf Course	66.68	66.68	36	3.6	39.6	50	30	-20
PZ 641 Simpson Road	34.48	101.16	55	5.5	60.5	117	75	-42
PZ 730 Hermiston Drive	0.77	0.77	40	4.0	44.0	1	15	14
PZ 690 Morrow Avenue	10.65	11.42	104	10.4	114.4	25	25	0
PZ 628 Upper Dale Meadow	9.94	9.94	42	4.2	46.2	9	10	1
PZ 667 Fyffe Road	8.55	8.55	81	8.1	89.1	15	25	10
PZ 642 Trout Creek Reservoir	64.79	64.79	56	5.6	61.6	76	70	-6
PZ 627 Pollock Terrace *	0.50	0.50	41	4.1	45.1	0.4	5	5
PZ 586 Prairie Valley	307.16	1110.43						

* station to be abandoned once James Lake station is commissioned

Our assessment shows that upgrading is required to provide full redundancy at three stations. The Simpson Road station is the station that is most stressed in terms of horsepower capacity. Pump run times will dictate which stations are most stressed.

DISTRIBUTION SYSTEM HYDRAULIC CAPACITY REVIEW

The water distribution system was reviewed with respect to hydraulic capacity. The hydrant fire flow capacity of the distribution system was checked at critical locations and at the upper elevation limits of the pressure zones 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 3.15 illustrates a snapshot of pressures and watermain head loss within the water distribution system during MDD conditions. The parameter illustrated for water mains (lines) is unit head loss, which is defined as the amount of friction losses created by high water flow. A high unit-head loss will result in large pressure drops and reduced conveyance capacity. The junctions (circles) illustrated show pressure in metres of head. (1 metre of head = 1.42 psi)

The friction losses within the water mains are colour-coded. The red water mains have a 10 m/1000 m head loss or >1.00% head loss. Orange coloured pipes have a unit-head loss of 3 to 10 m/1000m head loss. The pipes that are red are flagged as being restrictive and should be upgraded under a renewal program. There is generally good interconnection in the District water distribution grid.

Water age is identified on Figure 3.16. The water age analysis was run under winter (low flow) conditions and the time is presented in hours from when the water entered the water distribution system.

3.12 WATER CONSERVATION STRATEGIES

The District of Summerland has progressed very well in the past four years in the development of a water conservation initiative. A full time Water Conservation Officer is on staff to facilitate the District water conservation program. This section provides a brief review and comment on the current water conservation strategies and direction for the District.

The core reasons to continue to promote and support water conservation strategies are numerous. They include:

- To make sure that the reservoirs in the watershed are left at the highest possible levels at year end so that the probability of refilling them in the following spring runoff is maximized;
- So that water is not wasted or overused so that additional evaporation or evapo-transpiration is not occurring where water is lost to our basin;
- To ensure that there is sufficient water available for both man and the environment so that good stream stewardship is practices and a normal means of operation;
- To delay the construction of additional reservoir storage or infrastructure piping as the costs to the community would be substantial;
- To reduce fixed operating costs for the district water system including water treatment chemicals, chlorine for disinfection, and electrical charges for pumping of water;
- To there is sufficient water to support additional agriculture in the community; and
- To allow water for future development and growth in the community.

There are several key documents in place that are being utilized and several documents that are in draft form. These include:

- Trout Creek Water Use Plan Operating Agreement;
- District of Summerland Drought Management Plan, prepared by Water Operations staff and the Water Advisory Committee;
- District of Summerland, Water Conservation Annual Report, 2007;
- District of Summerland, Draft Water Conservation Bylaw;
- Existing Summerland Water Rates and Regulation Bylaw No. 2358;
- Province of BC, Land and Water BC, Dealing with Drought Handbook.

The key items noted in the review of the documents were that some of the terminology is not consistent with the provincial terminology. *Water Restrictions* should be referred to as *Water Regulations*, particularly at the normal stage, when the use is not restrictive, but rather proper management that allows sufficient water for all reasonable uses. Definitions for the five stages of the program were also not clearly defined. The five stages as set out provincially appear to have been followed by the District and reflect:

1. Normal Conditions (normal water regulations apply)
2. Mild Drought
3. Moderate Drought
4. Severe Drought, and
5. Extreme Measures where only water for drinking water is available.

This terminology should be consistent as the Okanagan Basin Water Board is considering coordination of regional drought strategies so that common practises are followed throughout the valley. The *Dealing with Drought Handbook* is likely to be the template document for regional drought planning, so Summerland should closely follow the recommendations and staging within that document.

The key decision makers in the role of conservation and dealing with drought are the Water Conservation Officer, the Water Advisory Committee, the Engineering and Public Works Department, and Municipal Council. Since 2002, Summerland has made significant progress in their conservation initiatives. The major steps are commented on below along with actions to take in the future.

1. **District Commitment (on-going)** This commitment is apparent with the current initiatives taken towards metering and having a full time Water Conservation Officer on staff. The job role and tasks for the staff member may evolve in time however, with the implementation of meters throughout the community, the education that goes with metering will be on-going for several years.

2. **Education** A significant effort has been made by District staff on irrigation scheduling and education that has been focused towards the larger water users. This is effective as it targets where the larger blocks of water are used and even small percentage gains in efficiency are worthwhile.

3. **Water System Understanding (on-going)** In the last few years, there has been work by Water Management Consultants and within this report that break down the amount of water into the various user groups. This information provides an indication of the allocation of water required by each of the user groups. The understanding of water use will increase as the district collects data from meter reads.

   Although there are estimates provided within this report on water use from the various categories as set out in Table 3.10 and Figure 3.12, there are still minor discrepancies between the Ministry of Agriculture data and the Arable Lands tax roll. A rationalization and validation of land areas, water use categories and water use by those user groups could be refined. The data presented within this report should be reasonable, but there may be persons within the community that would like more detailed analysis. There are diminishing returns on investment in this type of data management work. Based on the best available information, an annual allocation of 800mm should be set over the taxed arable land area.

4. **Unaccounted for Water (UFW)** Reduction of UFW should be determined through a systematic procedure of determining where and how the water is used, quantifying the volume and cost of UFW, and then determining means of tracking down the missing volumes. High

technology leak detection equipment is available in the Okanagan as are portable strap-on flow meters c/w data loggers to determine water distribution system flow characteristics. The data available for the winter flows for the Trout Creek system appear to be accurate however, only estimates were made for the Garnet Valley system as the flow meter cannot read the low winter flows accurately.

Unaccounted for Water (UFW) was assessed for the entire water system through the review of SCADA records for overnight flow during times when there was no outdoor usage. It was determined in February of 2007 that the flow rate of UFW was 20.95 L/s in the Trout Creek distribution system. The number obtained from the flow meter records for the Garnet Valley system was determined to be inaccurate. The estimated leakage for the Garnet Valley system, based on age of the system and comparable pipe materials, was 2.16 L/s. The total system leakage is estimated to be 23.11 L/s or 729 ML per year. This amount is 5.95% of the total annual flow or enough water to supply 1,100 single family lots with water. It is recommended that leak detection analysis be conducted over time in the suspected high leakage areas of the water distribution system. Leak detection should be conducted in all areas prior to any major capital project be undertaken such as a sewer upgrade or road improvement.

5. **Educate the Water Users (Underway)** Education can be achieved through visits to the schools, visits with the operators of the larger sports fields, meetings with the agricultural growers, and assembly of informational mail-out brochures. Education has focused on irrigation scheduling. One of the more valuable educational tools will be the meters as the actual monthly water use information will help them gauge how much water they use. Delivering that information in a timely manner on a simple to understand form is critical for effective reporting.

6. **Water Meters (underway)** Water meters offer several benefits, including equity to users, accountability of water use, a tool to educate, a tool for self regulation, and if overuse of allocation continues, a tool from which additional costs to the District can be recovered. The addition of remote read technology to all meter installs is recommended to assist in the education and monthly reporting for all larger water use accounts. Information must be provided to the public in a timely manner.

7. **Pricing Strategies (area of future focus)** Pricing strategies provide an equitable means with which to reduce water consumption. Pricing in conjunction with education and metering forms a complete and defendable method for encouraging water conservation. There are numerous techniques for charging for water, with the inclining block rate being one of the most successful techniques in reducing water usage from the high users. An inclining block rate is where there is a sufficient allotment of water per month allowed to each user under there base water rate. If the water user exceeds their monthly limit, then a higher price for water is applied to create incentive to reduce consumption to reasonable levels.

Figure 3.15(N) Watermain Head loss and Pressure Map (North area)

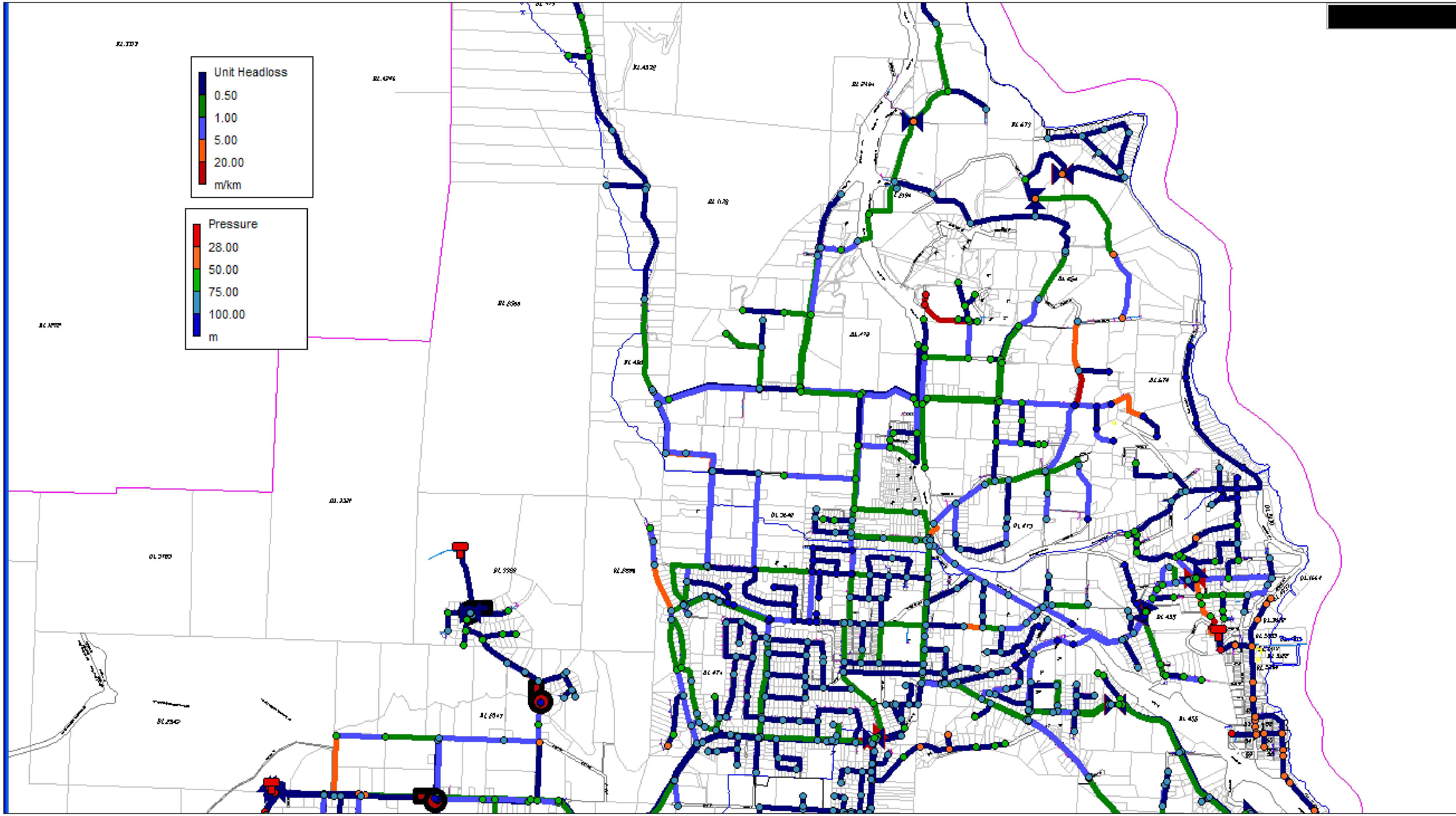


Figure 3.15(S) Watermain Head loss and Pressure Map (South area)

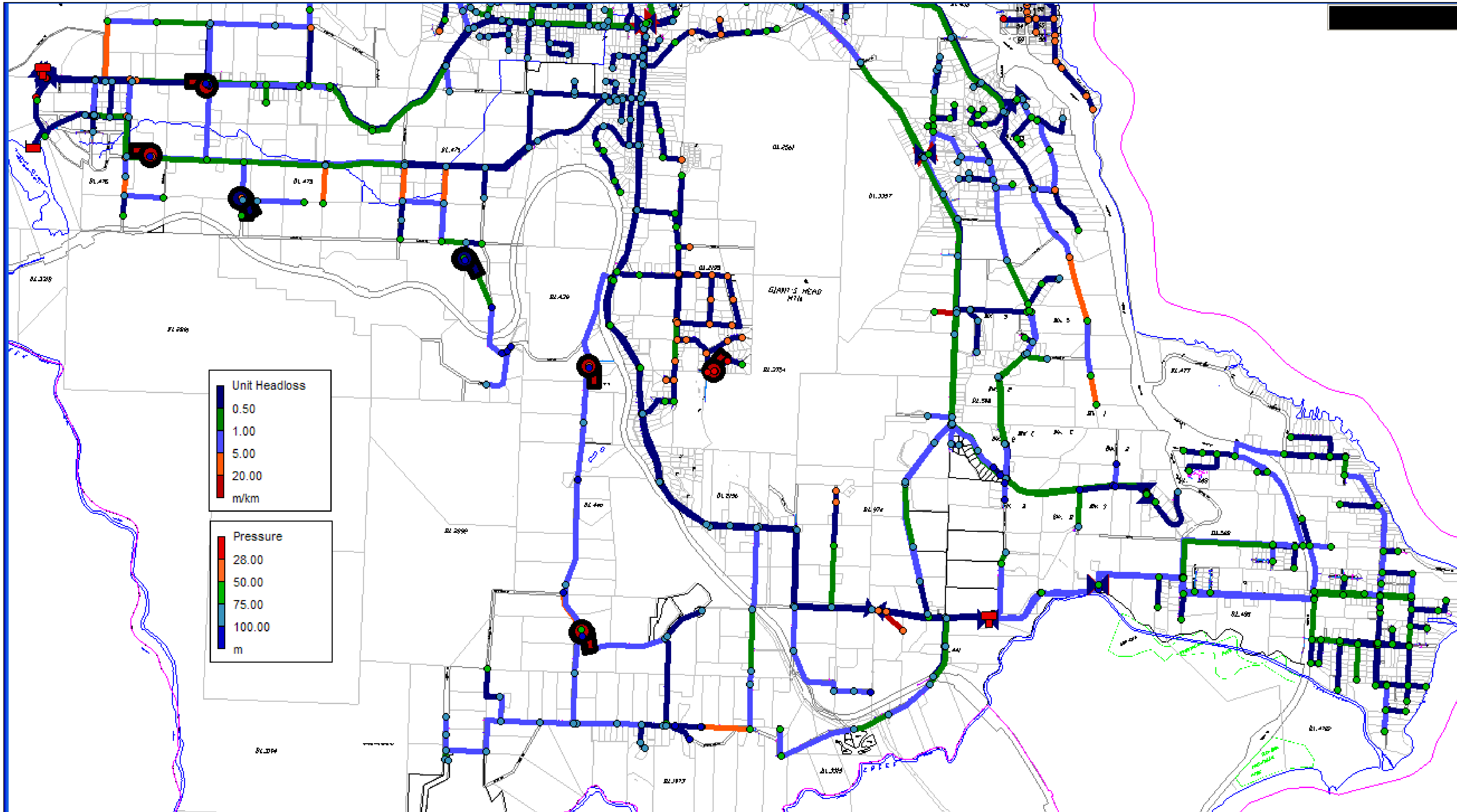


Figure 3.16(N) WATER AGE – North Area

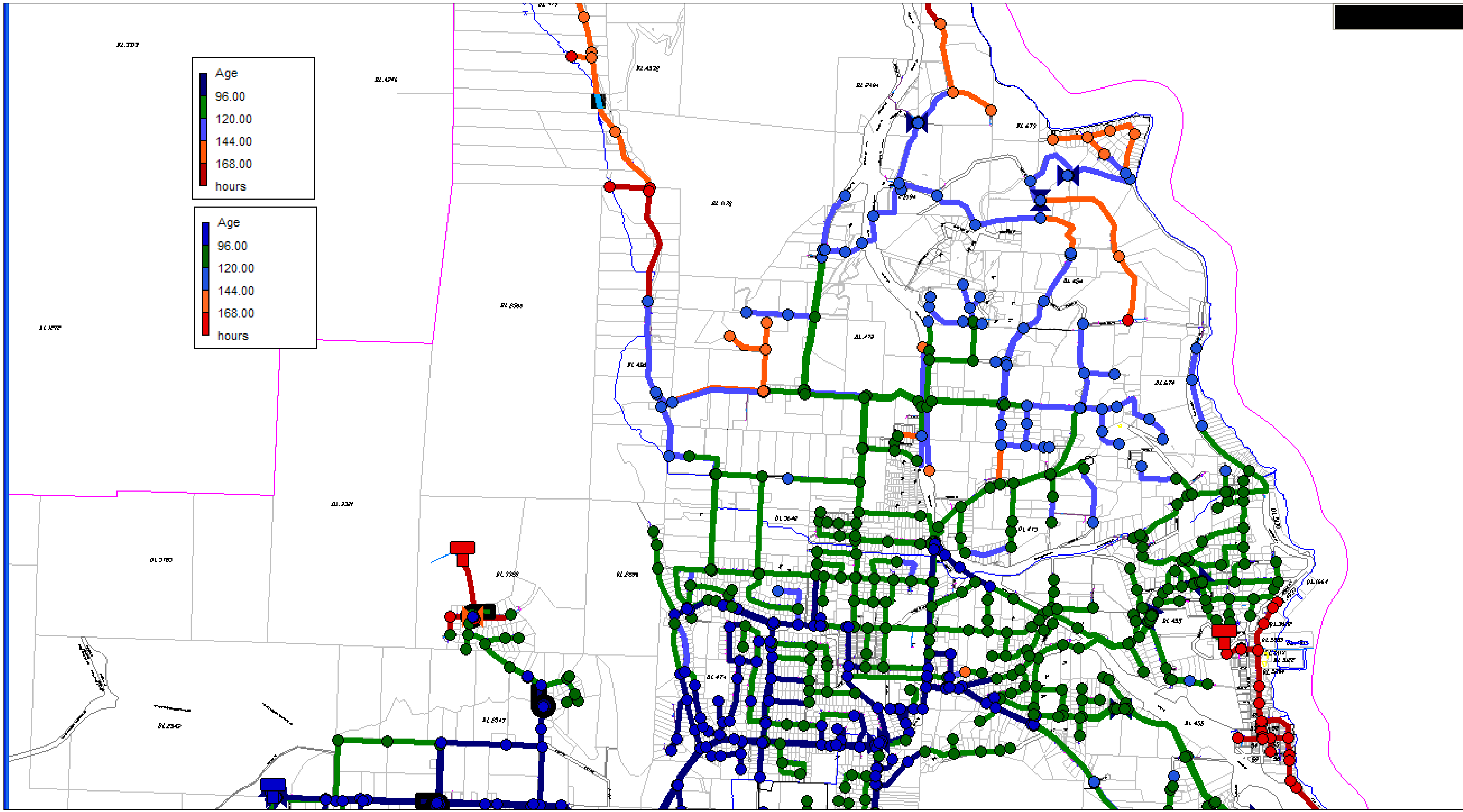


Figure 3.16(S) WATER AGE – South Area

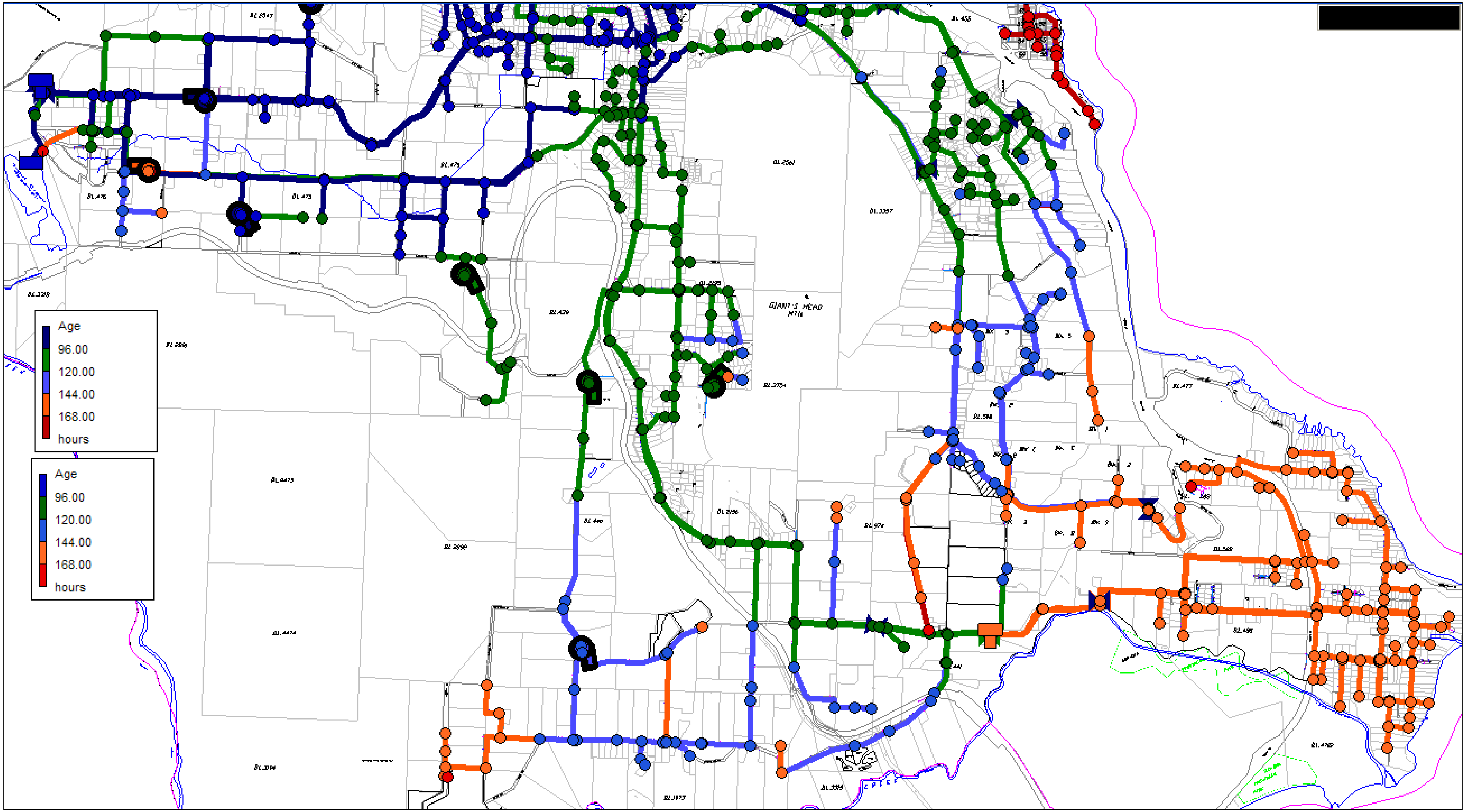


Table 3.16 - Irrigation Reporting Form (example)

Reporting Period: June 30 to July 31, 2008

	Consumption		
	m^3	US Gallons	Inches (depth)
2008 Allotment			
Initial Yr 2008 Reading			-
June 30 Consumption Read			
July 31 Consumption Read			
Reading Date No. 3			
Reading Date No. 4			
Total Consumption to Date			
Remaining Allotment			

Table 3.16 provides an example of a recommended reporting form for the larger irrigation parcels in Summerland. The form would be issued monthly to the large users of the water system. Remote meter read capacity is needed to report this information on a monthly basis.

Domestic readings would be provided in an alternate form in volumetric units and would be taken monthly, but reported quarterly with a total use reading for each month for the current year.

The annual allotment depth of water over the irrigated area would be 800mm which should be sufficient to support most forms of agriculture in Summerland. The volume of water that each property is assigned is based on the taxed land area multiplied by an 800mm depth. The amount of water used each month is reported in units of choice by Summerland. The volume is converted to a depth of water (millimetres or inches) over the irrigated land and is reported in the right column on the form.

The average depth of water used by other irrigators in the District is also provided so that there is an indication of what the larger District is using in that given month or year to date. It is recommended that Summerland delay implementing any type of metered rate or penalty for overuse in 2009 as the current focus should be on education. Other districts with water meters and large blocks of irrigation charge a taxed base water rate which provides a base depth of water for the year. The South East Kelowna Irrigation District utilizes a 675mm depth over the graded area, and charges for exceeding the 675mm depth.

3.13 WATER SYSTEM ELECTRICAL, INSTRUMENTATION AND CONTROLS AUDIT

A thorough review of the District water system electrical and controls was conducted as part of this report. The audit is presented in Appendix D. A key objective of the audit was to assess the condition of the electrical and instrumentation works within each of the water infrastructure facilities. The WTP was being commissioned and therefore was not reviewed in this assessment.

The electrical and instrumentation systems are becoming more critical to the effective operations of water supply systems. The monitoring requirements and expectations of the regulator is higher now than it has ever been. Up-to-date instrumentation for monitoring and controls is necessary also to meet the expectations of the public. Investment in this infrastructure is an on-going expenditure in water system operations.

Key findings and recommendations are as follows:

- SCADA software for the entire system should be upgraded to the standard RSView32 software set at the WTP. The existing SCADA software is dated and upgrades are not available. Purchasing the new WTP software will allow for a backup version of the software so that the distribution system and WTP controls are fully redundant which is a primary objective for this critical monitoring and control equipment;
- Centralize the Programmable Logic Controller (PLC) system to do communications and alarm monitoring for the remote sites. This will allow for more flexible monitoring and centralized alarm reporting. The number of phone lines can be reduced with this work. Having remote controls reduces operator stress and increases reaction times to events and emergencies;
- Garnet Valley Chorination Facility should be upgraded with UHF radio as the cellular phone system that operates in this location is dependant on Rogers cellular to operate. The chlorine equipment should also be located within a separate room so that corrosion of the electronic equipment occurs at a much slower rate;
- 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 booster stations should consider upgrades to allow remote operational control through the SCADA system. This results in quicker operator responses or acknowledgement and understanding of emergencies and better control capability by the operators;
- 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.

Overall, the stations are well maintained, but continual upgrading of the technology is needed to ensure functionality and efficiencies. An annual budget of $50,000 is recommended to carry out the SCADA upgrade work over time.

3.14 SUMMARY OF GENERAL WATER DISTRIBUTION ISSUES

Project upgrading is required in the water distribution system. As development progresses in town, some of the capacity issues related to pump stations or PRVs may be upgraded. There are projects that will be corrected through development and projects that will be part of the normal upgrading works carried out by the Public Works staff.

- **Hydrant Coverage:** Although hydrant coverage is generally very good, there are locations where hydrant coverage is inadequate. It is recommended that the District work towards filling in the gaps in hydrant coverage. It is recommended that eight hydrants per year be installed. The works can be done either by private contractor or by the Public Works department. Funding would be part of the public works capital budget or there may be funds for hydrants in the fire department budgets. Hydrant works are included as Project 30 in Appendix A.
- **PRV Rehabilitation:** The PRV stations are key components to the safety and performance of the water system. They must be maintained, serviced and rebuilt when necessary. There are three stations that are considered to be stressed under a MDD plus fire demand condition. These stations include PRV 3, 13 and 14. Upgrading of the main valve is required in these stations. For the simpler installations where there exists a 100mm valve and 150mm adjacent piping, the District staff can correct these issues. Where more significant process piping works is required, the process piping work can be contracted out. A budget for this work is included as Project 36 in Appendix A.
- **Distribution Reservoir Storage:** Distribution storage is noted to be lacking in several pressure zones. Generators should be considered for some of the pressure zones in order to reduce the risk of failure to supply. 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, either a contribution to additional storage must be made or the building fire demand must be reduced. A contribution for reservoir storage to PZ 586 is listed as Project 34.

  In addition to the large reservoir project, an interconnection is proposed at Pump Station 2B to allow improved fire flow capacity back down into the middle pressure zone. This zone is a flow-through zone where water is pushed up to the Deer Ridge tank. This work is listed as Project 16.
- **Pump Station Upgrades:** As listed in the Electrical and Instrumentation Audit, the services for all of the stations are 480 Volt. Standard voltage for new services is 600 Volt – 3 phase for the larger services. Development will correct some of the deficiencies as reservoirs are constructed above the higher serviced lands. Some of the pumps will also be upgraded as the system separation work takes place. The capacity at some stations will improve as the distribution system is separated. For this reason, the detailed station upgrades are not provided as they will evolve with more detailed design work.

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4. WATER QUALITY REVIEW

4.1 INTRODUCTION

This section provides the criteria used for this report. The criteria include:

- A summary of water supply risks and the need for supply redundancy;
- Multi-barrier approach to drinking water security;
- Presently known drinking water risks;
- Review of water supply quality in comparison with the IHA requirements;
- A summary and assessment of present raw water quality from all sources;
- Factors affecting present and future supply and treatment strategies;
- Recommendations with regards to water treatment direction.

There are risks affecting the overall water supply such as a landslide or forest fire. There are also risks that specifically affect drinking water. Comments for both are provided in this section but the majority of information is related to drinking water risks. The only relevant document to date that sets out drinking water risks for the District is the *Watershed Risk Assessment* report prepared by Earth Tech in 2002. That report is included as Appendix G.

4.2 WATER SUPPLY RISKS

The District of Summerland has invested a significant amount of money in the new water treatment plant (WTP). The plant will be a critical tool in providing high quality, safe drinking water to the residents of Summerland. 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.

Presently, the District of Summerland provides water to customers by gravity, with the majority of water being drawn from Trout Creek.

Algae Bloom in Okanagan Lake, 2003

The District has been monitoring and sampling water quality from the various supply sources for many years. A significant risk facing Summerland is the lack of alternative supply capacity in the event of a catastrophic event such a major algae bloom in Thirsk Reservoir or a natural event such as a major forest fire that could render the watershed water supply unusable. Although this hasn't occurred, the possibility exists. There are several projects in this report that address means of increasing the water supply capacity from other sources. Projects for expansion of the conveyance capacity from Garnet Reservoir and expansion of capacity from Okanagan Lake are presented in Appendix A of this report.

4.3 MULTI-BARRIER APPROACH & SOURCE TO TAP ASSESSMENTS

As part of the Drinking Water Protection Act, a Water System Assessment Plan must be developed for each water supplier. The purpose of an assessment is to identify, inventory and assess:

(a) The drinking water source for the water supply system, including land use and other activities and conditions that may affect that source;

(b) The water supply system, including treatment and operation;

(c) Monitoring requirements for the drinking water source and water supply system; and

(d) Threats to drinking water that is provided by the system.

MULTI-BARRIER APPROACH

A primary objective for the development of a safe water supply is to implement a multi-barrier approach. A multi-barrier approach is defined by Health Canada 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.

COMPREHENSIVE SOURCE TO TAP ASSESSMENTS

Modules 1 and 2 Within this document, much of the work required within those modules is completed. The assessment and delineation of the water sources, mapping, area, volumes of runoff and quality of that raw water runoff are all documented with all of the available information.

Module 7 In addition to the mapping and data provided in Sections 3 and 4, and the 2002 Risk Assessment work in the Appendix, a list of potential drinking water risks that may impact on the District water sources are listed in Table 4.1. The overall level of risk occurrence facing Summerland is considered to be low to moderate for all scenarios except for the high *E.Coli* spikes during the summer. The moderate risks are manageable and can be improved to low risks through simple and relatively low cost upgrades.

Module 8 Recommendations with respect to source protection, future source development and water treatment upgrades are also listed within this report.

Table 4.1 - District of Summerland - Risk Summary Table

No.	DW RISK	IDENTIFICATION METHOD(S)	REVIEW COMMENTS	RISK RATING
1.1	Human Activity	Total/*E.Coli* monitoring of raw water is presently done and should continue. *E.Coli* is the primary indicator if there is the threat of protozoa	Organic waste is present in watershed. Risk exists if both high *E.Coli* levels occurring in the summer months . Chlorine by itself inadequate treatment/disinfection. Septic tanks are present in the Faulder area. Failed septic tanks are a risk of waste contamination.	Low to Moderate
1.2	Natural Wildlife	Visible siting of wildlife	Average wildlife populations	Low
1.3	Pine Beetle	Visible damage to pine trees	Less forest canopy is expected to result in more total and extreme runoff, sediment movement, increased nutrient concentrations in the source water.	Moderate
1.4	Cattle	Cattle present with 2 grazing licensees operating in the watershed.	Cattle activities and management can always be improved.	Moderate to High
1.5	Leachate	Monitoring wells, water level in Trout Reservoir	Protection in place if Trout Reservoir operates at higher water levels. If reservoir level is lower, testing of wells should take place	Moderate
1.6	Chemical Spill	Call-in by public or notification by road officials. Phone call.	Trucking of hazardous chemicals is low. Monitoring issue and filling issue of Trout Creek reservoir can be improved through gate control on Trout Creek intake at the creek.	Low
1.7	Algae Blooms in raw water reservoirs	Source water monitoring. Visible to the eye. Biological monitoring and testing required.	Risk exists and is expected to be higher in Trout Creek system for the next 5 years due to release of nutrients that will occur with the uncovered native soils in the raising of Thirsk Dam. Aeration may improve biological impacts.	Moderate to High risk
1.8	Distribution system regrowth	Customer complaints. Low chlorine residual levels.	Any issues previously noted by residents should be reduced with the WTP coming on-line. Water model has water age and chlorine residual analysis capacity. This will help identify water distribution sections with the oldest water in the District.	Low
1.9	Cross Connection	Measurable loss in Cl_2 residual level.	There is a cross connection policy in place for all new development. Premise isolation and backflow is in place. There are a number of commercial and high hazard installations. These must be tracked down as a normal part of protecting the water distribution system.	Low to moderate
1.10	Watermain Break	Contractor will phone or customers will phone in the break.	Entrainment of silt, sediment and stirred up sediment from within the distribution system piping will create turbidity within the distribution system. Vacuum condition may result at highest elevations if break is at a lower elevation.	Moderate. Same as any utility.
1.11	Power Failure	Alarms to Operator of Communications failure or equipment failure.	Emergency generators or power supply required for SCADA and alarms.	Moderate

The Risk Rating denotes risk of occurrence. Risk of occurrence is the assessment of whether or not the risk is present. If there is a risk of occurrence, then a risk of waterborne disease outbreak is possible.

Watershed Drinking Water Protection Strategy

In 2002, Earth Tech Canada Inc. carried out a Drinking Water Risk Assessment for the District for their surface water sources. The work was completed in 2002 by members of the current study team and is included in Appendix G. The document provided a summary of all identified risks to drinking water facing Summerland in 2002. The work is still relevant today.

The largest risks facing Summerland include:

- Cattle grazing and watering near mainstem creeks within the watershed (real);
- Failed septic tanks in the Faulder area (real potential);
- Abusive recreational activities such as mud-bogging (real);
- Diesel spill at Kettle Valley rail station;
- Tanker trucks and industrial container trucks spilling waste accidentally into Trout Creek (minimal potential);
- Algae blooms in the lower elevation reservoir lakes (real potential);
- Increased nutrient and sediment loading in creeks and reservoirs due to pine beetle kill in the watershed and less tree canopy (real).

Trout Creek monitors raw water quality at the WTP but not on-line within Trout Creek. Two recommendations are to automate the head gates on Trout Creek, and to conduct periodic testing on the reservoir-lakes annually during the summer and late fall.

KNOWN MICROBIOLOGICAL RISKS

A leading authority on microbiological risks in drinking water is the American Water Works Research Foundation. They track and provide funding for research to understand drinking water risks, contamination and emerging contaminants. Their manual M-48, Waterborne Pathogens sets out a summary of all known waterborne disease causing contaminants. The contaminants are listed in groups of either bacteria, viruses and protozoa.

Protection from these contaminants is by a disinfection process which is the critical step in achieving the desired health outcomes. A summary of the characteristics of each of the known waterborne pathogens is included the Supplemental Data section in Appendix E. The summary includes the type of pathogen, a description of the disease it can cause, reservoir or agent for the pathogen (where it resides), modes of transmission, methods in which it is detected, how long it survives in the natural environment, documentation of known outbreaks, methods of treatment and the reference location in Manual M-48.

The primary conclusion from the table in Appendix E is that disinfection is the primary method for providing safe water. Key components of providing safe water include appropriate treatment and a strong reliable disinfection process, combined with water source protection and proper waste management.

Table 4.2 - Bacterial, Parasitic and Viral Pathogens

Bacterial Pathogens	Parasitic Pathogens	Viral Pathogens
Acinetobacter	Acanthamoeba spp.	Adenoviruses
Aeromonas	Ascaris lumbricoides	Astroviruses
Camplyobacter	Balamuthia mandrillaris	Emerging viruses
Cynaobacteria	Balantidium coli	Enteroviruses and Parechoviruses
Enterohemorrhagic (Escherichia coli)	Balastocystis hominis	Hepatitis A virus
Escherichia coli	Cryptosporidium parvum and Cryptosporidium hominis	Hepatitis E virus
Flavobacterium	Cyclospora cayetanensis	Human Caliciviruses (Noroviruses and Sapoviruses)
Helicobacter pylori	Entamoeba histolytica	Reoviruses
Klebsiella	Giardia lamblia	Rotaviruses
Legionella	Isospora belli	Norovirus
Mycobacterium avium complex	Microsporidia	
Pseudomonas	Naegleria fowleri	
Salmonella	Shistosomatidae	
Serratia	Toxoplasma gondii	
Shigella	Trichuris trichiura	
Staphylococcus		
Vibrio chlorerae		
Yersinia		

Source: AWWARF – Manual M-48 Waterborne Pathogens, 2005;

4.4 REGULATOR (IHA) REQUIREMENTS

With the new WTP operating as designed, Summerland will meet the 4,3,2,1,0 protocol developed by IHA for the Trout Creek source for flows up to 75 ML/day. The issue facing Summerland is the requirement to either separate the water system or provide additional treatment so that the differential flows during high water demand conditions meet the regulators' requirements. Table 4.3 provides a summary of the IHA protocol requirements and lists criteria that are not currently met by the existing water system.

Table 4.3 Summerland Treated Water Quality - 4,3,2,1,0 Compliance Summary

IHA Protocol	Description	Trout Creek	Garnet Reservoir	Rodeo Ground Well	Okanagan Lake (Proposed)
4	4 log (99.99% inactivation/removal of viruses)	Achieved by chlorination	Achieved by chlorination	Not applicable	requires chlorination
3	3 log (99.9%) inactivation/removal of Protozoa	Will be in compliance for flows under 75 ML/day when WTP is fully functional	Not achieved, background risk is low but requires additional treatment	Not applicable	requires Cl_2 and UV disinfection to achieve protection
2	2 types of treatment	Will be in compliance for flows under 75 ML/day when WTP is fully functional	Presently only chlorination is implemented	Not applicable	UV and Cl_2 are technically sufficient but not acceptable by IHA for new sources
1	< 1.0 NTU Turbidity	Same as above	usually less than 1.0 NTU, rarely above 5.0 NTU	Achieved	would be achieved
0	0 Total and E.Coli bacteria	Achieved	Achieved	Achieved	would be achieved
	Area of concern		Out of Compliance		

4 log Virus Inactivation Four log virus inactivation and three log bacteria inactivation is achieved at both surface water sources.

3 log Protozoa Inactivation With the new WTP, three log *Giardia* and two log *Cryptosporidium* inactivation / removal will be achieved as per USEPA rating criteria for WTP removal credits. This applicable only for Trout Creek water source when flows are less than WTP capacity. *Giardia* inactivation is not reliably achieved for the Garnet Reservoir source as the contact time to the first user is estimated to be in the range of 56 minutes. *Cryptosporidium* inactivation cannot be achieved at Garnet unless UV light disinfection is utilized.

2 Types of Treatment Chlorine provided at both surface water sources. The Summerland WTP is a Actiflo process that adds a sand ballast to assist in the removal of particulate matter. The USEPA gives conventional filtration treatment processes 2.0 log credit for the removal of *cryptosporidium*. Chlorination follows the Actiflo process. Additional treatment is required at Garnet in order to meet the IHA protocol.

< 1.0 NTU Turbidity Units For both surface water sources, less than 1.0 NTU is not reliably achieved. Normal turbidity levels are in the 1.5 to 3.0 NTU range. For Trout Creek, the turbidity levels will be below 1.0 NTU with the exception of short duration runoff events that are normally bypassed. The spring freshet is also reliably reduced to below 1.0 NTU. A natural level of turbidity in Trout Creek during the winter months is less than 0.40 NTU.

0 Total Coliforms and E.Coli Bacteria Chlorine provided at both surface water sources and contact times are sufficient to disinfect all viruses, bacteria and E.coli.

4.5 HIGH ELEVATION WATERSHED CONSIDERATIONS

Generally, for the BC Southern Interior, raw water quality improves with elevation. It is desirable that the water from the higher elevations be utilized for drinking water for the following reasons:

- High elevation lands generally have greater precipitation and more runoff water is produced per surface area;
- At higher elevations there is generally less waste and man-made contaminants (roads, pipe discharges into lakes, septic tanks, etc.);
- Water is available by gravity for re-use downstream;
- Natural wildlife risks are lower and more manageable than man-made risks;
- Temperatures are lower at higher elevations so risks such as algae blooms would occur at a lesser rate than within water bodies at lower elevations;
- Supply is more reliable as elevation increases and there is less evaporation and evapotranspiration;

Quality improves as elevation increases with less organic content in the water, particularly at elevations over 1,600 metres.

4.6 TROUT CREEK – EXISTING WATER QUALITY

A review of the raw water quality from the Trout Creek watershed was carried out. The results are summarized in this section. The data is summarized for both the period of time prior to 2002 from the Earth Tech Canada Cost Benefit Review report, and data collected since that time. Trends in water quality and comments on the data are provided in Table 4.4.

Raw Water Chemistry

A limited amount of water quality data is available on the upper watershed reservoir-lakes. Nutrient data for the Headwaters Reservoirs was extracted from the study on cottage lots performed by Lakeshore Environmental, 2003. The data located to date shows the Headwater Lakes have most of their nitrogen in organic forms and are nitrogen-limited. Phosphorus concentrations were moderate. No data is available on Thirsk Reservoir at this time however; the recent raising of the dam is expected to increase nutrient concentrations, productivity and water color.

Sampling is carried out twice per year on Trout Creek. Trout Creek water has:

- Variable water color from 35 TCU (during freshet) to < 5 TCU (during the clear-flow period);
- Conductivity, hardness and alkalinity are low, particularly during freshet dilution;
- pH remains in circum-neutral range of 6.8 to 7.97;
- Dissolved nitrogen concentrations were low while total phosphate concentrations were moderate, averaging 0.012 mg/L;
- Total cyanide averaged 0.007 mg/L with peaks as high as 0.015 mg/L during freshet, all far below the 0.07 mg/L guideline;
- Total iron concentrations frequently exceed the 0.30 mg/L aesthetic guideline and averaged 0.205 mg/L. It is possible that construction and sediments exposed in the raising of Thirsk Reservoir may have increased the iron concentrations in recent years.

Table 4.4 Trout Creek Water Source - Summary of Water Quality

Sample ID	Units	GCDWQ	Pre 2001 No. of samples	Pre 2001 Average	Post 2001 No. of Samples	Post 2001 Average	Comments - trending
Date Sampled							
Results are expressed as mg/l except where noted. < = Less than the detection limit.							
Physical Tests							
Colour	TCU	< 15 AO	64	22.3	11	14.1	Improving
Conductivity	uS/cm	no standard	40	244	11	103	Pre 2002 rdgs appear very high
Total Dissolved Solids	mg/L	≤ 500 AO	52	136.5	11	81.2	Improving
Hardness ($CaCO_3$)	mg/L	80 - 100*	13	38.9	11	44.6	Soft water
pH	unitless	6.5 - 8.5*	221	7.56	11	7.47	minimal change
Turbidity	NTU	< 1.0 MAC **	145	2.55	11	1.98	Minor reduction due to many factors
Dissolved Anions							
Alkalinity-Total ($CaCO_3$)	mg/L	no standard	41	99	11	38.3	Reducing
Chloride Cl	mg/L	< 250 AO	1	6.6	11	5.31	reducing
Fluoride F	mg/L	< 1.50 MAC		no data	11	0.11	
Sulphate SO4	mg/L	< 500 AO	28	34.6	11	4.8	
Nutrients							
Nitrate Nitrogen N	mg/L	45 MAC	14	0.022	11	<0.005	
Nitrite Nitrogen N	mg/L	3.2 MAC	40	0.123	11	<0.002	
Total Phosphate P	mg/L	no standard	56	0.008	11	0.012	
Organic Parameters							
Tannin and Lignin	mg/L	no standard	24	0.45	3	9.3	much higher, may be due to Thirsk Constr.
Total Organic Carbon	mg/L	no standard	24	4.94	3	2.76	very low for natural watershed
UV_{254} Transmissivity	%	> 80		no data	17	82.5	ok to use UV light
THM Production	ug/L	> 100 MAC	51	147	27	129	higher than MAC
Cyanides							
Total Cyanide CN	mg/L	< 0.2 MAC		no data	11	0.007	low, no issues
Total Metals							
Aluminum T-Al	mg/L	< 0.20 OGV	29	0.004	11	0.091	
Antimony T-Sb	mg/L	< 0.006 MAC		no data	11	<0.0005	
Arsenic T-As	mg/L	< 0.010 MAC		no data	11	<0.001	GCDWQ recently reduced from 0.025
Barium T-Ba	mg/L	< 1.0 MAC		no data	11	0.032	
Boron T-B	mg/L	< 5.0 MAC		no data	11	<0.1	
Cadmium T-Cd	mg/L	< 0.005 MAC		no data	11	<0.002	
Calcium T-Ca	mg/L	no standard	28	36.3	11	14.1	
Chromium T-Cr	mg/L	< 0.05 MAC		no data	11	<0.002	
Copper T-Cu	mg/L	< 1.0 AO		no data	11	0.101	
Iron T-Fe	mg/L	< 0.30 AO	28	0.086	11	0.205	increased recently
Lead T-Pb	mg/L	< 0.010 MAC		no data	11	<0.001	
Magnesium T-Mg	mg/L	no standard	28	9.5	11	2.28	
Manganese T-Mn	mg/L	< 0.050 AO	28	0.001	11	0.023	
Mercury T-Hg	mg/L	< 0.001 MAC		no data	11	<0.00020	
Molybdenum T-Mo	mg/L	no standard		no data	11	0.0023	
Potassium T-K	mg/L	no standard		no data	11	1.25	
Selenium T-Se	mg/L	< 0.01 MAC		no data	11	<0.0010	
Sodium T-Na	mg/L	< 200 AO	28	10	11	3.26	
Uranium T-U	mg/L	0.02 Q21IMAC		no data	11	0.0015	
Zinc T-Zn	mg/L	< 5.0 AO		no data	11	<0.05	

* Optimal Range
** GCDWQ allow higher NTU if disinfection is not compromised

MAC - Maximum Acceptable Concentration
IMAC - Interim Maximum Acceptable Concentration
AO - Aesthetic Objective
OGV - Operational Guidance Value

UV transmissivity data was collected between November 2002 and April 2004 from the Trout Creek System. Trout Creek water averaged 82.5% before chlorination and 84.5% after chlorination (Table 4.7). UV transmittance is typically reduced by the large organic carbon concentrations, particularly during freshet. The UV transmissivity is of sufficient clarity to allow for the use of UV disinfection technology as the overall clarity and organic interference is lower than most watersheds in the Okanagan region.

Trihalomethanes in chlorinated Trout Creek water occur primarily as chloroform and are usually above the 0.100 mg/L MAC as listed in Table 4.8. The running mean of quarterly measurements since 1998 is 0.131 mg/L chloroform out of a total THM of 0.137 mg/L. THM production in Trout Creek water will be affected by the organic load, the chlorine dose, contact time and water temperature. Algae production in the Headwater and Thirst Reservoirs and agriculture in the Darke Lake area will contribute reactive carbon compounds to Trout Creek and increase THM formation potential.

With the exception of THM production, Trout Creek water quality is acceptable in the clear flow period. Reduced water quality during freshet was the impetus for a water treatment plant. The sources of the large *E. Coli* counts seen intermittently between May and October in raw Trout Creek water should be tracked because *E. Coli* serve as an indicator of fecal contamination. Some contaminants such as endocrine disruptors, which can come from septic tank effluent and through the groundwater, are not effectively dealt with by conventional water treatment plants. These risks are manageable. The challenges facing Summerland's WTP can be minimized through watershed protection.

Biology

Only one algae sample was available for the Trout Creek system. This raw water sample from May 2008 showed no blue-green algae but had five species capable of causing a fishy taste and odour. The dominant, *Pandorina* is a large colonial that is a well-known fishy taste and odour offender that could also clog filters. It prefers lakes that are rich with organic material.

E.Coli counts from raw water from the Trout Creek Reservoir are highest in the May to October period. During the Jan 2004 – Dec 2007 study period, 24 peaks exceeded the proposed IHA filtration deferral guideline for source water of 20 cfu/100 mL.

Figure 4.1 - Total Coliform Bacteria in Trout Creek Balancing Reservoir 2004 - 07

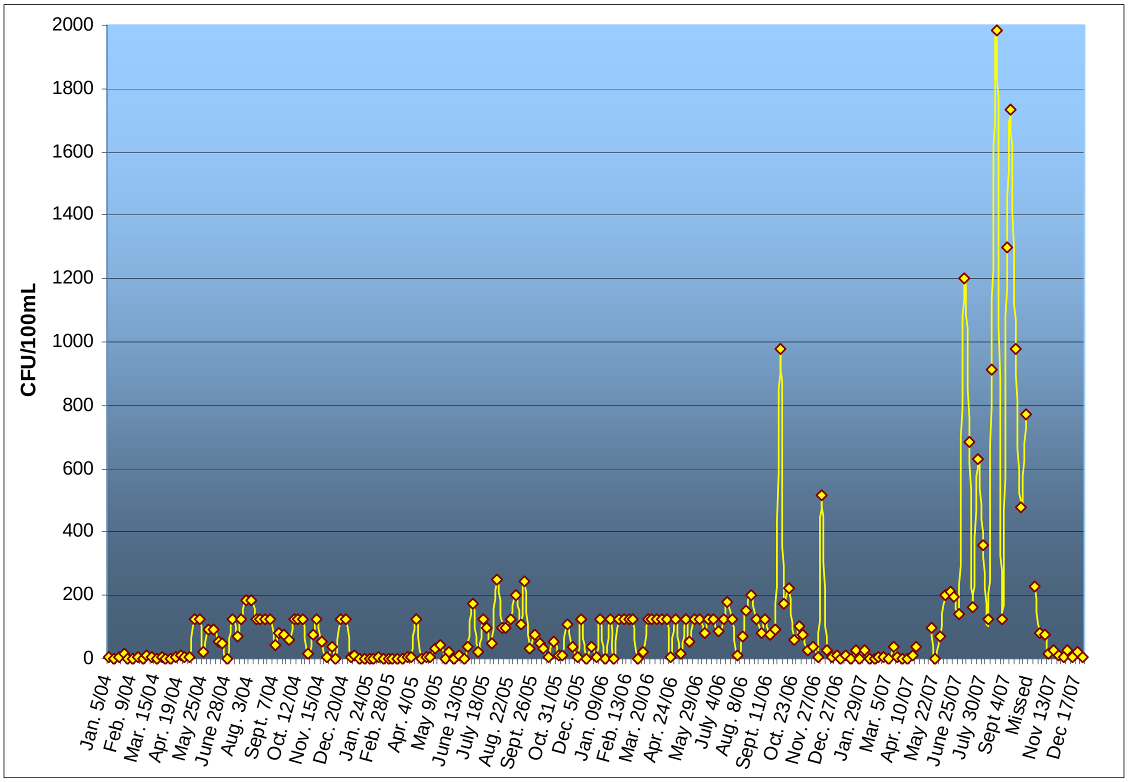
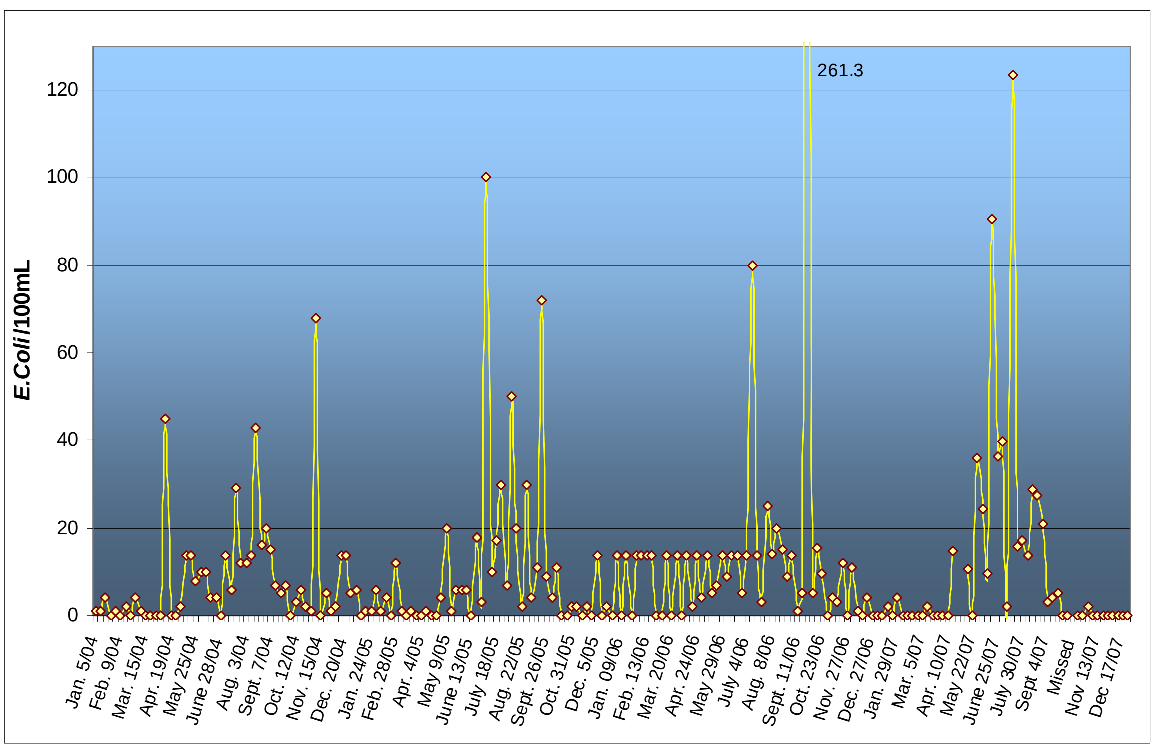


Figure 4.2 - *E.Coli* Bacteria in Trout Creek Balancing Reservoir 2004 - 07



4.7 GARNET RESERVOIR – EXISTING WATER QUALITY

A review of the raw water quality from the Eneas Creek watershed was carried out. The results are summarized in this section.

Garnet Reservoir Raw Water Chemistry

Water quality samples collected from the Garnet Valley Reservoir system from 2002 to present are summarized in Table 4.5. Garnet Valley Reservoir has:

- low color (<5 TCU)
- episodes of high turbidity (2.4 – 6.8 NTU) concentrated in the spring;
- Conductivity and hardness are moderate with most of the hardness caused by carbonate minerals and not sulphates;
- pH is alkaline and ranged from 7.5 to 8.3;
- nitrogen occurs primarily as organic forms; nitrates are rarely above detection in the summer stratified period which may encourage blue-green algae;
- total phosphate concentrations average 0.024 mg/L, placing Garnet Valley Reservoir in the mildly eutrophic category;
- some parameters suggest that anaerobic conditions develop under winter ice .

UV transmissivity data was collected between November 2002 and April 2004. Garnet Valley Reservoir water averaged 89% before chlorination and 92% after chlorination as listed in Table 4.7.

Trihalomethanes in chlorinated Garnet Valley Reservoir water occur primarily as chloroform and meet the 100 micrograms/L (ug/L) MAC on most dates. Exceedances are rare and generally occur in the September/October period, perhaps due to a surge in algae production after the reservoir overturns. The running mean of quarterly measurements since 1998 is 47 ug/L chloroform out of a total THM of 55 ug/L as listed in Table 4.8.

Overall, Garnet Valley Reservoir has good water quality but its large phosphorus to nitrogen ratio will encourage algae production, particularly blue-green algae. Watershed protection and reservoir management through aeration are critical to preventing a resumption of toxic blue-green algae blooms.

Table 4.5 Garnet Reservoir Water Source - Summary of Water Quality

Sample ID	Units	GCDWQ	Pre 2001 No. of samples	Pre 2001 Average	Post 2001 No. of Samples	Post 2001 Average	Comments on Results
Results are expressed as mg/l except where noted. < = Less than the detection limit.							
Physical Tests							
Colour	TCU	< 15 AO	1	7	12	<5	No change
Conductivity	uS/cm	no standard	1	333	12	338	No change, shows high groundwater influence
Total Dissolved Solids	mg/L	≤ 500 AO	1	195	12	204	No change
Hardness ($CaCO_3$)	mg/L	80 - 100*	31	156	12	162	No change
pH	unitless	6.5 - 8.5*	127	8.3	12	8.1	No change
Turbidity	NTU	< 1.0 MAC **	32	2.2	12	1.8	No change, seasonal variation is wider
Dissolved Anions							
Alkalinity-Total ($CaCO_3$)	mg/L	no standard	31	99	12	172	groundwater inflow may be concentrating
Chloride Cl	mg/L	< 250 AO	2	3.8	12	5.11	OK
Fluoride F	mg/L	< 1.50 MAC		no data	12	0.294	OK
Sulphate SO4	mg/L	< 500 AO	2	10.5	12	9.9	OK
Nutrients							
Nitrate Nitrogen N	mg/L	45 MAC	2	< 0.05	12	0.019	
Nitrite Nitrogen N	mg/L	3.2 MAC	2	0.002	12	<0.0010	
Total Phosphate P	mg/L	no standard	1	0.017	12	0.024	
Organic Parameters							
Tannin and Lignin	mg/L	no standard	1	0.2	8	0.15	very low
Total Organic Carbon	mg/L	no standard	2	4.6	8	3.96	moderate and reducing
UV_{254} Transmissivity	%	> 80		no data	16	89	UV disinfection may be viable
THM Production	ug/L	> 100 MAC	51	55	27	54	low and wiithin Guidelines
Cyanides							
Total Cyanide CN	mg/L	< 0.2 MAC		no data	12	<0.005	
Total Metals							
Aluminum T-Al	mg/L	< 0.20 OGV	1	0.02	12	<0.01	
Antimony T-Sb	mg/L	< 0.006 MAC		no data	12		
Arsenic T-As	mg/L	< 0.010 MAC		no data	12	<0.001	std recently reduced from 0.025 mg/L
Barium T-Ba	mg/L	< 1.0 MAC		no data	12	0.045	
Boron T-B	mg/L	< 5.0 MAC		no data	12	<0.1	
Cadmium T-Cd	mg/L	< 0.005 MAC		no data	12	<0.002	
Calcium T-Ca	mg/L	no standard	1	49.5	12	51.4	
Chromium T-Cr	mg/L	< 0.05 MAC		no data	12	<0.002	
Copper T-Cu	mg/L	< 1.0 AO		no data	12	0.011	
Iron T-Fe	mg/L	< 0.30 AO	1	<0.03	12	<0.03	
Lead T-Pb	mg/L	< 0.010 MAC		no data	12	<0.001	
Magnesium T-Mg	mg/L	no standard	1	7.8	12	8.08	
Manganese T-Mn	mg/L	< 0.050 AO	1	0.015	12	0.014	
Mercury T-Hg	mg/L	< 0.001 MAC		no data	12	<0.00020	
Molybdenum T-Mo	mg/L	no standard		no data	12	0.004	
Potassium T-K	mg/L	no standard		no data	12	2.38	
Selenium T-Se	mg/L	< 0.01 MAC		no data	12	<0.0010	
Sodium T-Na	mg/L	< 200 AO	1	8	12	8.3	
Uranium T-U	mg/L	< 0.02 IMAC		no data	12	0.0089	Never above 0.010 mg/L in any samples
Zinc T-Zn	mg/L	< 5.0 AO		no data	12	<0.05	

* Optimal Range
** GCDWQ allow higher NTU if disinfection is not compromised
area of concern

MAC - Maximum Acceptable Concentration
IMAC - Interim Maximum Acceptable Concentration
AO - Aesthetic Objective
OGV - Operational Guidance Value for WTPs

Garnet Reservoir Water Biology

The existing Garnet Valley dam was completed in the 1970's and by 1978, algae blooms and anaerobic water were adversely affecting discharged water quality.

The anaerobic water problem was addressed with a destratification (bubbler) aerator but failed to stop the problem. In 1982, Larratt Aquatic performed dissolved oxygen/temperature profiles in a grid throughout the basin between the old submerged dam and the current dam. A trench was discovered 2-3 m deep connecting the old dam's submerged outlet to the new outlet. Cold, anaerobic water from the basin behind the old dam poured through the old intake, into the trench, passed under the aerator and entered the new intake. Old photos were then located by Summerland staff that showed the trench under construction. Several actions were recommended:

1) a second, linear aerator diffuser line was extended into the trench
2) the entire reservoir was lowered to close the outlet gate in the old submerged dam

These actions prevented the inclusion of anaerobic water into the distribution system as shown in the following diagram:

Figure 4.3 - Schematic of Garnet Reservoir Outlet Basin Showing Aerators

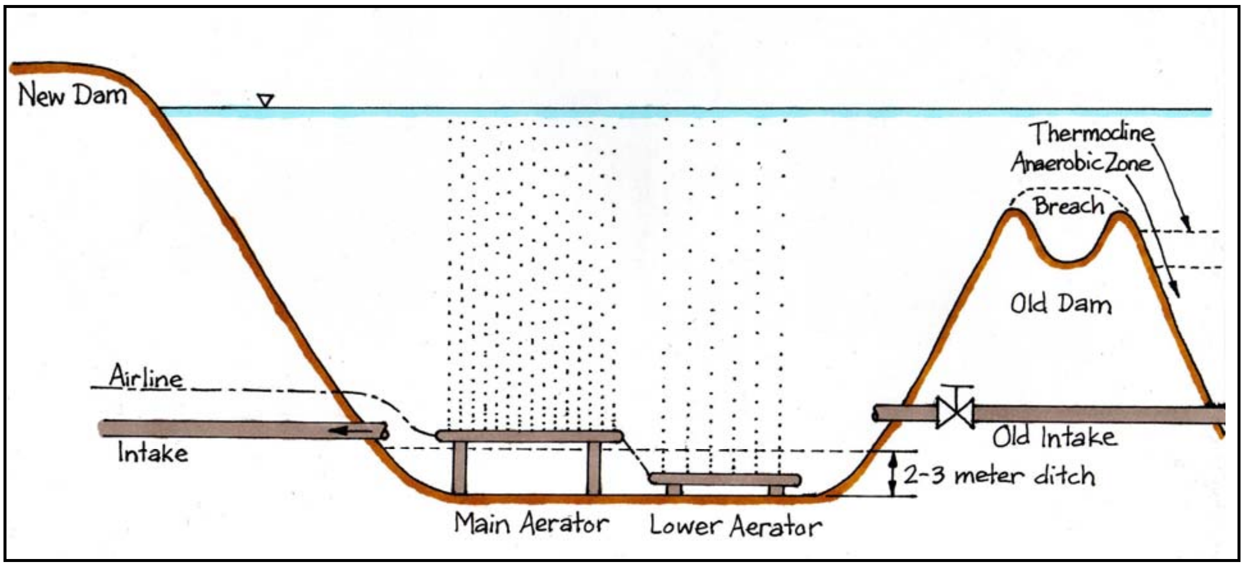
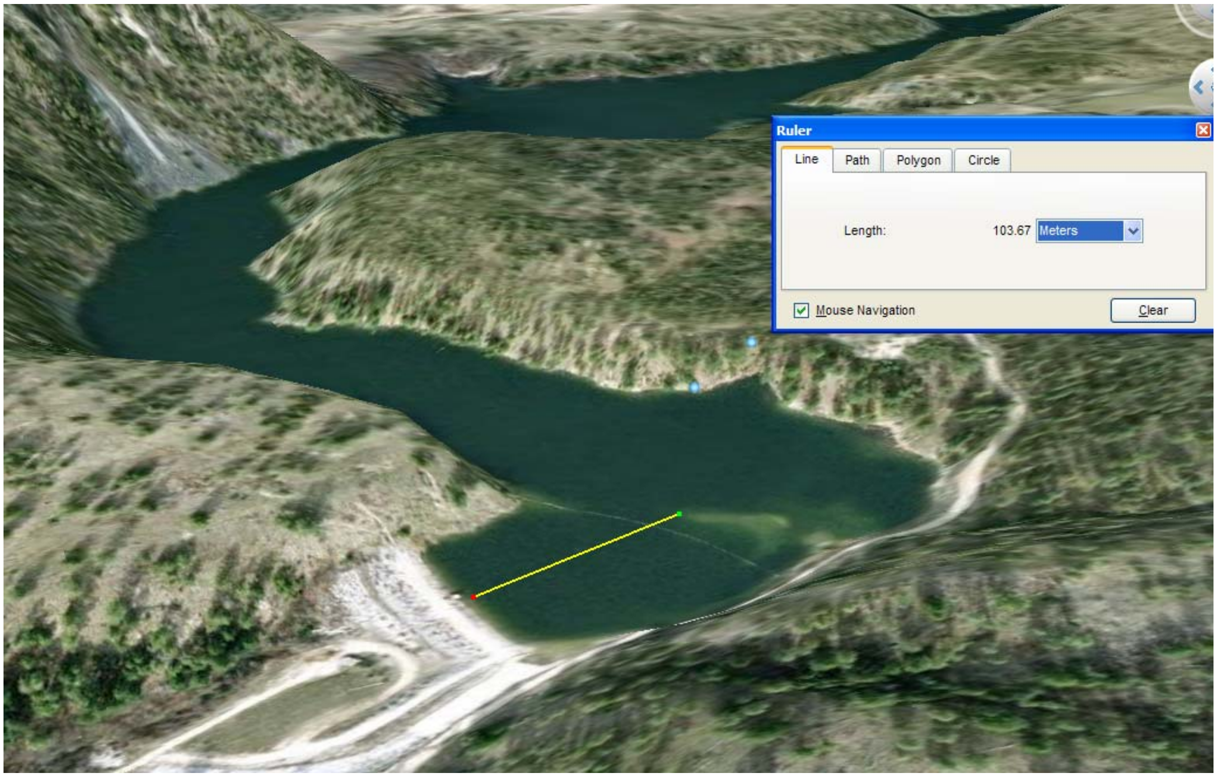


Figure 4.4 - Garnet Reservoir – Breached Dam Underwater – 105m to North



Algae problems are not solved as quickly. Garnet Valley Res. produced huge crops of odour-causing diatoms and flagellates after it was raised. The flagellates require lakes rich in organic carbon such as a newly flooded reservoir. By the 1980's the flagellate numbers had subsided but two types of diatoms (*Asterionella & Fragilaria*) persisted in problem numbers. The balance of nutrients shifted to favour *Anabaena*, a blue-green alga (cyanobacteria). *Anabaena* is a toxin-producing alga that can cause algae blooms. The number of cells/mL set by AWWA is 2000 cells/mL before additional treatment and public notification is warranted. *Anabaena* counts as high as Alert Level 3 - 15,000 cells/mL (See Table 4.6) were measured during a Garnet Valley bloom in 1983.

These blooms prompted the controversial step of applying copper sulphate to restrict toxic bloom formation. When a bloom reaches this stage, the issue of risk management must be considered and the harm persons digesting algae toxins versus the risk of having background levels of copper sulphate leads water suppliers in the direction of applying the copper sulphate in the raw water reservoirs.

Table 4.6 - AWWA Alert System for Lakes with a History of Cyanobacteria Blooms

Alert Level 1 Cyanobacteria biomass >500 but <2000 cells/mL Taste and odour problems may occur Move from weekly to twice weekly algae monitoring
Alert Level 2 Cyanobacteria >2000 cells/mL Perform jar tests with powdered activated carbon and with an oxidant (chlorine etc.) Develop treatment and monitoring contingency plan
Alert Level 3 Cyanobacteria > 15,000 cells/mL (6,500 cells/mL M. aeriginosa) Toxin presence is likely - implement contingency plan Monitor and analyze for algal toxins through the water treatment process until cell numbers drop below <2000 cells/mL

Over the years, the severity of the blooms has subsided and 2006 algae data showed no *Anabaena*, rather a smaller amount of a different toxic blue-green alga, *Anacystis* and non-toxic *Chroococcus*. The cell numbers counted by MB Labs were unusually low and were below the AWWA Alert Level 1. Diatom numbers have also moderated. Summerland staff observed that the "green soup" appearance of Garnet Valley Reservoir in the 1970/80's no longer occurs.

Algae samples collected in May 2008 showed prevalence of two formerly rare species; centric diatoms (filter clogging) and *Dinobryon* (fishy taste and odour), however, the total number of cells was unlikely to impact water quality. Garnet Valley Reservoir will remain productive for the foreseeable future. Careful management of its immediate watershed and shoreline will prevent the resumption of objectionable algae blooms.

Garnet Valley Reservoir *E.Coli* counts peak every summer. The June – August surge may relate to a localized land use such as a cattle turn-out or camping. During the Jan 2004 – Dec 2007 study period, only two peaks exceeded the proposed IHA filtration deferral guideline for source water of 20 cfu/100 mL.

Figure 4.5 - Total Coliform Bacteria in Garnet Reservoir 2004 – 07 (below 100 recommended)

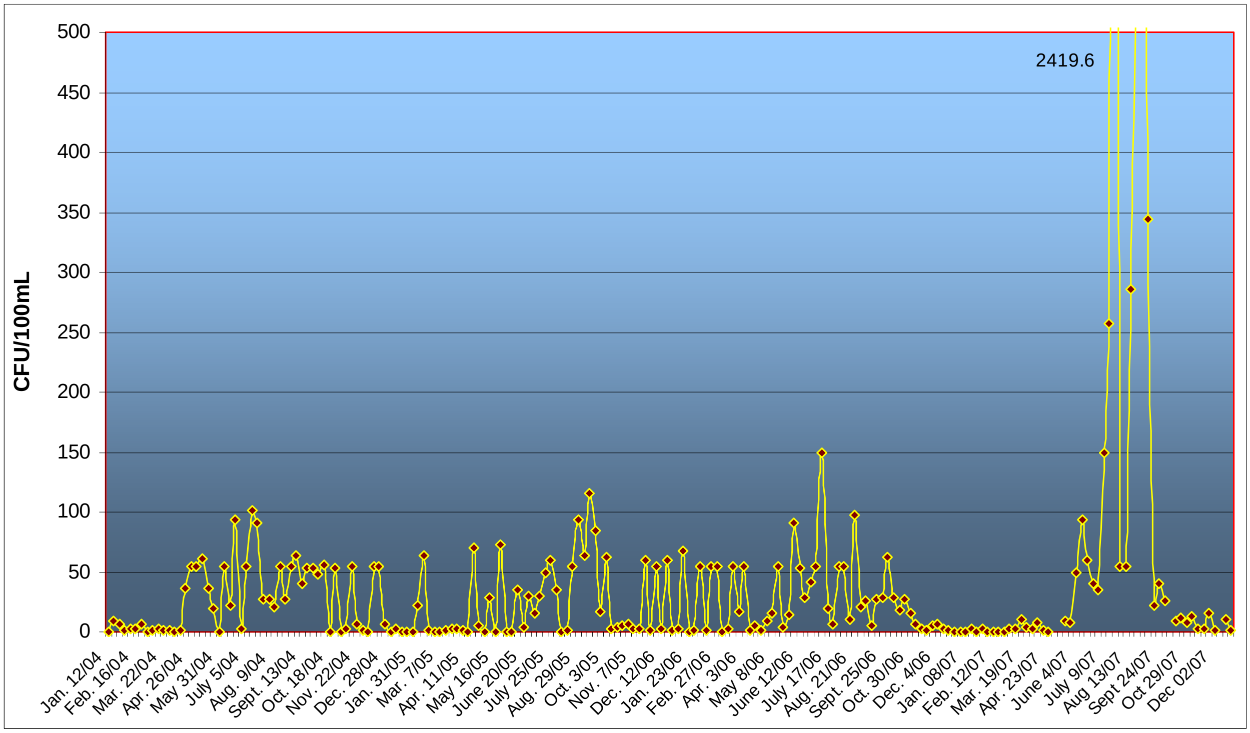


Figure 4.6 - *E.Coli* Bacteria in Garnet Reservoir 2004 – 07 (below 20 recommended)

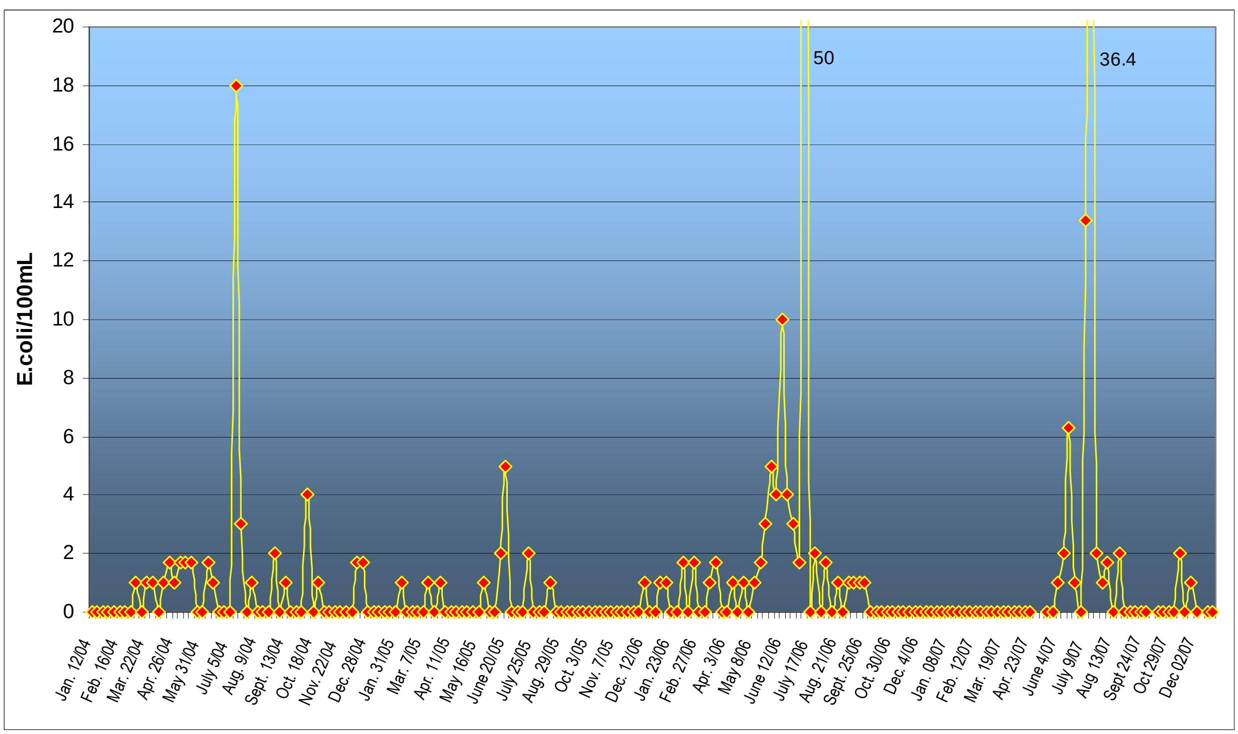


Table 4.7 - UV_{254} Transmissivity in Summerland Source Water

	TROUT CREEK SYSTEM WATER		GARNET VALLEY SYSTEM WATER	
Sample Date	% Transmittance before chlorination	% Transmittance after chlorination	% Transmittance before chlorination	% Transmittance after chlorination
Nov. 14/02	81	85	88	91
Dec. 9/02	87	87	90	93
Jan. 9/03	88	89	87	90
Feb. 12/03	89	90	91	93
Mar. 13/03	88	91	89	92
Apr. 8/03	88	92	90	93
May. 13/03	** 45	** 65	90	91
June 11/03	56	65	90	92
July 21/03	79	83	94	96
Sept. 4/03	90	78	90	92
Oct. 9/03	84	84	89	93
Nov. 24/03	83	85	81	91
Dec. 10/03	87	86	89	92
Jan. 21/03	88	89	89	91
Feb. 26/04	89	89	89	92
Mar. 17/04	87	91	89	91
Apr. 7/04	56	87		
Average	82.5	84.5	89	92

** Turbidity = 1.8 NTU

UV transmissivity data has been collected for a number of years to establish a baseline of information so that decisions can be made on the applicability of UV light as an applicable disinfection technology.

In comparison with other source water from watersheds in the Okanagan, the Trout Creek and Eneas Creek sources appear to have higher UV transmissivity than that of the watersheds of Mission Creek, Lambly Creek, Powers Creek, Mill Creek and the Duteau Creek watersheds. There is generally a lower level of organic content in the raw water and there appears to be a significant groundwater contribution to Garnet Reservoir.

The use of UV disinfection is considered to be achievable for both creeks. The use of UV light does not have any affect on turbidity levels and the turbidity in the raw water, if it is too high, may compromise the ability of Ultraviolet light to adequately disinfect the water.

Table 4.8 - THM Production in Summerland Drinking Water

	TROUT CREEK SYSTEM		GARNET VALLEY SYSTEM	
Jan 98- Present	Chloroform	Total THMs	Chloroform	Total THMs
DATE:	(ppb)	(ppb)	(ppb)	(ppb)
22-Jan-98	171	175	58	67
27-May-98	274	276	100	111
4-Aug-98	209	212	35	41
18-Nov-98	156	161	52	57
1-Mar-99	108	113	61	70
19-Jul-99	204	206	55	61
25-Oct-99	146	149	88	97
20-Dec-99	127	130	55	63
24-Feb-00	123	155	36	43
17-May-00	38	38	8	11
6-Oct-00	66	68	34	42
20-Dec-00	73	76	29	34
23-May-01	77	78	13	13
27-Jun-01	180	182	33	41
14-Sep-01	32	35	29	33
14-Dec-01	135	139	155	163
4-Apr-02	57	61	36	44
25-May-02	249	251	52	59
5-Nov-02	104	108	60	70
11-Dec-02	89	92	67	75
17-Jan-03	80	83	80	89
27-May-03	188	189	36	41
16-Oct-03	82	85	45	54
17-Dec-03	140	145		81
4-Mar-04	62	65	39	47
3-May-04	148	148	22	25
17-Aug-04	243	247	40	45
7-Oct-04	94	96	29	34
20-Dec-04	146	149	43	50
5-Feb-05	117	120	47	55
13-Jul-05	159	159	47	54
12-Oct-05	133	135	50	59
8-Dec-05	101	105	42	48
27-Feb-06	63	67	43	51
30-Mar-06	59	64	32	38
18-Apr-06	51	55	21	27
24-May-06	250	252	56	65
17-May-07	214	216	46	53
4-Jul-07			28.4	34.8
31-Oct-07	156	159	46	53
Average (ppb)	**131**	**134**	**47**	**55**

	TROUT CREEK SYSTEM		GARNET VALLEY SYSTEM	
Jan 94 - Nov 97	Chloroform	Total THMs	Chloroform	Total THMs
DATE:	(ppb)	(ppb)	(ppb)	(ppb)
27-Jan-94	120	126	34	40
4-Mar-94	110	113	53	60
25-Mar-94	150	154	22	27
28-Apr-94	190	192	39	45
27-May-94	170	172	33	38
21-Jul-94	160	163	35	41
23-Aug-94	100	104	36	43
23-Sep-94	120	123	36	43
24-Oct-94	88	92	46	54
16-Nov-94	89	93	25	32
15-Dec-94	78	82	39	46
23-Jan-95	52	55	21	27
20-Feb-95	56	60	27	33
16-Mar-95	95	96	48	56
20-Apr-95	122	126	16	18
24-May-95	151	153	24	28
20-Jun-95	153	156	35	41
24-Jul-95	160	163	26	30
23-Aug-95	153	155	42	48
26-Sep-95	106	108		
26-Oct-95	159	162	121	130
21-Nov-95	163	166	54	62
20-Dec-95	154	158	26	33
22-Jan-96	166	169	34	42
20-Feb-96	128	131	47	55
13-Mar-96	137	140	52	60
25-Apr-96	142	145	64	73
28-May-96	234	236	38	42
27-Jun-96	240	242	88	95
22-Jul-96	170	173	73	80
14-Aug-96	113	116	43	49
26-Sep-96	142	146	106	119
23-Oct-96	144	148	103	113
26-Nov-96	166	171	55	62
18-Dec-96	138	142	83	92
5-Feb-97	99	101	64	72
27-May-97	276	278	64	67
2-Jul-97	272	274	61	65
25-Nov-97	156	160	54	60
Average (ppb)	**144**	**147**	**49**	**56**

Trihalomethane (THM) levels were reviewed for the Garnet and Trout Creek water after chlorination. THMs form as a byproduct 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 GCDWQ has set the recommended MAC of 0.100 mg/L (100 ppb) for total THMs.

Two sets of sampling data were reviewed. The columns above on the left show recent data from 1998 to present with samples taken quarterly. The data above on the right shows monthly data taken over the course of three years from 1994 to 1997. The levels from the Garnet Reservoir water appear to be stable as there over the 14 years of monitoring with little change. The times of highest THM production in Garnet appear to be annually in September and October, but still below 100 ug/L.

Trout Creek has improved somewhat but this may be due to the testing procedures or lack of full monthly testing. The highest times for THM production in Trout Creek appear to be from May to August annually. The WTP should reduce THM levels to well below the GCDWQ limits of 100 ug/L.

Figure 4.7 - Quarterly THM Levels – 1998 - Present

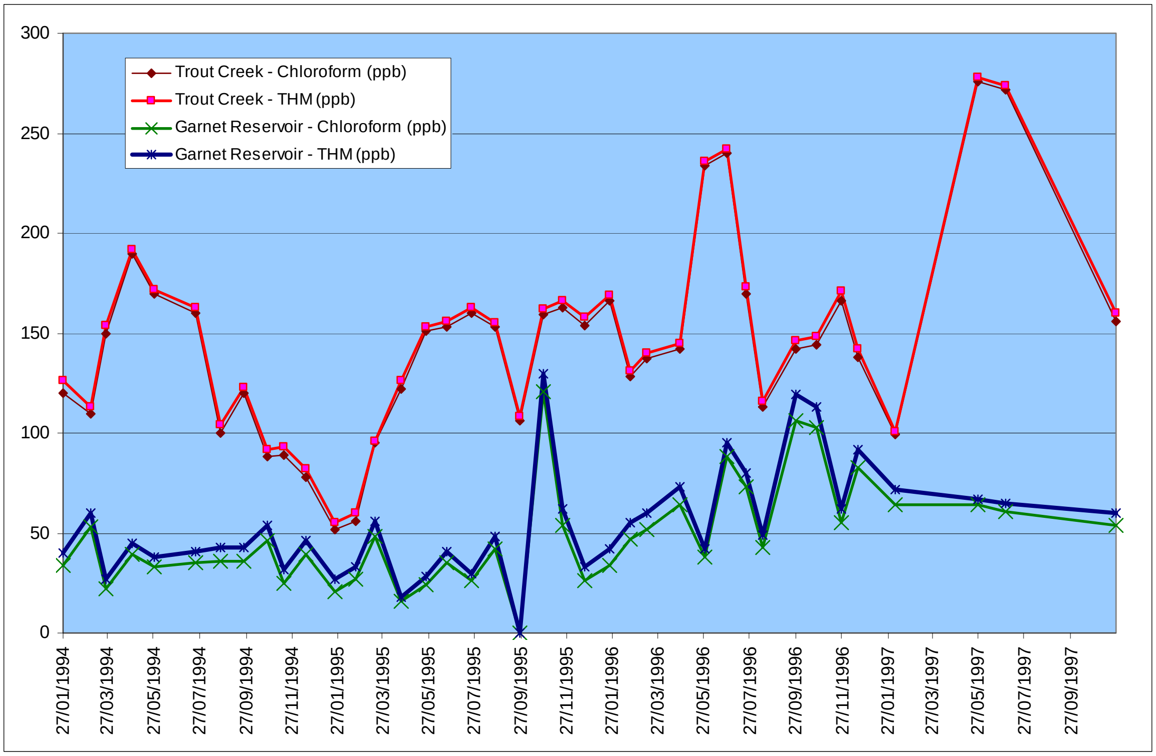
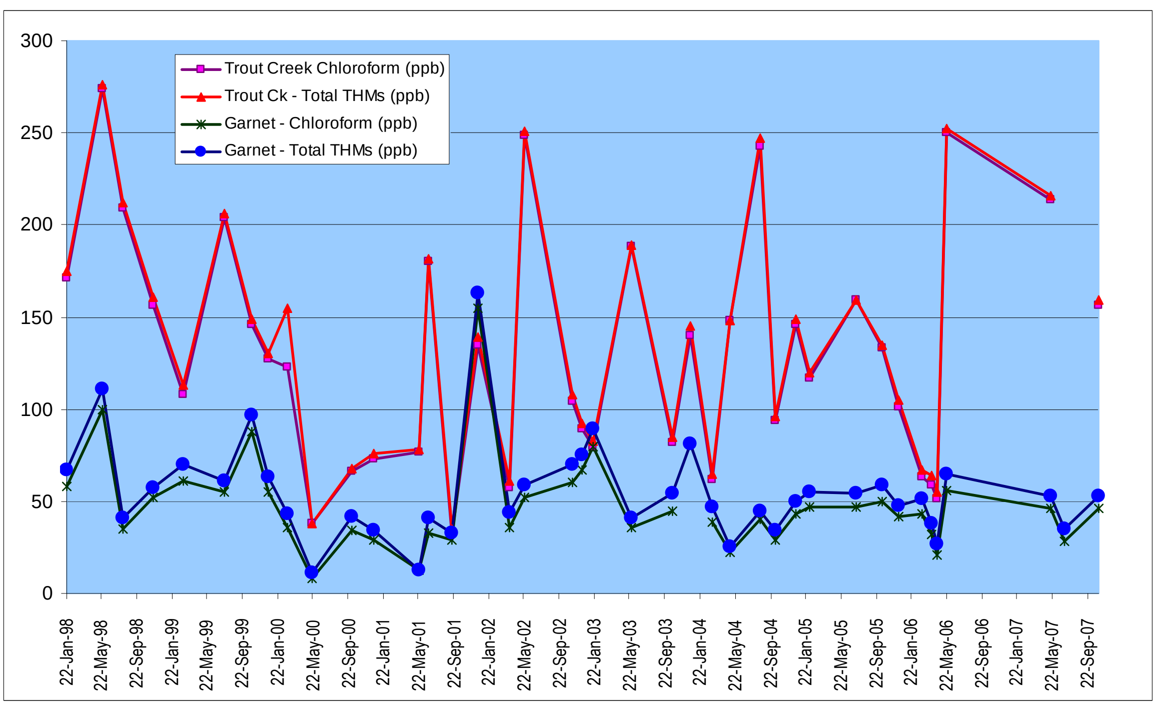


Figure 4.8 - Monthly THM Readings, 1998 - Present



4.8 GROUNDWATER WELLS – EXISTING WATER QUALITY

A review of the raw water quality from the Rodeo Grounds Groundwater Well was carried out. The results are summarized in Appendix E with the supplemental data.

Chemistry

Groundwater is not subject to algae growth or contact with organic molecules but it can be contaminated by human activity. The Rodeo well samples had the following characteristics:

- Similar hardness to Garnet Valley Reservoir (150 – 160 mg/L as $CaCO_3$);
- pH measured 8.28 on May 2007 but 7.4 on Oct 31. This variation is significant and merits investigation;
- Nitrate and phosphate concentrations are high from an algae production standpoint but are well below the drinking water guidelines (e.g. 10 mg/L nitrate);
- Sulphate concentrations are too low to encourage the unwanted sulphate-reducing bacteria responsible for the "rotten eggs" odour of some wells;
- Uranium levels in the well were below the Interim Maximum Acceptable Concentration (IMAC) of < 0.020 mg/L as recommended in the Guidelines, but levels were noted and are cause of concern. For this reasons, IHA has 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 to reduce raw water uranium levels. The wells are also not to be run for extended periods of time, but rather to be used for emergency supply;
- Total iron concentrations ranged from < 0.030 to 0.28 mg/L. The latter will increase water color and support unwanted iron-related bacteria. This variation is also significant and also merits investigation.

4.9 OKANAGAN LAKE – EXISTING WATER QUALITY

A review of the raw water quality from Okanagan Lake was carried out. The results are summarized in this section. Some of the data presented is the result of new research work carried out on the lake with respect to algae concentrations at depth in both the north and south basins of the lake.

Chemistry and Limnology

Okanagan Lake water chemistry is excellent for potable water, with its low color, low turbidity, pH usually between 7.5 and 8.0 and low nutrient concentrations. A representative summary of water quality parameters is presented in Table 4.9.

Table 4.9 - Okanagan Lake – Representative Raw Water Quality

Sample ID	Units	GCDWQ	Pre 2001 No. of samples	Pre 2001 Average	Comments - trending
Results are expressed as mg/l except where noted. < = Less than the detection limit.					
Physical Tests					
Alkalinity-Total ($CaCO_3$)	mg/L	no standard	61	107	
Colour	TCU	< 15 AO	30	< 5	
Conductivity	uS/cm	no standard	46	267	
Hardness ($CaCO_3$)	mg/L	80 - 100*	47	115	
Iron T-Fe	mg/L	< 0.30 AO	5	0.07	
Nitrite Nitrogen N	mg/L	3.2 MAC	13	0.03	
pH	unitless	6.5 - 8.5*	56	8.11	
THM Production	ug/L	> 100 MAC	40	49.1	
Total Dissolved Solids	mg/L	≤ 500 AO	46	153	
TSS	mg/L		5	< 5	
Turbidity	NTU	< 1.0 MAC **	51	0.69	Affected by proximity to creeks
Biology					
Fecal Coliforms	# / 100 mL	< 1	4	1	within water after disinfection
Giardia Lamblia	cysts/100L	no standard	1	0	3 log inactivation required after disinfection
Total Coliforms	# / 100 mL	< 1	4	33	within water after disinfection

Source - Earth Tech Report - Data originates from elsewhere on Okanagan Lake
Information provides only a representation of what can generally be expected near Summerland.

Seiches are a wind-induced internal wave traveling along the thermocline. In Okanagan Lake, the temperature fluctuations caused by passing seiches decrease with depth according to the following table:

Table 4.10 - Maximum Seiche-Induced Temperature Fluctuations at Okanagan Lake Intakes

Intake Depth (m)	Central Basin Temp. fluctuation & (Min – Max temp)	North Basin Temp. fluctuation °C & (Min - Max temp)
<20	13 (5 – 18)	13 (5 – 18)
25	10 (5 – 13)	9 (4 – 13)
30	7 (5 – 12)	7 (5 – 12)
40	5 (5 – 10)	5 (5 – 10)
50	3 (5 – 8)	4 (4 – 8)
>60	< 3 (4 – 6)	< 3 (4 – 6)

Modeled by Hayco (Measured by Larratt)

The 40-50 m depth has a satisfactory temperature regime for most water treatment plants. The 40-50 m depth evades summer seiches and is briefly affected by seiches during October and/or November.

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.

Blue-green algae are also called cyanobacteria and they are a wide-spread and problematic group. In Okanagan Lake, nutrient concentrations, light and temperature conditions have biased the lake towards blue-green production for at least 70 years (Andrusak et al., 2005, Clements, 1939). Cyanobacteria usually account for about half of the phytoplankton community in summer and they can increase to 60% of both algal density and biomass in the fall (Stockner, 2003).

There have been two potentially toxic blue-green algae blooms on Okanagan Lake in the last decade. The last *Microcystis aeruginosa* bloom in 2003 affected Westbank, Peachland and the Westbench Irrigation District.

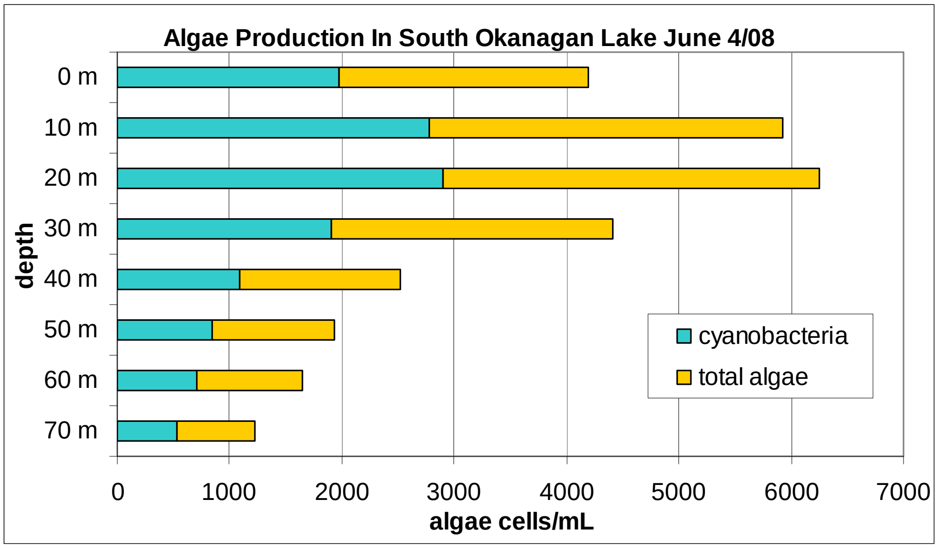
Table 4.11 - Problems Caused by Dominant Okanagan Lake Cyanobacteria

Dominant Okanagan Lake. Cyanobacteria	Toxins	Taste and Odour when Moderate / Abundant
Microcystis /Anacystis	Yes	grassy /septic
Anabaena flos-aquae*	Yes	musty / septic
Aphanocapsa sp.		
Aphanizomenon disperses	Yes	musty / septic
Chroococcus sp.		
Gomphosphaeria aponina		grassy / grassy
Lyngbya limnetica	Yes	
Lyngbya sp. (5um green)	Yes	
Oscillatoria sp.	Yes	grassy / musty, spicy

*Species found in 1939 study but not in recent studies

The May 2008 profile samples on Okanagan Lake contained more blue-green algae cells than Garnet Valley Reservoir, however, Garnet Reservoir is more vulnerable to algae blooms based on its small size and nutrient concentrations. Blue-green algae (cyano-bacteria) counts peaked at 20 m in the June 4 samples, dropped below 2000 cells/mL by 30 m and was much improved by 40 m (see Figure 4.9). The species were different from those in Garnet Valley Reservoir and cell counts were higher. Additional sampling will be conducted in 2008 and 2009 under an OBWB grant.

Figure 4.9 - Algae Production Profile in South Basin of Okanagan Lake



Preliminary Information from study funded by OBWB

Figure 4.10 Okanagan Lake - Typical Depth vs. Temperature

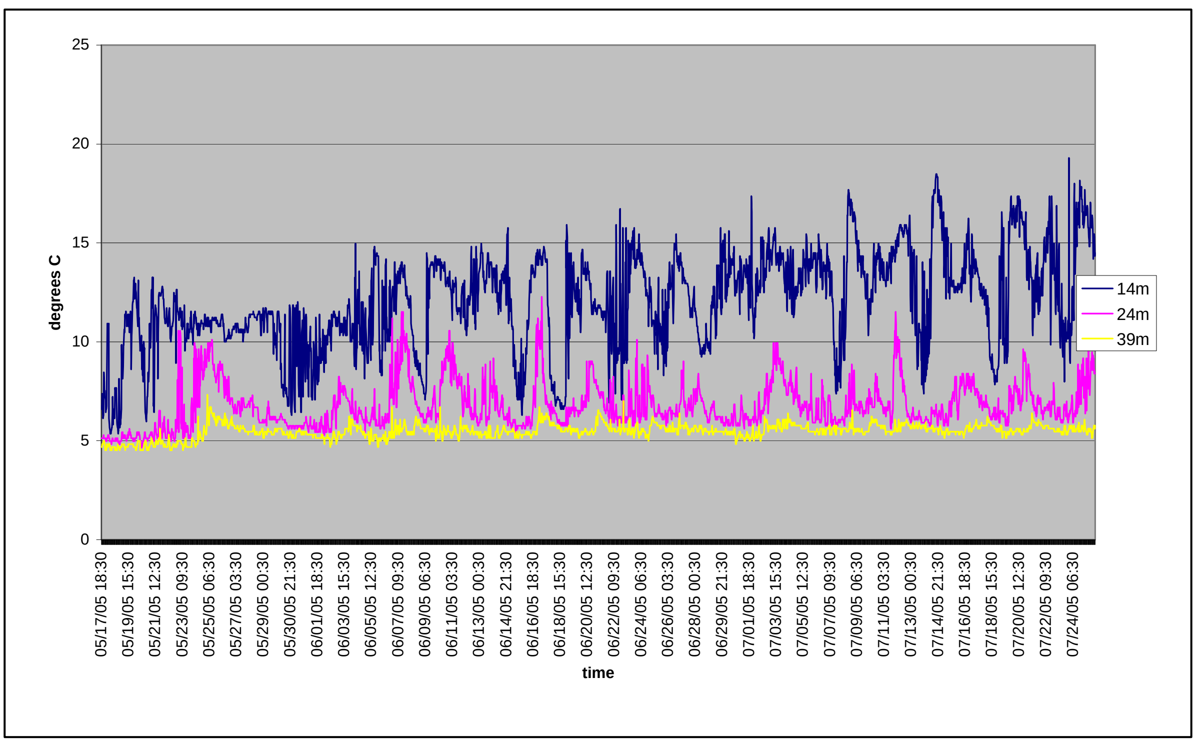


Figure 4.10 is insightful as it illustrates the temperature-depth relationship that occurs in Okanagan Lake during the summer months. The changes in temperature over time are due to wind blown seiches that drive warmer water to depth. The lower and colder the water, generally the less biological activity and more stable the water is for the disinfection process.

DATA COLLECTION RECOMMENDATIONS / FURTHER STUDY REQUIREMENTS

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

- May to September samples should be obtained from the Headwater and Thirsk reservoirs. These reservoirs are the largest and collecting and understanding their water quality characteristics sets out a baseline for Summerland to use, should any changes in activity occur at these reservoirs;
- Investigate the improvement of Trout Creek raw water quality by adjusting the timing of reservoir releases. By monitoring of water quality parameters such as nutrient levels and sensitive physical parameters such as temperature, there may be opportunity to improve the raw water quality obtained in Trout Creek through adjustments in reservoir management. Currently reservoir management is solely managed based on quantity considerations. In the wetter years, there is the opportunity to change the reservoir management;
- Locate reservoir source of *Pandorina* in May 2008 Trout Creek sample through a watershed reservoir sampling program. This is a cause of concern and the location should be found so that it can be treated or contained;
- Continue to monitor Garnet Valley Reservoir algae levels during the growing season;
- Identify source of summer *E.Coli* spikes. It may be tied to livestock (cattle grazing) or natural wildlife, septic tanks or a number of other potential risks. A listing of all known risks is presented in Appendix G;
- Investigate variable Rodeo well water chemistry with twice a year sampling;
- If a new intake is to be developed on Okanagan Lake, then sampling at depth for temperature (thermistor string), and other physical water quality parameters should be conducted. THMs, UV transmissivity, *E.Coli* and Total Coliform testing, pH, conductivity, turbidity and algae samples should be collected every three months.

A raw water quality monitoring program is recommended for the following reasons:

- To notice changes in upper watershed prior to them becoming a serious problem.
- To establish a baseline for raw water quality so that future changes in land use can be assessed with a historic baseline in place for comparison;
- To understand depth-versus-area ratio within the reservoirs and what effect this has on raw water quality;
- To understand the elevation-versus-water quality aspects to see whether or not elevation and surrounding vegetation has an impact on water quality.

4.10 SUMMERLAND WATER TREATMENT PLANT

The $18,000,000 Summerland WTP was completed in 2007 and is currently in the process of being commissioned. The plant utilizes a proprietary "*Actiflo*" water treatment process which uses ballasted sand during chemical addition to assist in the settling of water treatment flocculated particles.

The process effectively removes the colour and particulate matter from the Trout Creek water source and with filtration that is in place, can reduce the water turbidity from levels of greater than 20 NTU to less than 0.10 NTU.

Photo: Summerland Water Treatment Plant

The critical issue with the WTP is that it is only a part of the solution for the Summerland Water Treatment issues. The WTP capacity is designed to be 75 ML/day however maximum daily summer demands for Summerland are 112 ML/day. The shortfall in WTP capacity can be made up in a combination of ways:

1. Increase WTP capacity through increasing the process rate (recommended);
2. Separate the irrigation demand off of the water system so that the plant can provide high quality water to the domestic customers (recommended); and
3. Increase the WTP capacity through expansion of the facility (not recommended).

The WTP requires additional staffing and there will be increased operational costs annually in the range of $450,000. This cost is to cover water treatment plant chemicals, operator labour costs, utilities, sludge removal and miscellaneous items. There is also debt repayment that is assigned to each property within the District of Summerland to service the debt created by this project and the raising of Thirsk Dam.

There are several issues that Summerland is currently working on with respect to the WTP:

1. A critical issue that is being resolved is the sludge handling and residuals management systems for the WTP. There are a number of issues to be resolved with respect to the WTP processes. The *Actiflo* Process results in a large recycle flow of water that is to be either wasted or recycled to the head of the water treatment plant. The Actiflo process typically allows a maximum recycle of 10% of the MDD flow rate.
2. The WTP is to be tested in the late spring of 2009 with higher flow rates to see what would be the highest reasonable rate at which to run the WTP. The supplier is to be present for this work;
3. Operator training must occur so that Summerland has a Level 4 WTP Operator. Due to the technology present, the WTP will likely be classified as a Level 4 facility and as such, requires a Level 4 WTP Operator. The most stable way that this can be developed is by training and certifying present staff to a higher level;
4. Plant optimization will be occurring over the first 3 to 5 years with operators understanding the process and the characteristics of the raw water better with each subsequent year of data from plant performance.

4.11 RECOMMENDED APPROACH TO WATER QUALITY IMPROVEMENTS

The recommended approach to water quality improvements is to reduce the highest drinking water risks first and then move to full compliance. The recommended steps are set out below.

1 **Optimize WTP Performance:** Work to ensure that the plant is fully functional to the design capacity of 75 ML/day including the sludge handling component;

2 **Maximize WTP Flow Capacity:** In the interim, until separation or alternative source projects are develop, maximize capacity of plant to greater than 75 ML/day, even if treated water turbidity is compromised to the 0.30 NTU level at the WTP outlet;

3 **Monitor Upper Watershed Reservoirs:** Monitor the upper watershed reservoirs. Collect full parameters water quality data two times per year at these reservoirs. This will develop a baseline for their quality and will help to foresee any early warning signs for algae blooms;

4 **Monitoring of Rodeo Grounds Well:** Continue to monitor uranium and Total and *E.Coli* levels for the Rodeo Grounds Well. This will determine the risk and urgency to chlorinate the well and how often to use the well;

5 **WWTP Sampling for Drinking Water Risks:** As the District is considering the use of Okanagan Lake water, sampling of the WWTP outlet should be conducted to determine the number of viable *Cryptosporidium* oocysts or *Giardia* cysts present;

6 **Begin Water Distribution Separation:** Begin system separation works in Prairie Valley to reduce the flow requirements through the WTP. Separation, source development and flow projects to achieve the overall objectives of the highest possible quality of water for cost should be set out considering the cost –benefit analysis carried out in Section 5.7 of this report;

7 **Chlorine Residual Monitors:** Installation of additional chlorine residual monitors at three (3) additional locations within the water distribution system. Install one every two years;

8 **Okanagan Lake Intake c/w UV disinfection:** Develop a lake intake at Wharf Street or Powell Beach in Trout Creek. Presently IHA is requiring that all new intakes on Okanagan Lake be filtered. As a minimum, develop this as a raw water source that can be upgraded with UV disinfection at some time in the future;

9 **Watershed Protection Plan – Upper Watershed:** Development of a Watershed Protection Program for the Trout and Eneas Creek watersheds. This would be done to meet the requirements of the IHA. The Source to Tap assessment guide modules related to source protection should be considered for the watersheds to define the risks. Updating of the 2002 Earth Tech Report will be required to meet current requirements. Investigate opportunities for obtaining a 200m buffer around all Reservoirs;

10 **Aeration Upgrade at Garnet:** Upgrade the aeration system at Garnet Reservoir to include aeration behind the old dam structure. This in time should improve the biological health of the larger reservoir and reduce the large anaerobic zone located behind the breached dam structure. This in turn should result in less potential for blooms and taste and/or odour issues;

11 **On-Line Monitoring of Sources:** Install upgraded water quality instrumentation at the Trout Creek and Garnet Reservoir intakes. This will allow more accurate reading of raw water from the surface water sources and will allow year-round control on the inlets. The on-line data collected should be linked to the District SCADA system. Parameters that should be collected include turbidity, dissolved organic carbon, temperature, conductivity and pH.

5. FUTURE WATER SYSTEM

5.1 INTRODUCTION

This section sets a plan for how the water system should evolve to be able to handle the impacts of growth, climate change and meet the requirements of IHA to provide high quality drinking water for all domestic services.

The developments proposed within the municipal boundaries of Summerland are listed in this section. The recently updated Summerland OCP is 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).

In developing a plan for the future water system, the availability of raw water resources was considered as were all potential future projects. Expanded reservoir storage and/or source development is summarized in Section 5. Cost estimates for water supply options are presented in Appendix A.

Perhaps the most difficult issue to predict and plan for is climate change. Changes in the seasonal patterns are predicted by the scientists. The impacts that climate change will have over the next few decades remains to be seen however, adaptation and methods for developing a more resilient water supply with customers that can adapt are presented in this section.

5.2 FACTORS INFLUENCING CHANGE IN WATER MANAGEMENT IN THE OKANAGAN

For water in the Okanagan, there is one way in and two ways out. Water enters the Okanagan Valley by means of precipitation. Water leaves the valley either through evaporation-evapotranspiration or overland and groundwater runoff southwards to the Okanogan River. There is an extensive amount of scientific research work underway in the Okanagan Basin to better understand these mechanisms. Having one of the hottest climates in the country in a defined relatively small basin makes the Okanagan a desired venue for research. The information developed from this research must be applied in an effective means so that our water resources are well managed and protected. The following valley-wide factors are expected to influence the direction of future water supplies in the Okanagan Valley.

1. **Basin-Wide Water Board:** A basin-wide legislative body to provide leadership and coordination of water resources management must be in place and must be effective. The existing Okanagan Basin Water Board (OBWB) is evolving into this role with recent successes. With the support of the Okanagan Water Stewardship Council which is the expert advisory panel, the OBWB is dealing with a wider range of water supply issues. Water supply issues such as conservation, water allocation, and groundwater protection are all now currently being studied and the reports provide insight for water managers and regulators throughout the valley;
2. **Knowledge of Quantity:** The *Okanagan Water Supply and Demand Study* will be completed within the next 1 ½ years and there will be a stronger understanding of the basin hydrology, groundwater, evaporation and evapotranspiration, how much is used on an annual basis, and how much is required for the various frequency drought years.

3. **Tools:** The increased use of meters will result in more effective monitoring. Water will be allocated equitably and used with increased knowledge in a more responsible manner. Through increased monitoring, inefficient water usage of water will decrease.
4. **Technology:** The technology to manage the moisture levels in surface soils of irrigated lands continues to improve. There will be more effective water use for irrigated areas. This will allow water to be better held in the top zones of soils for growing food.
5. **Value:** The price for water will increase. As the price increases, the perceived value will also increase as will the public's willingness to save and ration water. Less water will be used per person.
6. **Densification:** Our urban areas will densify where utilities already exist, where servicing costs are the lowest, and where people can afford to live. The amount of irrigation (outdoor use) in these densified areas cannot increase as the areas are already developed. The amount of water required per person will continue to be reduced because of densification. Much of the water for purely domestic use is not lost to the valley hydrological cycle, as it is treated to a high level at the WWTP and returned to Okanagan Lake;
7. **Groundwater Legislation:** Densification will result in increased competition for the water resources, including groundwater. Legal battles related to groundwater rights will become inevitable and will occur more frequently. Licensing of groundwater will become necessary.
8. **System Renewal:** The water suppliers will implement full-cost pricing of their utilities, particularly with respect to water quality improvements and system renewal and reinvestment. For Okanagan water utilities, system renewal is the largest annual cost presently not fully accounted for by many utilities within their existing water rates.
9. **Supply Management:** Even as the Okanagan Valley struggles to better understand the water resource, the value of water will increase, and the valley will inevitably reach the finite limit of the annual sustainable supply. After Okanagan Lake is fully licensed, drought management procedures will be implemented in the dry years more frequently. Common drought management procedures should occur on a local and then regional basis, dependant on the severity of the drought. Regional management for the valley water supply cannot function effectively without local implementation and stewardship.
10. **Increased Reservoir Storage:** The need to develop additional high elevation water supply storage will increase. Additional water stored at high elevations will reduce the drought impacts and provide buffering storage in the drought and flooding cycles that are expected to occur with more frequency.
11. **Public Awareness:** Public awareness on water-related issues will continue to increase, and the implementation of water meters will become standard for most domestic and irrigation connections within the next 5 years. Water suppliers' policies to improve water conservation practises will continue to improve as will the public's willingness and ability to meet these policies.
12. **Resiliency and Adaptation:** Alternative and/or contingent supplies will be developed by the water suppliers. For most utilities in the Okanagan, this includes groundwater. These supplies will result in more flexible and reliable water supply capacity. This should result in reduced financial hardship by the water users during a major drought.

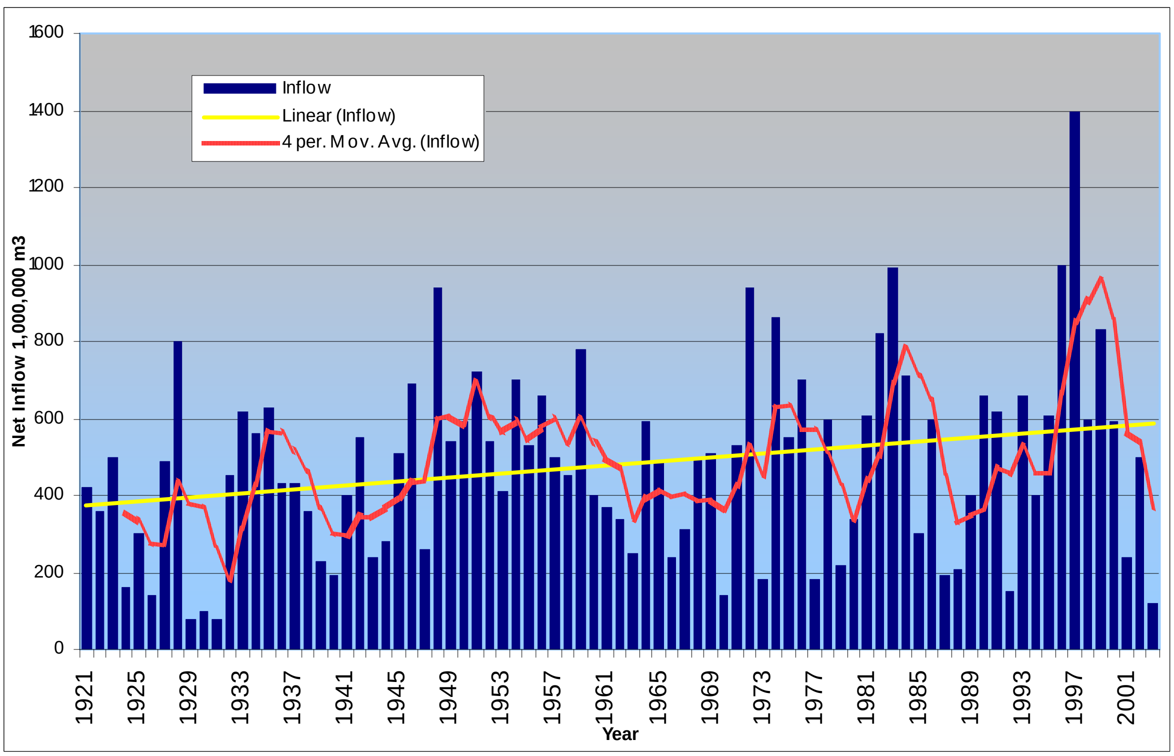
5.3 CLIMATE CHANGE IMPACTS

The issue of climate change continues to garner attention. The last 100 years have shown a quantifiable increase in the world's temperatures and this is expected to continue well into the 21st century. There are arguments to whether this is a natural condition or influenced by man. This report only comments on the basin trends that are occurring.

Figure 5.1 provides a summary of inflow into Okanagan Lake for a period of 82 years. The graph shows the extreme limits of the 1929-1931 drought to the high inflow in 1997. In an average year, there is approximately 440,000 ML of water that flows into Okanagan Lake.

Two trend lines are presented in Figure 5.1. The yellow line is a linear trend of the annual inflow, which appears to be increasing. The red trend line presents a 4-year moving average of the annual inflow. The red line shows an increase in variation of inflow.

Figure 5.1 - Okanagan Lake Inflow (1921-2003)



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

The Okanagan Valley is recognized as the most water stressed area within Canada. As a result, it has been closely studied. A key report that has garnered a great deal of media attention in the valley was prepared by a team of researchers led by Dr. Stewart Cohen titled "*Expanding the Dialogue on Climatic Change in the Okanagan Valley*".

Their predictions of the impact that global warming will have on the Okanagan Valley are as follows:

1. For the next 80 years, it is expected that temperatures will continue to rise.
2. In the next 50 years, the length of summer season within the Okanagan is expected to increase by approximately 6 to 8 weeks, although the total annual precipitation levels are expected to remain nearly the same.
3. The timing for precipitation would be such that a greater proportion would be expected over the winter season with less throughout the summer months. Less water would be stored in the hills as snowfall during the winter period. This would impact water suppliers as this would result in a hotter and longer growing season. This would lead to water suppliers having to access storage water at an earlier date and for a longer period of time.
4. Based on the work in the surrounding watersheds, it is expected that annual flows from the creeks could be reduced by as much as 15% by the year 2050 and as much as 30% by the year 2080.

It is clear that the climate will continue to change. This combined with the trends of increased growth and water demand could severely stress water supplies. Development of additional sources may be required in the future however, this remains to be seen. Even if the findings do become true, with proper management of the water resources, the construction of additional reservoir capacity could be deferred for many years. Facts to consider in the whole scenario of climate change are as follows:

- If the air temperature becomes warmer, it will have the ability to hold more water;
- With more water in the air, more intense storm cells and increased variation in frequency can be expected;
- The potential for flooding and high stream flows may increase;
- Mitigation of damage may be possible through the creation of more storage in the upper watersheds;
- Snow packs could be reduced although total annual precipitation may not change;
- With higher temperatures comes the potential for higher evapotranspiration rates;
- With warmer air temperatures, agricultural lands at higher elevations may become viable;
- Increased excess drought and excess moisture cycles should be expected.

RESILIENCY AND ADAPTATION

The public is presently being overwhelmed with information from the media on water conservation and the sustainability of our water supply. There are several economic and social mechanisms that will influence how the public uses water in the future. Some of the mechanisms previously discussed will inherently result in a lower per capita water demand rate.

A realistic objective for our water utilities is to develop a resilient water supply. This concept is one where the water supply is sustainable, environmentally responsible, fiscally sound, and adaptable on a seasonal basis. The resiliency must be developed jointly by water utility staff and the community. Storage in the upper watersheds will form a part of the long term solution in future years as additional storage will help to buffer the drier years and help to mitigate flooding.

Ultimately, adaptation is the key to managing the impacts from climate change.

5.4 PROBABLE GROWTH ESTIMATES AND WATER DEMAND

Several documents were reviewed in the development of a long term demand for water supply. The growth areas illustrated in Figure 5.2 were obtained from the recent District of Summerland 2008 OCP prepared by Brent Harley and Associates.

The probable development areas for the District of Summerland are presented for the next 20 years with the areas projected to develop sooner than that having a the designation of an *Urban Growth Area*. The actual rate at which development will proceed will be based on availability of municipal services, market absorption, developer risk and financing. The physical constraints of topography and resulting construction costs will impede the development growth rate, as will the high cost of new housing.

Population Growth

The historic population growth rate for Summerland as presented in Section 3 of this report is 2.07%. Table 5.1 provides an estimate of the population for a number of growth rates. The gray column is the population projection used within this report. Our experience with economic modeling has shown that if development occurs at a slightly higher rate, Summerland will be in a much healthier economic position provided that sufficient user fees and DCC rates structures are in place. Although the OCP predicts a 2.00% growth rate, a lower growth rate of 1.25% is used in the economic model as this allows for more conservative financial planning.

Table 5.1 - Possible Population - Growth Rate

Year	Period	0.50%	1.00%	1.25%	1.50%	2.00%	3.50%	3.00%
2006	0	10,592						
2010	4	10,805	11,022	11,132	11,242	11,465	12,155	11,921
2015	9	11,078	11,584	11,845	12,111	12,658	14,436	13,820
2020	14	11,358	12,175	12,604	13,047	13,976	17,145	16,021
2030	24	11,939	13,449	14,271	15,141	17,037	24,185	21,531
2040	34	12,549	14,856	16,159	17,572	20,767	34,115	28,936
2050	44	13,191	16,410	18,296	20,393	25,315	48,123	38,888
2060	54	13,866	18,127	20,716	23,667	30,859	67,882	52,262
2070	64	14,575	20,024	23,456	27,467	37,617	95,755	70,236
2080	74	15,320	22,119	26,559	31,876	45,855	135,072	94,391

Table 5.2 provides a summary of the ultimate projected water demand for the District of Summerland. A summary of existing areas and new development areas are listed. Water demands are projected both on the basis of maximum daily demand (MDD) and annual demands (average daily demand or ADD). The MDD is required to determine the size and capacity of future conveyance infrastructure and water treatment capacity. The ADD must be known for licensing, source development, reservoir storage, and reliability forecasting. The irrigation demands are also included in the table to provide an indication of land area that would be serviced.

Table 5.2 - Development Areas

Type	Existing Development Areas	SFE (lots)	MF (units)	ICI (units)	Equiv. Irr. (ha.)	Total Area (ha.)	MDD (L/s)	Annual Demand (ML)
	SF Residential	3717					297.4	2342
	MF Residential		915				43.9	384
	ICI			261			20.9	164
	Present Arable Lands (utilized)				1249	2461	921.8	8649
	Arable Lands (not in production)				331	331	244.3	2648
	Full allocation remainder to existing lands to 800mm depth				1249			1343
	Leakage (23.1 L/s)						23.1	729
	Actual Usage	3717	915	261	2498	2461	1307	12269
	Present Commitments	**3717**	**915**	**261**	**2829**	**2792**	**1551**	**16259**
ID No.	**Potential Development Areas**							
1	Summerland Vistas	180	78		2.1		19.7	163
2	Summerland Hills	1115	650		90.9		187.4	1702
3	Cartwright Mountain				34.0	136.0	25.1	272
4	South of Cartwright Mountain (Infill)				15.1	60.4	11.1	121
5	Lower Town (all Infill)							
5a	Shaughnessey Springs		200				9.6	84
5b	Lower Town Water Front		200				9.6	84
5c	Lakeshore South		200				9.6	84
6	Downtown (infill)		500				24.0	210
7	Rattesnake Mountain				20.6	82.2	15.2	164
8	Jersey Lands	409	282		6.0		50.7	424
9	Victoria Road				8.7	34.9	6.4	70
	Outlying Lands & Densification			50	61.3	245.0	49.2	490
	Penticton Indian Band Lands	1000			106.0		158.2	1478
	Potential Future Commitments	2704	2110	50	345	559	576	5346
	TOTAL ULTIMATE DEMAND	6421	3025	311	3174	3351	2127	21606
	Population (SF + MF + Area equivalent)	16817	5282		4937	**TOTAL =**	27035	

* Population estimate provided at the bottom of Table 5.2 provide a population projected for the identified lands.

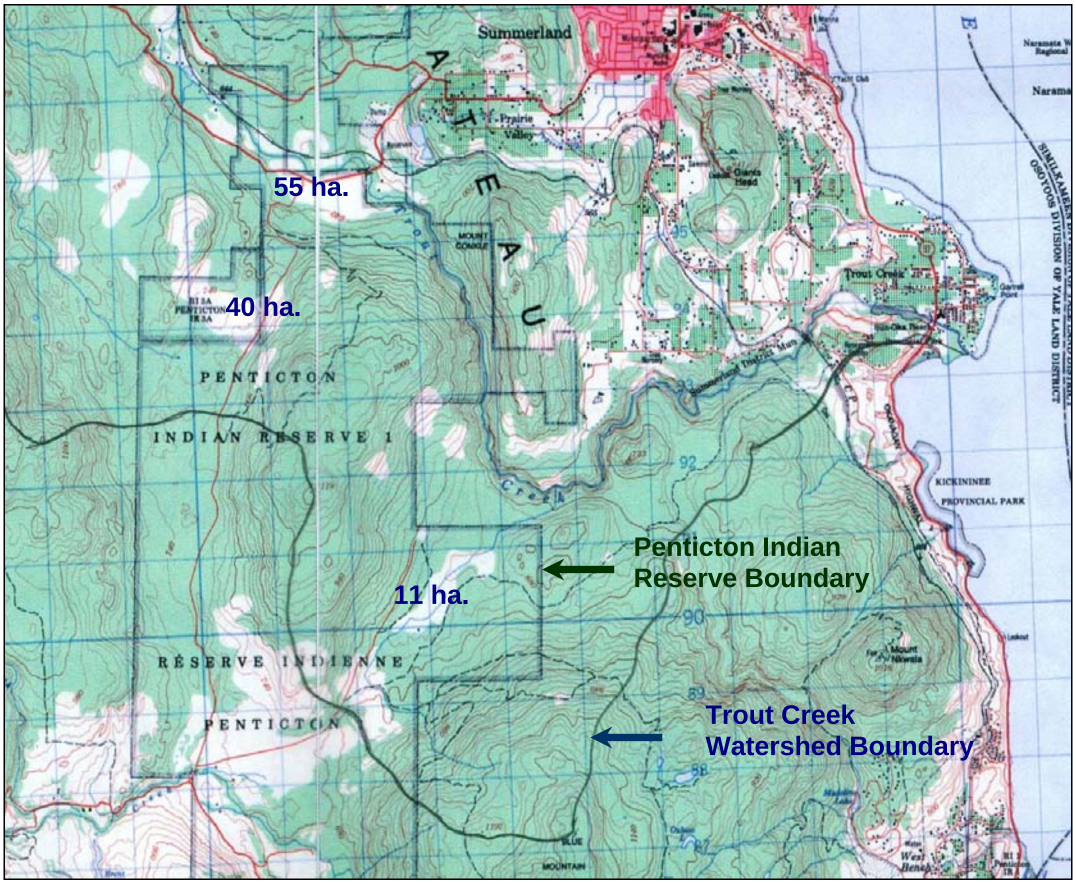
The development areas listed in Table 5.2 correspond to Figure 5.2 which illustrates their location. The numbers presented are for build-out of the identified areas. It is not imperative that the exact locations and lots counts for future development be determined at this time. It is more important that a long term lands and service area be identified and a reasonable volume of water for future servicing be determined for those areas. The Maximum Daily Water Demand (MDD) and Annual Demand numbers will be the guiding values for long term planning.

In review of the historic trends for domestic use, it is apparent that additional water will be required for the dry lands outside those areas presently serviced. These outlying dry lands will require significantly more water than infilling MF unit developments.

5.5 PENTICTON INDIAN BAND CONSIDERATIONS

The Penticton Indian Band holds reserve status lands within the Trout Creek watershed. Band lands that are within the Trout Creek watershed are illustrated in Figure 5.3. The total area of this land is estimated to be 24.2 km^2. Of the 24.2 km^2, the area of irrigable lands was estimated based on a review of aerial images. The irrigable lands are estimated to be only 1.06 km^2 (106 ha.) in the white coloured valley.

Figure 5.3 - Penticton Indian Band Lands



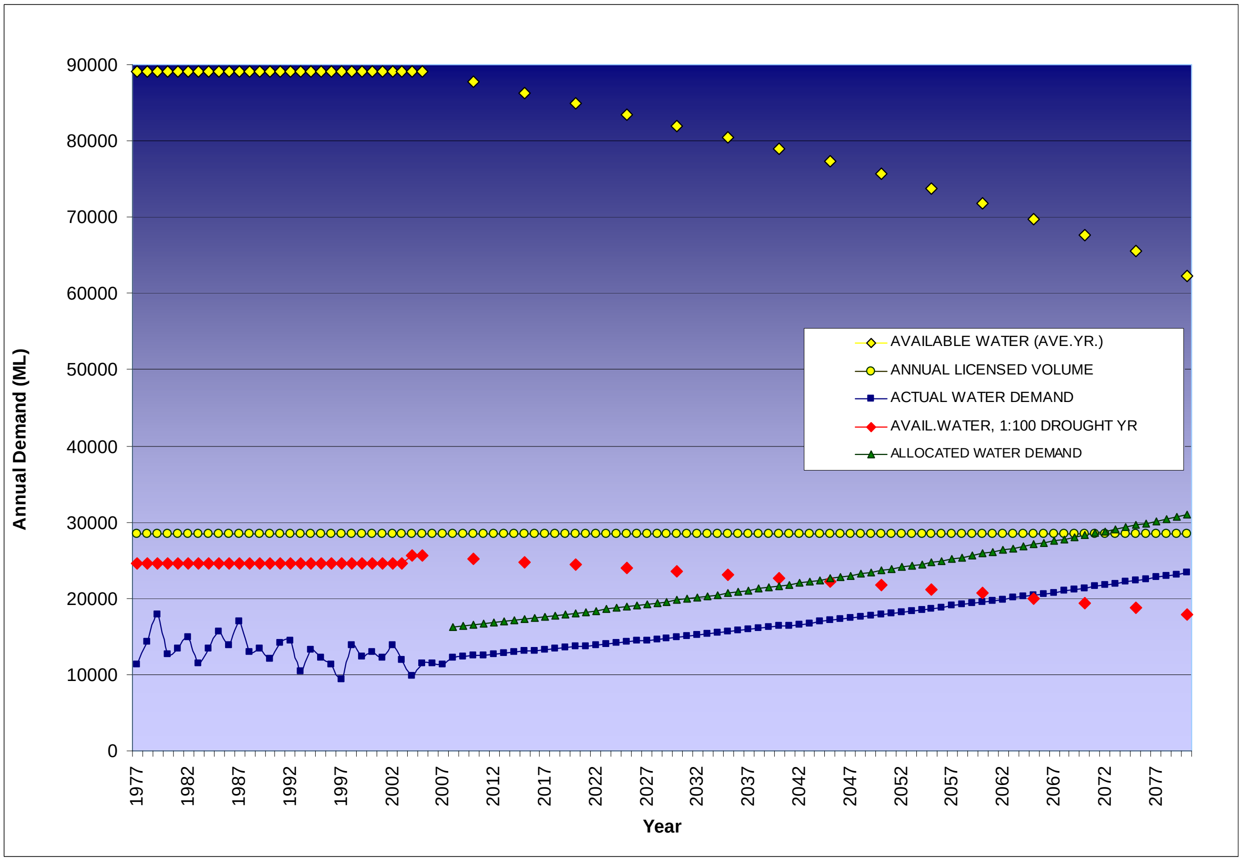
Water may be required by the Penticton Indian Band for the land area identified above. An estimate for water use by the Penticton Indian Band was provided within the 1997 Master Water Plan. A time frame for when the development would occur was not provided.

As the Penticton Indian Band reserve lands develop, it is expected that they will utilize water from Trout Creek. The development of storage on the creek would be necessary to secure a year-round reliable supply of water. Potable water may be requested of the District in which case it would be expected that the Band would cover the infrastructure costs for accessing water from storage facilities on Trout Creek. If high quality domestic water is needed, the required costs for water treatment would also be provided. Groundwater may be a more cost effective solution for the PIB. Details for this would be developed at the appropriate time. Should the Penticton Indian Band approach Summerland regarding water supply, it is recommended that the District work with the Penticton Indian Band at that time to develop a mutually satisfactory agreement.

5.6 SOURCE WATER DEVELOPMENT PLAN

The annual average available water and predicted drought frequency capacities are presented in Section 3.5. The data assembled in this section is projected over a 75 year timeframe so that some of the climate change predictions for the greater Okanagan Valley can be considered. Figure 5.4 provides an illustration of the predicted water supply and demand for Summerland for the future.

Figure 5.4 - Projected Source Capacity vs. Annual Water Demand



Trend lines within Figure 5.4 starting from the top down, are described below.

▪ Yellow Diamonds:	Source water available in an average year from all available sources;
▪ Yellow Circles:	Annual consumptive licenses - Irrigation and WWLA licenses = 28,417 ML/yr;
▪ Red Diamonds	Extreme 1:100 year drought source water available from the watersheds and groundwater plus reduction of 15 % source water by 2050 and 30% source water by 2080. The 2004 increase accounts for the installation of groundwater wells;
▪ Green Triangles	Allocated water starting at 16,230 ML/year in 2008 and increasing demand at a 0.90% growth rate;
▪ Dark Blue	Actual water demand, all uses increasing at 0.90% rate each year.

It is expected that water demand will increase at a lower rate than population. Throughout the Okanagan, the amount of water used per person is declining. This trend is expected to continue for a number of reasons:

- Demand side management techniques are being implemented to reduce consumption;
- Future development has much more multi-family type housing resulting in less irrigation per person;
- Less 'dry" land is available for development as those lands are typically further away from existing water infrastructure and as a result, more expensive to develop;
- The value of water is expected to increase as supplies become more constrained;
- Less agriculture is being practiced as family farms are economically challenged;
- More efficient irrigation practises are occurring.

In determining the most viable direction to pursue securing additional supply, all potential projects that would secure more water or improve water use efficiencies were reviewed. A more detailed description and cost estimate for all projects is included in Appendix A. For the supply projects, a cost per ML/year is also provided in order to provide a cost-benefit review. A summary of all of the water supply projects is listed in order of cost-benefit in Table 5.3.

Table 5.3 - Cost / ML to Secure Source Water

No.	SOURCE CAPACITY PROJECTS	ML Secured	Project Cost	Cost / ML
4	REMOTE READ AGRICULTURE METERS	432	$ 291,077	$ 674
21	TROUT CREEK INTAKE MONITORING & CONTROLS	330	$ 255,639	$ 775
23	ADDITIONAL GROUNDWATER CAPACITY	413	$ 347,875	$ 842
9	OKANAGAN LAKE PUMP STATION (PHASE 1)	5141	$ 5,253,229	$ 1,022
23	CONNECT TW3 & TW5	524	$ 543,824	$ 1,038
39	SITE 13 RESERVOIR (3,700 ML)	3700	$ 4,199,800	$ 1,135
47	LOWER TOWN LAKE INTAKE - SOURCE UPGRADE	402	$ 569,250	$ 1,416
27	SITE 2 RESERVOIR, 7600 ML + PITIN CREEK DIVERSION	7600	$ 12,037,229	$ 1,584
50	OKANAGAN LAKE PUMP STN - PEACH ORCHARD DR.	12000	$ 19,512,000	$ 1,626
3	DOMESTIC METERING PROGRAM	405	$ 674,800	$ 1,666
40	SITE 9 RESERVOIR, KATHLEEN CREEK (1600 ML)	1600	$ 2,828,793	$ 1,768
41	SITE 1 RESERVOIR, UPPER TROUT CREEK (2220 ML)	2220	$ 4,797,386	$ 2,161
32	TROUT CREEK RESERVOIR EXPANSION	730	$ 3,055,608	$ 4,186

The projects presented in Table 5.3 should be used only as a guideline for assessing the cost effectiveness of various projects. The table does not address the factors of risk involved with each of the options or whether or not the fully developed supply will be reliable or secure for an on-going basis.

The cost per ML developed or saved is only one issue to be considered when reviewing the projects for implementation. Other issues include physical location of the project, how the project integrates into the greater needs of the community, and the ability of the District to fund the project.

5.7 DISTRIBUTION SYSTEM SEPARATION

The District of Summerland recently completed the Water Treatment Plant (WTP) at Trout Creek Reservoir. The WTP forms a portion of the solution for providing the District with domestic water that meets the requirements of the Interior Health Authority. The WTP has a hydraulic capacity of 75 ML/day. This is insufficient to supply the total maximum day demands which are currently in the range of 112 ML/day. Of that amount, 98 ML/day is consumed within the Summerland (Trout Creek) water service area and 14 ML/day is used in Garnet Valley. There are two options available in which to meet the IHA requirements:

1. Construct additional WTP capacity in the amount of 40 ML/day to make up the shortfall;
2. Split off the irrigation portions of the water distribution system so that the WTP capacity can handle the remaining distribution demands.

The approximate cost to construct an additional 40 ML/day of WTP capacity is $12,000,000. The cost to separate out the water distribution system has been estimated to be in the range of $12,000,000. One advantage of system separation is that the work can be staged. Another is that it is possible that new development can fund a portion of this work rather than being required to fund WTP capacity upgrades. To determine where and when system separation is economically viable, a lifecycle analysis was carried out. For this analysis, the lifecycle cost is defined as:

"the total amount of money that would have to be set aside in present day dollars to cover the operational and capital costs over the time frame"

Operational costs typically create 75% of the total lifecycle cost and their impact is typically underestimated in the pursuit of short term gains. The results from that analysis are presented herein with details provided in Appendix E. A summary of that analysis is provided in Table 5.4 and Figure 5.5.

Table 5.4 - Lifecycle Analysis for System Separation (including WTP costs)

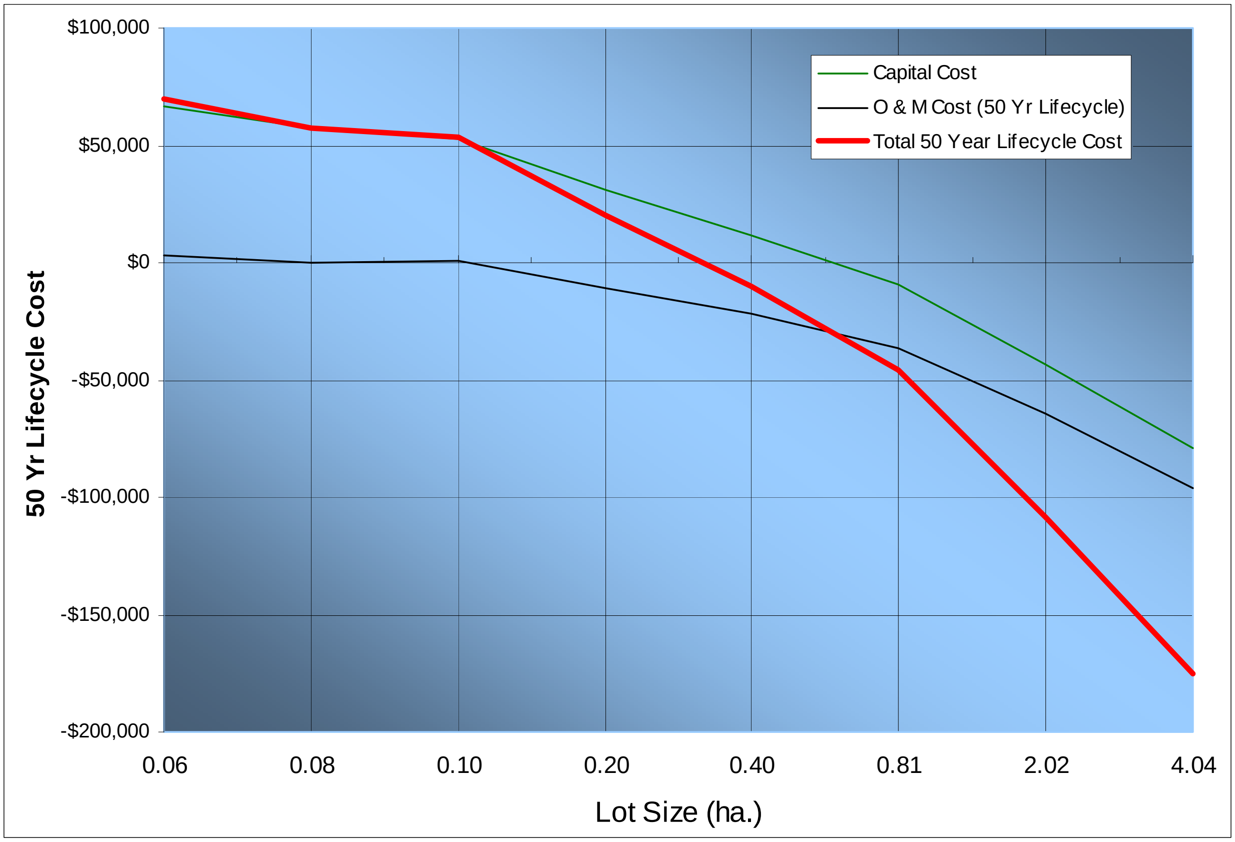
Lot Size (ha.)	**0.06**	**0.08**	**0.10**	**0.20**	**0.40**	**0.81**	**2.02**	**4.04**
Land Area (m2)	600.00	810.00	1010.00	2020.00	4040.00	8100.00	20200.00	40400.00
House, driveway area (m2)	302.0	302.0	302.0	302.0	302.0	302.0	302.0	302.0
Outdoor Depth (m)	0.692	0.692	0.692	0.692	0.692	0.692	0.692	0.692
Outdoor water use	206.2	351.5	384.83	1188.9	2586.7	5396.2	13769.4	27747.8
Indoor Water Use	215.17	215.17	215.17	215.17	215.17	215.17	215.17	215.17
Lot Size (ha.)	**0.06**	**0.08**	**0.10**	**0.20**	**0.40**	**0.81**	**2.02**	**4.04**
Capital Cost	$ 66,689.14	$ 57,124.29	$ 52,985.64	$ 30,709.47	$ 11,670.03	$ (9,172.42)	$ (43,529.24)	$ (78,931.47)
O & M Cost (50 Yr Lifecycle)	$ 3,379.47	$ 283.02	$ 452.05	$ (10,599.26)	$ (21,554.84)	$ (36,336.53)	$ (64,636.81)	$ (96,171.89)
Total 50 Year Lifecycle Cost	$ 70,068.62	$ 57,407.31	$ 53,437.68	$ 20,110.21	$ (9,884.81)	$ (45,508.95)	$ (108,166.05)	$ (175,103.36)

Table 5.5 shows the net lifecycle cost for various size lots. For sizes of 0.06 ha. to 0.20 ha., there is a cost increase for installation of a separated water system. For the smaller lots, a higher percentage of water that is consumed is for domestic purposes. As the lots get larger, the majority of water utilized is for irrigation. The savings for not having to construct additional water treatment plant capacity is included in the estimates. Table 5.4 shows that over 50 years, the net total savings in separating out a 4.0 hectare lot

would be approximately $175,000. The capacity cost is shown to be an immediate savings primarily due to the savings in water treatment capital costs.

Figure 5.5 illustrates the results presented in Table 5.4. The red line in the graph illustrates the 50 year lifecycle cost for varying lot sizes. Where the red line is below $0.00 is where there is a net benefit in carrying out separation works.

Figure 5.5 - System Separation Lifecycle Costs (including WTP costs)



System Separation Design Principles

The following principles were followed in the conceptual designs presented within this report:

- Maximize the use of gravity water through the irrigation system;
- Maximize the use of existing infrastructure;
- Where possible, design new watermain installations on alignments that are off-pavement and in the shoulder of the roadways;
- Garnet Reservoir water is to be used only for irrigation so that there is one less source to have to treat and maintain over time. Centralized treatment from the WTP is the primary objective;
- Where a lot has both an irrigation and domestic distribution service, the domestic water is to only be used within the home;

- All lots 0.40 ha. in size and larger should be considered for system separation;
- For lots with both an irrigation connection and a domestic connection, an in-home design flow of 225 L/person/day was used;
- Fire protection is provided off of the irrigation water system wherever practical;
- Both the irrigation and domestic water systems are functional and operated year round;
- Where systems are running parallel, the higher operating pressure should be set for the domestic system to reduce the potential for cross connections between the water systems. 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;
- Chlorination will remain on the irrigation system indefinitely so that biofilm growth in the irrigation distribution system is controlled;
- Care must be taken to ensure the systems are fully separated and secure, and a full cross connection control program must be maintained;
- Watermain sizes as small as 50mm diameter should be considered for the domestic system where the number of connecting homes is limited;
- Separated domestic water mains are to extend only to where they are absolutely necessary;
- Staging of the separated domestic water system must originate from the WTP.

Drawings and cost estimates for ten 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. Twelve separation areas were considered and costs for each of the areas is presented on Table 5.5.

Table 5.5 - System Separation Cost Estimate Summary

No.	SEPARATION PROJECTS	Local Area MDD (ML/day)	MAX DAY DEMAND EQUIVALENT ($ / ML/ DAY)	Total Treated flow directed to WTP (ML/day)	Project Cost ($)	Cumulative Cost ($)
	WTP CAPACITY	75	$ 240,000		$ 18,000,000	$ 18,000,000
	EXISTING MDD - ENTIRE WATER SYSTEM			112		
5	SYSTEM SEPARATION - PRAIRIE VALLEY (WEST)	5.46	$ 102,050	106.54	$ 557,190	$ 18,557,190
6	SYSTEM SEPARATION - PRAIRIE VALLEY (EAST)	7.60	$ 78,540	98.94	$ 596,907	$ 19,154,097
12	SYSTEM SEPARATION - GARNET VALLEY	13.00	$ 163,580	85.94	$ 2,126,541	$ 21,280,638
13	SYSTEM SEPARATION - JONES FLATS (WEST) & CARTWRIGH	11.20	$ 74,714	74.74	$ 836,798	$ 22,117,435
17	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	5.35	$ 225,223	69.39	$ 1,204,944	$ 23,322,380
18	SYSTEM SEPARATION - FRONT BENCH ROAD	2.12	$ 375,681	67.27	$ 796,444	$ 24,118,824
19	SYSTEM SEPARATION - HAPPY VALLEY	5.56	$ 185,905	61.71	$ 1,033,632	$ 25,152,455
20	SYSTEM SEPARATION - HESPLER ROAD	1.27	$ 123,113	60.44	$ 156,354	$ 25,308,809
35	SYSTEM SEPARATION - JONES FLATS (EAST)	10.50	$ 227,530	49.94	$ 2,389,060	$ 27,697,869
37	SYSTEM SEPARATION - SIMPSON ROAD	2.71	$ 561,828	47.23	$ 1,522,554	$ 29,220,423
38	SYSTEM SEPARATION - VICTORIA RD. / CANYONVIEW RD.	9.22	$ 147,012	38.01	$ 1,355,448	$ 30,575,871
45	SYSTEM SEPARATION - TROUT CREEK	6.95	$ 250,870	31.06	$ 1,743,550	$ 32,319,420
	TOTALS	**80.94**	**$ 176,914**		**$ 14,319,420**	**$ 32,319,420**

Works required for WTP to handle 75 ML/day MDD flow

Table 5.5 provides details for each of the separated areas on a cost-benefit basis. A description of each column in Table 5.5, starting from the left, is described as follows:

1. Project Number - Project Number as listed in Appendix A;
2. Project Name;
3. Maximum day demand volume that would be freed up at the WTP if project is implemented;
4. Cost effectiveness ratio of the project in $/ML/day. It costs roughly $240,000 for each ML/day of additional WTP capacity;
5. Total Capacity reduced with each project implemented, declining from current MDD of 112 ML/day;
6. Project Cost;
7. Cumulative cost for WTP plus each separation project.

The projects are generally listed in order of implementation but there are other factors that will influence how the program will proceed. Funding and development contributions will influence the program as will the implementation of supply from Okanagan Lake.

Currently, the IHA is not permitting new intakes on Okanagan Lake without filtration, however, the recent expert Technical Advisory Committee report on *Turbidity and Microbial Risk in Drinking Water* prepared for the Ministry of Health clearly stated that fortunately cost effective alternatives to filtration are available. For some raw waters, the same health outcomes that can be achieved with filtration can also be achieved with available best technologies such as UV disinfection. Disinfection is essential and filtration is desired.

This report recommends that Summerland follow the expert technical advice and work towards an intake and UV / chlorination disinfection system on Okanagan Lake. A 20 ML/day lake intake is proposed in Appendix A as Project No. 9. Monitoring of the source water is the first step in determining if this is in fact viable.

To get close to supplying the required total system MDD flow of 112 ML/day, Summerland would have to carry out the first two phases of separation plus install the Okanagan Lake intake and UV system. This would create 33 ML/day of flow during the maximum day demand conditions. Garnet Valley system separation will require separation works and 11.1 ML/day can be developed by separating Garnet Valley and Cartwright Mountain and Jones Flats West.

5.8 FUTURE PROJECTS

Based on our system review, a number of probable projects were identified to correct existing issues, meet the existing and long term demand requirements of the District and to achieve the IHA requirements. All projects were assessed based on their viability, cost, and benefit to the District of Summerland. Details, rationale and cost estimates for the projects are included in Appendix A.

Table 5.6 provides a summary of the costs for **all** recommended projects, along with a cost apportionment and priority. 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 (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 should be completed ahead of high priority projects only when there is beneficial opportunity such as underground construction 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 latecomers charges set up by Summerland.

The project listing is in the recommended order of implementation. In addition to the projects listed, there are 14 other projects that were considered but not included in the recommended list. All projects are included in the Project Sheets in Appendix A.

Project priority was based on a number of factors including:

- Whether or not the project work was already underway;
- Project funding had been already received for the project;
- It was a critical item that was necessary for effective water distribution system or water treatment plant operations;
- Projects that would reduce peak flows to the WTP and allow the District of Summerland to come off the Water Quality Advisory that had been on throughout most of 2008;
- Project that benefits all residents of the District and those areas where minimal changes or benefits have occurred in the past.

Table 5.6 - Project Summary List (All recommended projects listed)

Priority	#	PROJECT NAME	Current Users	DCC Project	TOTAL
H	1	JAMES LAKE PUMP STATION	$ 764,138	$ -	$ 764,138
H	2	WTP - SLUDGE HANDLING SYSTEM	$ 822,250	$ -	$ 822,250
H	3	DOMESTIC METERING PROGRAM	$ 674,800	$ -	$ 674,800
H	4	AGRICULTURAL METERING PROGRAM	$ 291,077	$ -	$ 291,077
H	5	SYSTEM SEPARATION - PRAIRIE VALLEY (WEST)	$ -	$ 557,190	$ 557,190
H	6	SYSTEM SEPARATION - PRAIRIE VALLEY (EAST)	$ -	$ 596,907	$ 596,907
H	7	THIRSK OUTLET MODIFICATIONS	$ -	$ 183,425	$ 183,425
H	8	ELECTRICAL AND INSTRUMENTATION UPGRADES	$ 792,902	$ -	$ 792,902
H	9	OKANAGAN LAKE PUMP STATION (PHASE 1)	$ -	$ 3,131,508	$ 3,131,508
H	10	OKANAGAN LAKE BOOSTER STATIONS (PHASE 2)	$ -	$ 2,121,721	$ 2,121,721
M	11	TROUT CREEK RESERVOIR SCREENING WORKS	$ 638,825	$ -	$ 638,825
M	12	SYSTEM SEPARATION - GARNET VALLEY	$ -	$ 2,126,541	$ 2,126,541
M	13	SYSTEM SEPARATION - JONES FLATS (WEST) & CARTWRIG	$ -	$ 836,798	$ 836,798
M	14	RESERVOIR SPILLWAY WEIR MONITORS	$ 15,813	$ -	$ 15,813
M	15	CHLORINE RESIDUAL MONITORS	$ 18,975	$ -	$ 18,975
M	16	PUMP STATION 2B - SOLENOID VALVE	$ 44,275	$ -	$ 44,275
M	17	SYSTEM SEPARATION - GIANTS HEAD ROAD (NORTH)	$ -	$ 1,204,944	$ 1,204,944
M	18	SYSTEM SEPARATION - FRONT BENCH ROAD	$ -	$ 796,444	$ 796,444
M	19	SYSTEM SEPARATION - HAPPY VALLEY	$ -	$ 1,033,632	$ 1,033,632
M	20	SYSTEM SEPARATION - HESPLER ROAD	$ -	$ 156,354	$ 156,354
M	21	TROUT CREEK INTAKE MONITORING & CONTROLS	$ 139,229	$ 46,410	$ 185,639
M	22	GARNET RES. INTAKE MONITORING AND CONTROLS	$ 50,600	$ -	$ 50,600
M	23a	ADDITIONAL GROUNDWATER CAPACITY	$ -	$ 347,875	$ 347,875
M	23b	CONNECT TW 3 AND 5	$ -	$ 543,824	$ 543,824
M	24	TROUT CREEK DISTRIBUTION SYSTEM INTERCONNECT	$ 107,019	$ 107,019	$ 214,038
M	25	BULL CREEK HYDROMETRIC STATION	$ 9,488	$ -	$ 9,488
M	26	GARNET RESERVOIR - AERATION SYSTEM	$ 43,643	$ -	$ 43,643
L	27	SITE 2 RESERVOIR, 7600 ML	$ -	$ 10,727,100	$ 10,727,100
L	28	PITIN CREEK DIVERSION TO SITE 2	$ -	$ 1,310,129	$ 1,310,129
L	29	RESERVOIR TANK MIXING IMPROVEMENTS	$ 142,313	$ -	$ 142,313
L	30	HYDRANT INSTALLATIONS	$ 257,600	$ -	$ 257,600
L	31	BLOW-OFF PROGRAM	$ 86,250	$ -	$ 86,250
L	32	TROUT CREEK RESERVOIR EXPANSION	$ 3,055,608	$ -	$ 3,055,608
L	33	WTP - FLOWMETER AND PROGRAMMING	$ 12,650	$ -	$ 12,650
L	34	DISTRIBUTION STORAGE PROJECTS	$ -	$ 1,391,500	$ 1,391,500
L	35	SYSTEM SEPARATION - JONES FLATS (EAST)	$ -	$ 2,389,060	$ 2,389,060
L	36	PRV STATION UPGRADES	$ 295,193	$ -	$ 295,193
		TOTALS	**$ 8,262,644**	**$ 29,608,379**	**$ 37,871,023**

The ability to finance and carry out the recommended projects is discussed in Section 6.

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6. FINANCIAL PLAN

6.1 INTRODUCTION

This section provides a summary of the economic factors facing the District of Summerland water utility. The present operating and reserve accounts are summarized. This section sets out a plan for implementing the proposed projects and provides a rationale for setting equitable Development Cost Charge (DCC) rates. A comprehensive Economic model is included in Appendix B that provides a tool for forecasting the impact of probable projects and the required User Fee and DCC rate adjustments.

6.2 PRESENT ACCOUNTS

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

1. **Water Capital Fund and Cash Deposits (year end 2007 - $ 773,879)**
   This account is the District water utility operating account. User fees and Parcel Taxes collected are held here and this fund is utilized to pay for day to day operations and, when necessary, emergency works. This fund effectively does not collect a significant amount of interest. A minimum balance of $500,000 should be held in this fund at all times in the event of an emergency.
2. **Development Cost Charge Reserve Fund (year end 2007 - $230,000)** This is a reserve account for the District for Capital funds for water system improvements paid for by additional development. The monies within this fund collect interest. This fund is typically used to fund source development or source replacement. It is rarely used for debt servicing of capital expenditures related to the water supply system.
3. **Capital Works Reserve Fund (year end 2007 - $100,000)** This fund is a holding account for monies for upcoming capital works. The fund levels are low at the present time due to the major expenditures of the WTP and the remediation and expansion works at Thirsk Dam.

There is no specific Renewal Reserve Fund for the replacement of water system infrastructure. As the water infrastructure ages, the District may consider setting up a Renewal Fund, however the accounting requirements have changed with the Ministry of Community Development (renamed from Ministry of Community Services / Municipal Affairs) and assets are to be reported and depreciated over time.

Within this report is a summary of the quantity and age of of the water distribution system infrastructure. The base work is in place and there would be a nominal amount of additional work to determine the renewal reserve contribution required to set aside a reasonable amount of capital for renewal works. It is expected that the remaining lifespan of the oldest watermains is still greater than 20 years. For this reason, the funds that are currently being used to fund the WTP debt and Thirsk dam construction debt may be available in the future to fund renewal at the appropriate time.

Fund levels for the District water utility for 2005 through 2007 are set out in Table 6.1

Table 6.1 - Recent Annual Fund Balances

Reserve Fund (Year End)	2005	2006	2007
Long Term Capital Reserves - Water	$ 63,187	$ 65,809	$ 67,948
Water Revenue Fund	$ 235,724	$ 421,257	$ 457,468
Operating Fund	$ 275,543	$ 521,538	$ 773,879
Total – Reserves and Surpluses	$ 574,454	$ 1,008,604	$ 1,299,295
Development Cost Charge Fund	$ 1,272,814	$ 1,419,059	$ 234,934
Water Fund Capital Assets	$ 19,617,800	$ 29,260,887	$ 46,098,873

The "Equity in Physical Assets" number is obtained from the financial statements. It is a value that has evolved over the years as additions are made to the water system. The number includes all facilities and the WTP. It is noted that this number is not the replacement value for the water infrastructure but rather the accrued capital value of the utility over the years.

6.3 EXISTING REVENUE STREAMS

The District of Summerland has three potential revenue streams for maintaining and improving their water system. Revenue can be generated through one of the following general areas:

1. **Irrigation Rates:** Irrigation rates are charged to all parcels of land that are utilizing water within the district. Land is defined as either arable or not arable, depending on whether or not water is being used. The rate for irrigation is $128.84/year/acre. There is a discount if the rate is paid early and this is accounted for in the cost and revenue projections. Based on an irrigation depth of 0.80 metres per year, the irrigation water rate is in the range of only $0.03915 per cubic metre. This rate barely covers the cost to operate without the WTP and does not cover the cost to renew or replace the irrigation system. The cost to operate the WTP is in the range of $\$0.075/m^3$. The evolution of the irrigation system has resulted in low cost irrigation water. Some form of rate structure similar to what is presently in place must be maintained so that the quality of life and character of the community is maintained. There is the objective for Summerland to transition to a volumetric-based rate. There are several forms in which this can occur. The fairest way is to provide an allotment of water for the base tax rate and then a volumetric amount for any overuse above the base allotment;
2. **User fees:** Existing users pay user 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 is $31.77 per month or $381.24 per year. If paid early, there is a discount and this is accounted for in the cost and revenue projections. The User fee must cover the operational costs of the water utility including initiatives to improve existing water quality, the cost of monitoring and testing of the water, metering costs, renewal costs, and the day to day operations. Historically, the general public have desired the lowest possible water costs, however this has led to many utilities having insufficient working capital to meet all of improvements to meet the water quality regulations and to responsibly fund system renewal. The best run utilities rarely have low water rates;

3. **Water Tax Levies:** Water tax levies are assessed to each parcel in the District to cover the debt incurred for recent major projects. There are 4,935 parcels and each parcel pays these funds to service the debt for the WTP and Thirsk Dam expansion. The total fee per parcel is $285 per year for the debt servicing timeline. As more parcels are added to the district, the rate per parcel would be reduced and would only be sufficient to service the debt.
4. **Development Charges**: Development cost charges form 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 conditions and the amount of new development that will occur within the municipal boundaries. The amount of revenue generated is directly dependant on the DCC rate charged. The rate should cover the complete cost to add new development onto the existing District of Summerland infrastructure.
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 agricultural metering program. A grant of 2/3 of the project cost of $3,199,056 was received for the domestic metering and the first and second phases for the irrigation separation works. The grants monies are subject to the level of priority of the project in relation to other provincial projects requesting grant monies. For the basis of this analysis, we have included the recent grant monies awarded to Summerland and the projected gas tax refund monies that are identified to be supplied to the District.

Future funding programs include the National Water Supply Expansion Program, the Provincial Gas Tax rebates to communities, small water projects grants from the OBWB, and the Municipal Infrastructure Grant Program.

6.4 EXISTING DEBT SERVICING

The District has completed a substantial amount of work on some projects that should serve the District well for the future.

Table 6.2 - Summary of Long Term Debt

Bylaw No.	Amount	Name	Debt Retired Date	Interest Rate (%)	End of 2006	End of 2007
99-039	$ 1,035,000	Waterworks Upgrade	2019	5.99%	$ 753,765	$ 711,210
00-161	$ 6,000,000	WTP	2025	4.17%	$ 5,798,509	$ 5,588,959
00-213	$ 6,000,000	Thirsk Expansion	2026	4.66%	$ 6,000,000	$ 5,798,510
00-195	$ 6,000,000	WTP	2027	4.82%		$ 6,000,000

Domestic Water Rate Pricing Structure

Water rate pricing structure is currently a flat rate. Until water meters are installed, Summerland does not have many alternative options for water rate pricing. Currently the District operates on a flat rate without any consumption charge. The flat rate guarantees a base revenue for the District and does not provide the public with incentive to use less water. This rate structure is easy to monitor but relatively ineffective in terms of stimulating efficient water use. The installation of water meters to all connections could remedy this and allow Summerland to charge a base flat rate with consumption charges for overuse.

Based on the projects in Appendix A, it is recommended that domestic meters be installed. Once in place an education program is needed to educate the customers on water usage and how water rates might evolve. Eventually, when there is the means to read the meters frequently through remote read technology, an overage charge could be implemented for those customers that use more than a reasonable amount.

Based on the current inflation rate, the Consumer Price Index (CPI), and the Construction Cost Indices (CCI - construction inflation rate), the recommended annual increase to the water and tax rates is 2.50%. Construction costs have increased significantly in the Okanagan Valley in recent years and have been well above the 2.75% rate. The rate of increase should be reviewed annually and should be at a minimum rate of the CCI. For the current year and upcoming 5 years, a minimum rate increase per year of 2.75% is recommended.

Metering forms a primary means of controlling water use through effective price structuring. The ability to read the meters more frequently through the high use times of the year allow a utility to educate their public and utilize more stringent controls for usage. Having Radio Frequency Read (RFR) meters allows the utility the ability to read the meters at more regular intervals for minimal cost. Having meters without this ability limits their effectiveness to educate the public and reduce water consumption. The cost to retrofit existing meters to RFR technology is in the range of $150 per connection.

Irrigation Water Rate Pricing Structure

Water for agriculture and irrigation is charged at a flat tax rate base on arable land acreage. It is recommended that the District begin a meter reading and education program to inform the larger water users of their monthly water use. This program would be directed to helping the growers manage their water allotments in an effective and knowledgeable way.

In time, once the majority of the water users are more comfortable with how much water they use, a volumetric price should be consider only for those watering well in excess of their annual allotment. A reporting form is provided in Section 3.12 of this report.

6.5 SYSTEM RENEWAL ALLOWANCE

A summary of lengths of watermain in Summerland and the age of that watermain is included in tables C.6 and C.7 in Appendix C. The pipe age data was entered into the computer model and exported to obtain the tables of pipe lengths and materials. An annual reinvestment/renewal allowance is typically included in the Economic Model at a rate of 1.00 or 1.50% of the total annual revenue. This has not been added to the model at the current time as all funds are required to go to the major projects that are proposed.

An important issue to consider is the timing for renewal projects. It is suggested that the District time their renewal projects away from the times when an economic boom is occurring. This will result in more competitive pricing from engineers and contractors in the design and construction of the works. The result could mean pricing reductions of greater than 10% of the value of the works.

6.6 WATER DEVELOPMENT COST CHARGES

Development cost charges are developed in accordance with the Ministry of Community Development Best Practices Guide. Several points of discussion in the development of water DCCs are summarized in this section.

Timing of Water DCC Program

The Economic model was utilized to determine equitable DCC rates for water. Project costs, system revenues and expenditures are projected forwards to a 40 year horizon in the model with only 20 years summarized and only the first 10 years being closely reviewed. The project timeline and the horizon for utility financing review are closely reviewed for only the next 10 years. As a result, the DCC rate should be suitable to fund the development share of shared infrastructure works for that time frame with consideration of the unit costs for the various works that the District will be facing beyond 20 years.

Area Specific or District Wide Charges

Consideration was given as to whether the water system DCCs should be District-wide charges or area-specific. Using fairness and equity as the driving principles, the District-wide charge is recommended for the following reasons:

- Flexibility to use the DCC funds on projects where it is needed the most and of highest benefit to the overall District water utility;
- Simplicity in administering the DCC rates;
- Outlying lands have higher costs to develop and will pay specific charges with respect to water supply in getting the utility extended to their lands.

Development Pay Concept

The principle set out in this document is that development pay for its share of infrastructure upgrading. This means that any impact on the District water utility or eroding of the system capacity must be paid for by the developer requiring water service. This includes all areas of water supply, including source development, conveyance of source water to the WTP, WTP capacity expansion or equivalent works (separation of distribution system to free up WTP capacity), conveyance capacity of transmission mains and distribution system balancing storage. Any local changes to existing District water infrastructure that are necessary to provide additional water demand must also be covered by the developer. The previous DCC rates did not cover the cost for water treatment or provide sufficient monies to construct new storage reservoirs.

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 four (4) components presented below.

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 660 m^3 per year or a volume of 0.66 ML. The cost to construct reservoir storage to maintain the current reservoir storage volumes is estimated to be $1,500 / ML. For a SFE equivalent lot, the cost for source capacity replacement is estimated to be **$990.**

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 average single family equivalent (SFE) lot is estimated to use 7,200 L/connection per day or 0.0072 ML/day. The cost of the WTP was $18,000,000 for a capacity of 75 ML/day. The cost per ML works out to $240,000. For a SFE unit, the WTP capacity replacement cost is estimated to be **$1,728**.

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 $550 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 7,200 L/SFE/day, the balancing volume (plus emergency storage of 25%) is 2.25 m^3 per unit. This works out to a SFE rate of **$1,238**.

4. **Conveyance Capacity Replacement:** There are minimal capacity replacement projects identified in the Capital Plan. 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 minimal allowance is included for water distribution projects of **$44** /SFE lot.

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

This recommended rate is a substantial jump from current rates. For simplicity, it is recommended that the rates for oversized lots, MF housing units, high density MF housing units, commercial and industrial units are all based on a ratio of the rate for SFE housing units.

Agricultural Water DCCs

Currently there is no DCC for water supply to agriculture lands. Through much of the Okanagan, water supply for agriculture is protected and preserved through a rate structure that presumes that only raw water is required. Irrigation development charges elsewhere in the valley range between $4,000 and $15,000 per hectare, depending on water utility and their specific situation. Domestic water costs range between $30,000 and $50,000 per developed hectare of SF units. Based on the principle that irrigation supply must only replace storage reservoir capacity, the irrigation water DCC for Summerland should form 25% of the total DCC amount required for residential and ICI type development. An tabular explanation of costs is provided below

DCC Component	Domestic	Agricultural	Upgrade to Domestic
Source Replacement	$ 990	$ 990	$ 0
WTP Capacity	$ 1,728	-	$ 1,728
Conveyance	$ 44	$ 10	$ 30
Distribution Storage	$ 1,238	-	$ 1,238
TOTAL	**$ 4,000**	**$ 1,000**	**$ 3,000**

Note: 10 lots per hectare is used in providing an average equivalent lot density between SF lots and agriculture.

For a 1.0 hectare parcel, 10 SFE lots can be developed. At the proposed rate increase, this would generate DCC revenue of $40,000 per ha. developed. It is recommended that a rate of $10,000 per hectare be applied for irrigation water. Should the agricultural lands be developed in the future, the development would have to pay a DCC amount to cover off infrastructure costs for the difference for water treatment, conveyance and balancing storage in the amount of $3,000 per SFE ($40,000 - $10,000 = $30,000 per hectare). This 75%-25% ratio would apply to all development classes.

A two-tiered approach is recommended, based on if the lands are taxed and considered arable or if they are not taxed and are presently dry. From this analysis, it is recommended that the agriculture DCC rate be structured to be ¼ of the total revenue that might be generated from single family housing development.

6.7 ECONOMIC MODEL

An EXCEL computer spreadsheet model was developed for several purposes:

1. The worksheet was to determine rate increases necessary for the implementation of projects identified that are the responsibility of the existing District ratepayers;
2. The spreadsheet was also developed to determine the revenue from Development Cost Charge rates. The DCC rates are determined by the works necessary to maintain water supply to the current levels;
3. Another purpose is to determine staging of projects with timing that is affordable and reasonable within the financial capacity of the District water utility;
4. Project costs are entered for all known projects including unit cost rates that can be updated with the most current information as it comes available.

The spreadsheet has inputs for growth rate, return on investment, financing charges, inflation, DCC rates, User fees and Parcel tax rates, and timing for capital projects. It also has a construction cost unit rate input sheet that allows relatively easy updates so that Project costs can be simply updated with best available unit costs.

Outputs include annual projected account balances, revenue surplus/deficit, and the timing for Capital Projects. The model should be used as a tool for making equitable decisions for DCC rates and for User fees.

Economic Model Layout

Commentary on the model is provided below.

- The economic spreadsheet model is included in Appendix B;
- The spreadsheet model is set out on two pages. The first page includes input variables and the fund balances. The second page includes the project costs and escalation tables over time;
- The model extends out to a 40 year horizon to assess long term viability, however, only the first 20 years are presented and only the first 10 years should be closely considered;

- 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;
- Because the majority of growth will be either single family or multi-family development, the majority of future development revenue generated is expected from these types of development. Therefore, for ease of interpretation, the DCCs from industrial and commercial development are set as a ratio equivalent to the residential development forms;
- The model escalates the estimated capital project costs at a reasonable rate to the future year of implementation;

For the economic model review, it was desired that all of the projects of High Priority be completed in a 10-year time frame however, this may be limited by the financial capacity of the District.

Economic Model Sensitivity

The model was run over a variety of scenarios including different rate settings and growth rates.

- **Sensitivity of Growth Rate:** This is one of the higher variable factors within the model. It was found that if growth increased at a higher rate, generally the District would be in a stronger financial position to implement projects as more revenue would be generated both by development and by existing user tax and toll rates;
- **Sensitivity of DCC Rate:** The DCC rate was tested at levels of $3,500, $4,000 and $4,500 per single family connection. The DCC rate has influence on the financial position, but it is a relatively minor source as the majority of revenue will be generated by toll rates and parcel taxes;
- **Sensitivity of User fees:** The toll rate is a significant factor in determining the financial well being of the District. The toll rate must increase at rate equal to or greater than the construction inflation rate in order for the utility to be sustainable. The construction inflation rate is higher than the Consumer Price Index. The Construction Cost Indices rate in the last 10 years has been 2.75%, however, construction costs have escalated substantially in the last 5 years;
- **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 financing, good foresight in planning, and implementation of projects.

6.8 RECOMMENDED ECONOMIC PLAN

User Fee / Irrigation Rate Escalations

Historic construction cost escalations have been in the range of 2.50% to 2.75% except for the last five years where it has averaged 5% per year. It is recommended that the District raise their water rates at a minimum rate of 2.50% for the next five years or at a level equal to the construction cost inflation rate or the rate of inflation.

The model shows that in order to develop the water system to meets all of the IHA regulatory requirements so that water quality notifications are not required, the water toll rate would have to increase from $385 per year to $415 per year in 2009 and up to $445 per year in 2010. There would then be additional funds generated so that water system separation works and WTP optimization can occur.

An equivalent percentage rate would also have to apply to taxed arable lands. A $10.00/acre increase would be required to match the additional domestic charge in 2009 and the same would be required in 2010. Agriculture can argue they should not have to pay for drinking water improvements. At the same time, the domestic customers can argue that agriculture is not covering the cost of supply. Because of all of the subjective factors involved, equivalent percentage increases across the board are the simplest most equitable means of adjusting irrigation tax and domestic toll water rates.

It is recommended that the types of development within Summerland be grouped into the general land use types as presented in Table 6.4. Ratios of water use are set out in Table 6.4 so that equivalent water demands for development types can be assessed.

Development Cost Charge Rates

Development Cost Charge rates were set up based on the majority of DCC contributions coming primarily from SF and MF development. Charges for all of the other land use types were set up based on the ratio of water use in comparison with a SFE lot.

The economic model predicts the financial position of the District water utility if the high priority projects are implemented within a 10-year time frame. A summary of the recommended water DCC rates is set on Table 6.4. A DCC rate of $4,000 per SF lot is recommended.

The difficulty facing Summerland is that developer charges will not be sufficient to cover off the cost of separation within a sufficient time period. The revenues from the existing rate payers are the most secure and reliable source of funding. In order to carry out all high priority projects within a 10 year time frame, a rate increase in the range of 15% is required.

Table 6.4 - Recommended Guideline for Water DCC Rates

LAND USE DESIGNATION	Dry Lands Rate $/Unit	Irrig. Lands Rate $/Unit	UNIT	Notes
AGRICULTURAL ZONES				
Agricultural Zones	$ 10,000	n/a	ha.	Allowed one house on a single property
	$ 1,440	$ 1,080	bldg.	Pickers Cabin with water
RURAL RESIDENTIAL ZONES				
Country Residential Zone	$ 4,800	$ 3,600	lot	Allows max. outdoor irrigation area of 1000m2
				After 1000m2 area exceeded, capital charge applies of $120 per 100 m2
URBAN RESIDENTIAL ZONES				
SF Detached Dwellings	$ 4,000	$ 3,000	lot	Includes muliple unit manufactured homes
oversized SF lots				After 1000m2 area exceeded, capital charge applies of $120 per 100 m2 lot area
Manufactured Home (single), Duplex per side, strata	$ 3,200	$ 2,400	lot	
Strata, Row Housing, Triplex, Fourplex	$ 3,200	$ 2,400	lot	
Apartments, Cluster Housing, Stacked Row, Carriage House	$ 2,400	$ 1,800	unit	
Suite, Hotels and motels, Congregate Care homes	$ 1,920	$ 1,440	unit	
COMMERCIAL ZONES				
All Commercial uses	$ 4,000	$ 3,000	ha.	For base amount of water for 150 m2 of floor area including mezzanines
	$ 5.00	$ 5.00	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
INDUSTRIAL ZONES				
Industrial Zone	$ 4,000	$ 3,000	ha.	For base amount of water for 150 m2 of floor area including mezzanines
Industrial Zone	$ 5.00	$ 4.00	per m2>150m2	For remainder area greater than 150m2.
PUBLIC AND INSTITUTIONAL ZONES				
Parks and Recreation Zone	$ 10,000	n/a	ha.	
Forestry Grazing Zone			per m2>150m2	For remainder area greater than 150m2.
Institutional Zone	$ 3,200	$ 2,400	ha.	For base amount of water for 150 m2 of floor area including mezzanines
	$ 5.00	$ 4.00	per m2>150m2	For remainder area greater than 150m2.
SITE SPECIFIC				
Comprehensive Development Zone	As per housing and land use categories above			

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

	DRY LAND RATE Grade D lands	GRADED LAND RATE Grade A & C Lands	
LARGE SINGLE FAMILY	$ 4,800	$ 3,600	lot
SINGLE FAMILY RATE	**$ 4,000**	$ 3,000	lot
MULTI-FAMILY (Strata lots, Twnhomes)	$ 3,200	$ 2,400	lot or unit
MULTI-FAMILY (MED. DENSITY, APTS)	$ 2,400	$ 1,800	unit
MF HIGH DENSITY (HOTELS, MOTELS)	$ 1,920	$ 1,440	unit
SECONDARY SUITES	$ 1,440	$ 1,080	each
ICI CONNECTIONS	$ 3,200	$ 2,400	first 150m2
AGRICULTURE REGRADE 2 x SF rate	$ 8,000	n/a	ha.
Value of Irrig. Ha. (fully devel. with 10 lots/ha)	$ 40,000	$ 30,000	ha.

7. SUMMARY

7.1 INTRODUCTION

This section provides a summary of the major conclusions and recommendations of the 2008 Water Master Plan and Financial Review. Each conclusion and recommendation references the location in the Water Master Plan document where additional information may be located.

7.2 CONCLUSIONS

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

C-1 The strategic water supply principles of this report, developed by the Okanagan Water Stewardship Council, are recommended for management of water resources throughout the Okanagan. These principles provide a foundation for morally responsible and technically sound decision-making on water supply issues; (refer to Section 1.2)

C-2 Criteria used within the plan are set out in Table 2.1. The criteria are consistent with good engineering practices in the Okanagan Valley. Where criterion deviates from the existing Subdivision Servicing Bylaw is noted. Reduced allowances of water to new development both on a per capita basis and on a per development unit basis should be considered in the bylaw update (refer to Section 2.3 & 2.4);

C-3 Water allocation per irrigated area was reviewed and discussed with the Ministry of Agriculture and Lands staff. The MoAL have created an *Agricultural Water Demand Model* to assess water use for agriculture in the Okanagan. It is estimated that the average annual application depth for agriculture for the arable lands in Summerland is currently 690mm. An annual average annual allocation depth of 800mm is utilized in this report to ensure there is sufficient water for the years with higher moisture deficit (refer to Section 2.4);

C-4 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. Continued investment in water supply system is necessary to protect the community in times drought, fire or other emergencies and to maintain a high quality of life (refer to Section 3.2);

C-5 Summerland holds 25 licenses for storage, waterworks local authority, and irrigation on Eneas Creek, Trout Creek, and Okanagan Lake. The total annual allotments are 20,926 ML for Irrigation, 7,491 ML for WWLA, and 18,883 ML for storage. These licensed volumes should be adequate for the foreseeable future (refer to Section 3.3);

C-6 A summary of the watershed storage reservoirs owned and operated by Summerland is presented in Section 3.4. Details for each reservoir include storage volume, surface area, watershed catchment area, reliability to fill and other relevant data;

C-7 Trout Creek Balancing Reservoir, located at the top of Prairie Valley, is of concern as the reservoir has leakage in the amount of 4.0 ML/day as measured by District staff during the winter season. This amount works out to a total volume of 1,460 ML/year. This leakage charges the groundwater aquifer to supply lower areas in town. If this flow is reduced it may have a negative impact on the water supply for the Summerland Fish Hatchery (refer to Section 3.4);

C-8 A second off-stream balancing reservoir site is possible immediately to the west of Trout Creek Reservoir. The reservoir would provide additional off-stream balancing storage, protection from landfill leachate, and the ability to clean out the existing Trout Creek Reservoir. Costs can be offset for this project over time through gravel extraction (refer to Section 3.4);

C-9 Two important tools were used in the review and analysis of the Summerland water supply system. An EPANET *Water Distribution Computer Model* was developed by Agua Consulting Inc. for the analysis of the water distribution system. A *Watershed Reservoir Model* was developed by Water Management Consultants as part of the Water Use Plan and was updated and used to analyze watershed reliability. These two models should continue to be used on issues related to the water distribution system or the watershed (refer to Sections 3.4 & 3.11);

C-10 The watershed analysis confirmed that the recent Reservoir Drawdown Operating Procedures for Summerland set out in the 2004 Water Use Plan and repeated in this report are still valid (refer to Section 3.4);

C-11 The current annual reliable watershed yield is estimated to be in the range of 83,000 ML at the Summerland intake on Trout Creek. Of this annual average volume, a volume of 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 is available to Summerland in the amount of the current water licenses (refer to Section 3.5);

C-12 A frequency analysis was conducted and is summarized in Section 3.5 of this report. The frequency analysis shows that 10,600 ML of water should be available to Summerland in the event of a 1:100 year drought. At the same time, based on utilizing the trigger graph and operating scenario in the Water Use Plan, only 8,100 ML of water should be required from storage (refer to Section 3.5);

C-13 Trigger graphs from the Water Use Plan were updated with the inclusion of additional storage at Thirsk Reservoir. Updated graphs are included in Section 3.6 and Appendix F. The work confirms that the raising of Thirsk substantially improves the reliability of supply for Summerland (refer to Section 3.6);

C-14 Expansion of the water system should consider development of an Okanagan Lake water supply as it provides substantial supply capacity, should reduce system separation requirements, and allows redundancy in the supply from Trout Creek. Trout Creek is considered the most feasible area for a lake intake as larger capacity mains already exist to service this pressure zone and there is a substantial land area at low elevation where minimal pumping of water would be required. Sites to consider for the lake intake are Powell Beach and Wharf Street (refer to Section 3.7);

C-15 Groundwater is available to the District from Test Well 3 and 5. The total amount of water is 5.82 ML/day. Pumping this water directly into the irrigation system would reduce the treated water demand. System separation must first occur in west Prairie Valley for this to be viable (refer to Section 3.8);

C-16 A total of fifty (50) projects are listed within the 2008 Water Master Plan. Thirty six (36) of these projects are considered to be valid and worthwhile at this time. Projects that should be reconsidered some time in the future are included as Projects No. 37 to 49 (refer to Section 3.8);

C-17 The population growth rate for Summerland since 1921 has been 2.07%. The OCP projects an expected growth rate of 2 percent. A 1.25% population growth rate was used within the economic model analyses as it provides a more conservative financial plan. If growth occurs at a faster rate, Summerland will be in a stronger financial position (refer to Section 3.9);

C-18 Summerland's total annual water demand has decreased in recent years for numerous reasons including less agricultural production, transition to crop types with less intensive water requirements, public awareness and education, and more efficient irrigation practices (refer to Section 3.10) ;

C-19 Annual water use estimates for the various user groups in Summerland are listed on Table 3.10 of this report (refer to Section 3.11);

C-20 The total normalized (average) annual domestic system demand including ICI connections is estimated to be 2,900 ML (refer to Section 3.11);

C-21 Total normalized annual irrigation demand is estimated to be 8,650 ML (refer to Section 3.11);

C-22 Based on winter midnight water flows, the total distribution system leakage for both the Summerland and Garnet systems is estimated to be 23.11 L/s or 729 ML per year. The District should consider a leak detection program that, as a minimum, considers inspection of the water infrastructure ahead of any surface works such as paving (refer to Section 3.12) ;

C-23 If the Trout Creek Reservoir is drawn down too low, the possibility exists of leachate contamination through groundwater seepage from the landfill. The question is whether to carry out remedial works now or to invest the monies into an alternative source such as Okanagan Lake. Keeping Trout Reservoir full is the best defence without constructing an impermeable barrier. A second lined reservoir is being considered immediately to the west of Trout Creek Reservoir in the long term. This reservoir would be constructed once gravel extraction operations are completed in this area (refer to Section 3.4, Project 32 in Appendix A)

C-24 Should there be a drawdown of Trout Reservoir, then the emergency plan should provide methods for flushing and removal of leachate contamination and alternative supply methods. This item belongs in the Summerland Emergency Response Plan (refer to Section 4.2);

C-25 Based on the last 14 years of raw water data, source water quality appears to have been stable in the watershed. Drinking water risks presented in the 2002 Earth Tech report in Appendix G are still present today within the watershed. The largest risks that exist are cattle, recreation, wildlife and nutrient level changes that can cause algae blooms. Monitoring of water quality in upper watershed storage reservoirs remains a critical task necessary in order to establish a baseline of data (refer to Section 4.5);

C-26 Trout Creek Reservoir appears to have some benefits as levels of coliforms and *E.Coli* leaving the reservoir are significantly lower than the raw water levels in Trout Creek (refer to Section 4.6);

C-27 Water treatment plant capacity is limited to 75 ML/day which is insufficient to treat the entire maximum day demand for Summerland. System separation is required to reduce treated water demands to less than 75 ML/day. The WTP will be tested for expanded capacity greater than 75 ML/day in the late spring of 2009 with the supplier, John Meunier (refer to Sections 4.10 & 4.11);

C-28 A recent climate change study specific to the Okanagan predicted a decrease in precipitation in the next 75 years. It has been predicted that the total water supply volume could be reduced by 15% by the year 2050 and 30% by the year 2080. Figure 5.4 provides an indication of the reliability of the Summerland water sources considering the impact of climate change and a 1:100 year drought. Summerland should have sufficient source water available for the foreseeable future but may eventually have to develop additional reservoir storage (refer to Section 5.6);

C-29 For the foreseeable future, water demand is expected to grow at a lesser rate than that of new development. This is based on the growth rate and water trends that have occurred in the last 30 years in the Okanagan Valley. The District of Summerland OCP has predicted a low growth rate of 2.00% for the District for the upcoming years (refer to Section 5.6);

C-30 Two methods are available to provide all of Summerland with high quality drinking water: either expand the WTP capacity; or separate out the water system into domestic and irrigation systems (refer to Section 5.7);

C-31 Based on a lifecycle analysis, system separation appears to be cost effective in the long term for irrigated parcels of land larger than 0.40 ha. (refer to Section 5.7);

C-32 Presently the District has sufficient watershed storage reservoir capacity, adequate water treatment capacity for domestic water, but insufficient dual distribution mains to be able to fully utilize the WTP to supply all domestic demands. To provide high quality water to all residents of Summerland requires additional system separation (refer to Section 5.7);

C-33 The plan shows that the largest upcoming projects will be system separation in the Prairie Valley area and construction of a pump station along Okanagan Lake in the Trout Creek area (refer to Section 5.8) ;

C-34 Current debt servicing of the Thirsk Reservoir expansion and the Water Treatment Plant limits the ability of Summerland to fund additional projects in the short term. Time will be required to generate funds and move forward on separation and lake source development (refer to Section 6.4);

C-35 The development cost charge (DCC) 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 6.6);

C-36 A charge for buying in new arable lands for irrigation has been set at 10,000 per ha. (refer to Section 6.6)

C-37 Based on the economic analysis, there is a valid and technically defendable argument to allow water DCC charges to pay for system separation as the DCC would be paying for their share of WTP capacity that is being freed up through system separation (refer to Section 6.6) ;

C-38 There is insufficient capital reserve funds and DCC revenue to fund system separation projects within a reasonable time frame. This will delay the ability for Summerland to provide high quality drinking water throughout the community. Even with raised DCC levels, the funds generated through DCC revenue will be low and revenue support may be required through tax and toll rates and/or Grant monies; (refer to Section 6.8)

C-39 The existing debt load and present water rates are at significant levels. Further increases in the water rates should be moderate. Rate increase of $3.00 per month in 2009 and again in 2010 is necessary to be able to fund the projects in a reasonable time frame as set out in Appendix B; (refer to Section 6.8)

C-40 Development revenues will be dependant on the pace at which development occurs in Summerland. A rate of 1.25%, which is lower than the 2.00% OCP rate, was utilized in the Economic Model so that conservative financial projections were made. (refer to Section 6.8)

7.3 RECOMMENDATIONS

The major recommendations of this Capital Plan Update are as follows:

R-1 The District of Summerland should consider adopting the water supply principles in Section 1.2 of this document (refer to Section 1.2);

R-2 An 800mm depth of water should be held by the District and allocated to the irrigable taxed lands within the District that are greater than 0.2 ha. in size. The annual volume of water allocated would be the depth (800mm) multiplied by the arable (taxed) land area (refer to Section 2.4);

R-3 The District of Summerland should update their Subdivision Servicing Bylaw. Part of this update would include reducing the maximum day water demand criteria per person from 3,000 to 2,400 L/ca/day (refer to Section 2.4);

R-4 Storage license adjustments are required for Thirsk Reservoir and for Headwaters Reservoirs to make the licensed volumes match the volumes in-place (refer to Section 3.2);

R-5 The WUP plan review identified several scenarios for Summerland for drought frequencies and resulting reservoir storage levels. It is recommended that development and additional irrigation areas be permitted and not be held up due to water source capacity concerns, providing they pay the appropriate DCC charges. Development charges are a critical source of revenue for many of the proposed projects (refer to Section 3.6);

R-6 When upgrading or renewing PRV 10, additional consideration should be given to determine if hydro-electric generation is economically viable. PRV 10 is the only station with significant flows within the District (refer to Section 3.11)

R-7 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 duration (refer to Section 3.11)

R-8 With respect to water conservation initiatives, water metering and the installation of remote read technology throughout Summerland are strongly recommended. The remote reads will allow monthly reporting of water consumption throughout the District. The addition of remote read technology to the new irrigation meters is recommended as providing the water use information to the customers in a timely manner is a critical part of a successful education program (refer to Section 3.12);

R-9 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 nominal budget per year so that these works are a normal part of on-going operations (refer to Section 3.14) ;

R-10 The WTP should be tested to the highest possible flow levels in 2009 with the assistance and direction of the supplier, John Meunier (refer to Section 4.10);

R-11 Sludge withdrawal, handling, drying and disposal are required for the WTP. A preliminary budget number is provided within this report to install a sludge removal system to convey thickened sludge to the landfill for drying. The sludge handling is a bottleneck in the current water treatment process (refer to Section 4.10);

R-12 Water quality testing is recommended twice per year for each of Summerland's reservoirs. This will provide a baseline of data for Summerland so that any future changes or external influences can be measured and confirmed (refer to Section 4.10 & 4.11);

R-13 With respect to the watershed, the District of Summerland should continue to lobby the Province to stop the sale of lease lots and put in more stringent controls to the occupancy of leases around the reservoirs. An application to the Crown should be considered for a 200m covenant around the reservoir foreshore to protect these water reservoirs in perpetuity (refer to Section 4.11);

R-14 The WTP has a capacity of 75 ML/day while the District water demands in the summer can reach 112 ML/day. The shortfall must be made up by either expanded WTP capacity or system separation and system separation is recommended. It is recommended that separation be funded through DCC contributions to free up WTP capacity. WTP expansion is more expensive on a unit cost basis than the system separation works (refer to Section 5.7);

R-15 Funding applications should be submitted to continue the system separation works. The economic benefits of separation are set out with the lifecycle analysis in Appendix E of this report (refer to Section 5.7);

R-16 There are 36 Capital Projects identified in this report that should be implemented generally in the order provided. Timing will be dependant upon when Summerland can afford the works. The projects are to be funded by user rates, DCCs, direct developer contributions, government grants, or a combination of these capital funding sources (refer to Section 5.8) ;

R-17 Grant funding in the amount $3,199,056 was recently received by Summerland. The monies are slated to fund domestic water meters and the first two phases of system separation in Prairie Valley. This report agrees with the project selection and expenditure of these funds for the projects selected (refer to Section 6.3);

R-18 Applications for funding should continue to be made for the continuation of the system separation works. The economic benefits of separation are set out with the lifecycle analysis in Appendix E (refer to Section 6.3).

R-19 The water DCC rate is much lower in Summerland than elsewhere in the Okanagan Valley. It is recommended that development be required to cover their share of costs so that infrastructure capacity does not erode over time. The recommended DCC rate works out to $4,000 per single family lot. If a lower rate is utilized, development is being subsidized by existing ratepayers (refer to Section 6.6);

R-20 A dry land rate and arable land development rate is proposed to allow irrigation to continue to buy into the water district at rates to cover upper watershed reservoir storage capacity. This rate works out to $10,000 per hectare (refer to Section 6.6);

R-21 The recommended financial plan is presented in Section 6.8. The economic model is presented for consideration in Appendix B. An increase in the water toll rate in the amount of $3.00 per month in 2009 and another $3.00 per month in 2010 is required to allow Summerland to complete the highest priority projects within a realistic time frame. Toll rate increases beyond the year 2010 should be at a minimum rate of 2.50% or equal to the historic construction inflation rate. Otherwise the ability for Summerland to implement upgrading and improvement projects will become limited (refer to Section 6.8);

R-22 Rate increases should be implemented across all user groups at generally the same percentage rate. This maintains the social balance within the District when considering the needs of various water user groups (refer to Section 6.8).