Agua Consulting Inc.
"Engineered Water Solutions"
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November 22, 2016

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

Attention: Mr. Devon van der Meulen, Manager of Utilities

Dear Devon:

RE: Banks Crescent – Proposed 346 Unit Development
Preliminary Engineering Review – Water Supply Requirements

1.0 INTRODUCTION

This letter sets out our initial review of the water supply servicing requirements for the 346 unit multi-family development proposed at 13610 Banks Crescent. Also included is the possibility for commercial development for the same property. This engineering review comes as per your request in the e-mail dated October 13, 2016. The following information was reviewed and utilized in the preparation of this letter report:

- Summerland Subdivision Servicing Bylaw No. 99-004 and amendments;
- Summerland water plate maps and water base mapping;
- Summerland Arable Lands Assessment Roll;
- The most current version of the District of Summerland water distribution model;
- Development Servicing Report dated Sept 26, 2016 prepared by CTQ Consultants Ltd.;
- Architectural Drawings dated August 2, 2016 prepared by Derek Crawford Architects;
- Aerial images (Google Earth);
- District of Summerland 2008 Water Master Plan, System Separation Plan Layout;

This report is comprised of the following five sections:

1. Introduction
2. Engineering Criteria
3. Proposed Development
4. Water Service Assessment
5. Summary

It is noted that the proposal is currently at rezoning stage and that water demands and finalized water requirements would be confirmed at the Building Permit stage. This report provides an order of magnitude impact of the development on the Summerland water system.

Figure 1.1 - Existing Land Use

The multi-family development is proposed on Lot A, District Lot 455, Plan 2091, at the south limits of Latimer Avenue, at 13610 Banks Crescent. The land proposed for development is approximately 14.43 acres in size of which only 6.72 acres will be used for the development.

Existing land use is primarily as orchard as illustrated in Figure 1.1. The property has 4.75 acres of arable land registered with the District of Summerland for irrigation. The farmed area appears to be slightly larger being measured at 5.0 acres. One single family residence exists on the site with access off of Latimer and Lynx Avenue.

2.0 ENGINEERING CRITERIA

Criterion for the engineering review is generally consistent with District of Summerland Subdivision and Servicing Design Bylaw No. 99-004 and amendments. Specific criteria used are as follows:

Roughness Coefficient "C" for new PVC pipe (as per bylaw)	120
Maximum Allowable Velocity under fire flow (FF) condition	4.0 m/s
Maximum Allowable Velocity under Peak Hour Demand (PHD) condition	2.0 m/s
Housing Occupancy Density per MF development unit	2.35 persons / unit
Minimum Pipe Size	150 mm dia.
Minimum Fire Flow (FF)	As per FUS
Maximum flow from a single hydrant	90 L/s
Minimum Residual Pressure under Max Day Demand (MDD) plus FF	14.1m (20 psi)
Maximum Water main length (not interconnected)	200 metres
Fire Flow duration (as per FUS guidelines for flow rate)	see table below
Maximum hydrant spacing for flow for residential (as per FUS guidelines)	see table below

Table 2.1 – FUS Guideline Table

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		1 hydrant
75	4500	14750	68.5	137.0	1.670	564		1 hydrant
90	5400	14300	67.5	134.9	1.870	757	90 L/s	1 hydrant
125	7500	13250	64.9	129.9	2.000	1125		2 hydrants
150	9000	12500	63.1	126.2	2.000	1350	150 L/s	2 hydrants
175	10500	11750	61.2	122.3	2.130	1677		3 hydrants
200	12000	11000	59.2	118.3	2.500	2250		3 hydrants
225	13500	10375	57.5	114.9	2.875	2911	225 L/s	3 hydrants
250	15000	9750	55.7	111.4	3.250	3656		4 hydrants
275	16500	9375	54.6	109.3	3.625	4486	280 L/s	4 hydrants
300	18000	9000	53.5	107.0	4.000	5400		> 4 hydrants
325	19500	8625	52.4	104.8	4.375	6398		> 4 hydrants
350	21000	8250	51.2	102.5	4.750	7481		> 4 hydrants

Table 2.1 is derived from the tables on page 16 in the FUS Guideline document (1999). Once building types and siting are confirmed, the developer's engineer is required to submit a FUS calculation to show the fire demand for the proposed housing type, density, building materials and exposures proposed for this development.

Criteria utilized by not clearly defined within Subdivision Servicing Bylaw;

Domestic Water Demand for MF development 1000 L/ca/day
Irrigation Water Demand - maximum of irrigated land area equivalency to residential irrigation.

MF development does not have a significant irrigation component and as such will have a significantly lower water demand than SF development and the per capita demand numbers within the subdivision bylaw. For building development a conservative number of 1000 L/ca/day is used in this report, however we would recommend that consideration be given to lowering this number prior to the final design.

3.0 PROPOSED DEVELOPMENT

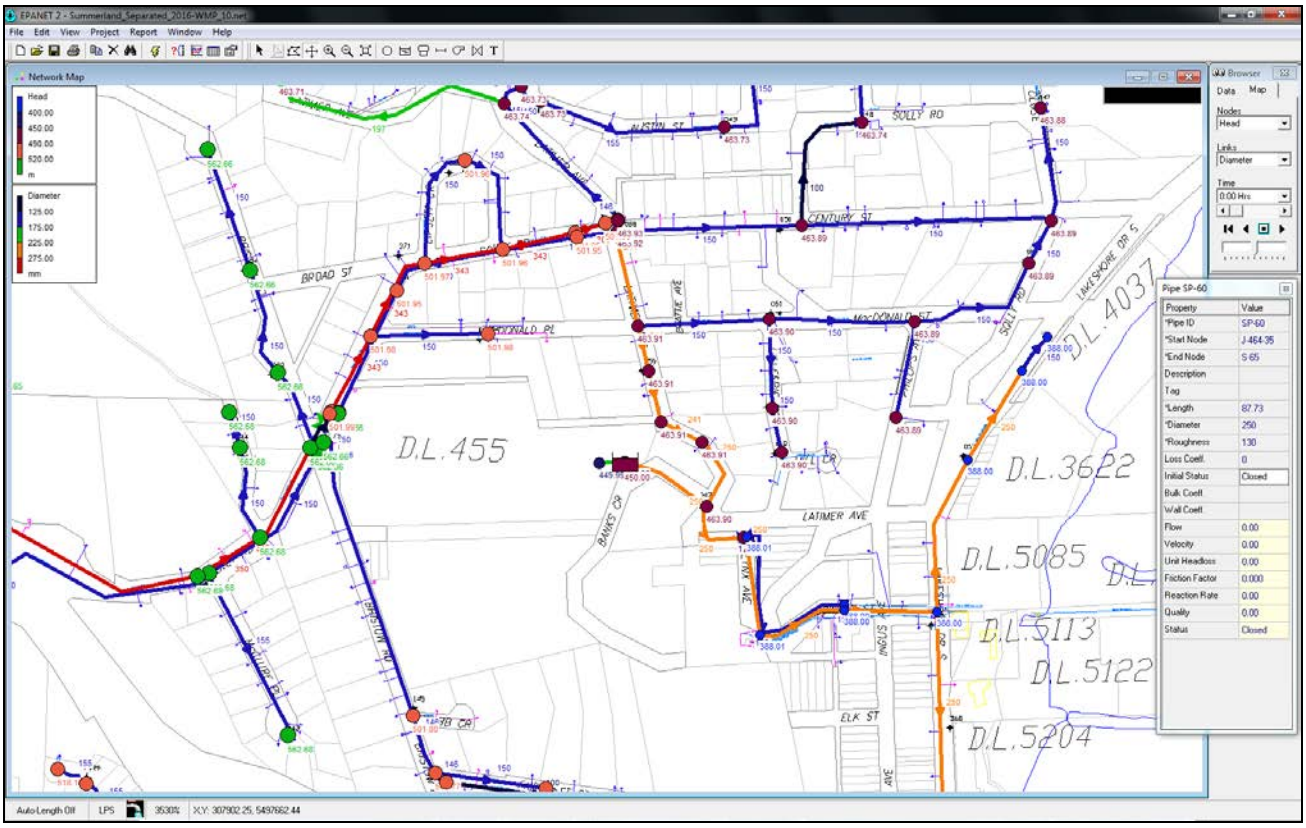
The development is to consist of five buildings in relatively close proximity of each other, housing 346 multi-family units and possibly a commercial restaurant. The preliminary layout is presented in Figure 3.1.

Figure 3.1 - Proposed Development Plan (Derek Crawford Architects Inc.)

Building site elevations across the proposed development site range from 407 metres at the main centre area for Buildings A, B and C to 397 metres main floor elevation for Building E at the east end. The highest floor to be serviced for the site is 427 metres.

A plan showing the existing water mains that feed the area is presented in Figure 1.2 on the next page. Water main sizes are listed in millimetres (inside diameter) and are colour-coded as per the bar graph in the image.

Figure 1.2 - Existing Local Water Mains



Existing Pressure Zones

Figure 1.2 presents the existing hydraulic grade lines (HGL) for off-site watermains near the development site. There are three pressure zones in the vicinity of the site, PZ 563 (green nodes), PZ 501(orange nodes) and PZ 463 (brown nodes). All zone identifications are based on the hydraulic grade line of the water system under maximum day water demand. The pressure zones all feed down from the Summerland Water Treatment Plant which has an operating HGL of approximately 586 metres.

PRV 8, which is a 200mm valve with 75mm low flow valve, exists on Solly Road that connects PZ 563 to PZ 501. Maximum daily flows through PRV 8 are estimated to be in the range of 50 L/s.

PRV 7, which is a 200 valve with 75mm low flow valve, exists on Solly Road at Latimer Avenue and connects PZ 501 to PZ 463. Maximum daily flow rate through PRV 7 is estimated to be in the range of 42 L/s.

3.0 WATER SERVICE ASSESSMENT

Section 3 provides a summary of our analysis of how water service can be provided to this development. With a large scale multi-family development, the critical water demand is for fire protection, considering both instantaneous flow and flow duration, which affects storage. The water distribution system must have the capacity to supply water for fire protection, indoor domestic use and outdoor domestic irrigation for lawn watering and incidental uses at the same critical time.

The District of Summerland EPANET model was utilized to estimate hydraulic capacity of the water distribution system. Computer model analysis was carried out to estimate the off-site water supply capacity. The storage capacity available from the Summerland Water Treatment Plant was reviewed to check the available fire storage capacity for the duration of fire flow.

Proposed Development Plan

The proposed preliminary plan by the developer is to connect to the 250mm diameter main on Latimer Avenue. This main has significant flow capacity, but also supplies water to the Old Town area below along Lakeshore Drive South. This main has limited hydraulic grade line capacity to feed back up the hillside.

Water Demand Assessment

The additional maximum daily domestic water demand created by the proposed development is estimated as follows:

346 MF units x 2.35 persons / residence x 1,000 L / ca / day = **MDD = 9.41 L/s**

The irrigation water demand required for the proposed development is to irrigate a land area of only 0.69 acres. The irrigation demand is estimated as follows :

0.69 acres - equivalent to irrigation for 3 SF residences, maximum of 10 USgpm irrigation per residence - = 30 USgpm flow or two irrigation zones of 15 USgpm/min. each = **MDD = 1.89 L/s**

A variance in the subdivision bylaw to permit the lower per capita design number could be considered. We would consider a reduction from 1,000 L/ca/day to 500 L/ca/day to be reasonable. The property has significant irrigation capacity at the present time with 4.75 acres of arable land at 6.5 USgpm/acre.

Separated Irrigation and Domestic Water Distribution System

The 2008 Water Master Plan was reviewed. The subject property is within an irrigation pocket with very few nearby agricultural lands. Project 17 in the 2008 Water Master Plan covers the separation of lands in this part of Summerland. Project 17 focused on getting irrigation water to lands to the south around Giant's Head, but due to the lack of surrounding irrigation land at this site, a separate irrigation and domestic water system is not proposed for this area. Therefore all water provided to this site will originate from the domestic water distribution system.

Computer Model Analysis

There are several options available for supplying water to the proposed development site:

1. Access PZ 463 and flow water down Latimer Avenue to the site (as per CTQ Servicing Report);
2. Access PZ 502 and obtain water from below PRV 8 by installing a main down the steep bank and reducing water pressure as required to service the lots;
3. Access PZ 563 and obtain water from above PRV 8 and service the site similar to Option 2;

The model was tested first with water servicing from PZ 463 and then from PZ 502. A limiting criterion for all model runs was the water velocity through the PRV stations. With existing maximum daily demand flows and any significant fire flow to the development, the PRV velocities exceed the manufacturer's recommended maximum velocity for a 200mm Cla-Val pressure reducing valve which is 145 L/s.

3.1 SERVICING FROM PZ 463 - LATIMER AVENUE

The computer model was tested to determine the available water from PZ 463 (below PRV 7). Another criteria limiting water supply capacity is the 4.0 m/s maximum permissible velocity under fire flow conditions. For a 250mm diameter main this limits flow to 196 L/s. When subtracting the MDD for irrigation and domestic demands, this is further reduced by 11 L/s to 185 L/s available for fire flow.

As modelled, there is 140 L/s available at the site with sufficient residual pressures. Subtract the 11.3 L/s for irrigation and domestic demands, there is only 128.7 L/s fire flow capacity to the site with a residual HGL of 450 m. A residual hydraulic grade line of 450 metres is insufficient to get sufficient water pressure to the upper building floor fire sprinklers.

With the highest floor at elevation 425 metres, a residual HGL of 472 metres is desired to get sufficient pressures to the sprinkler system. There are options for the developer to consider for the sprinkler system including an in-building fire pump system with emergency generator or connect to a higher pressure zone.

Results of pressure drawdown versus flow from the Summerland mains in PZ 463 is presented in Figure 3.1 and summarized in Table 3.1.

3.2 SERVICING FROM PZ 502 (SOLLY ROAD)

Supplying water to the site from Solly Road is viable as the main size and hydraulic grade line is sufficient to provide water to the highest floors of the proposed buildings, i.e. the fire protection sprinkler system. With a HGL at 502 meters elevation, a 180m length of 250mm diameter water main would be required to get the water from Solly Road, down the steep bank to the development site.

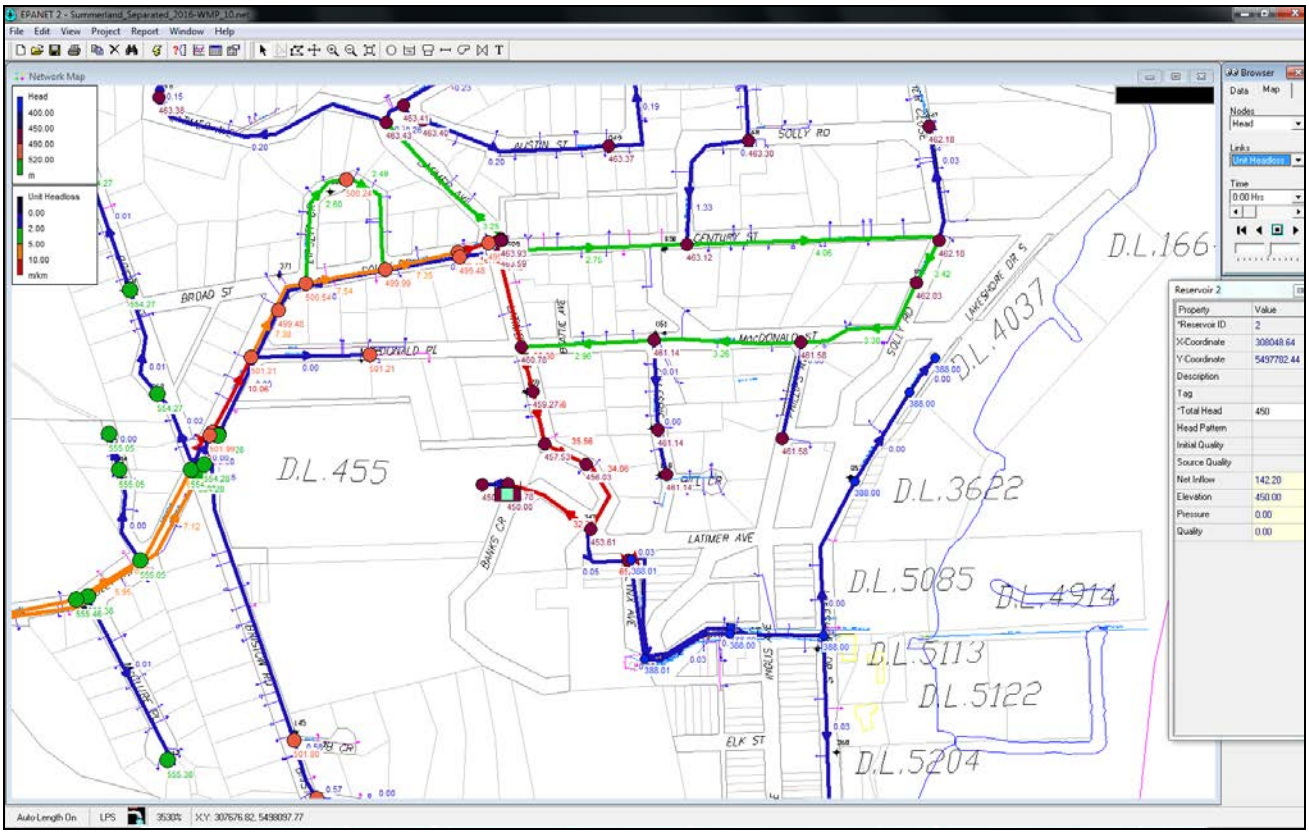
Based on a maximum pipe velocity of 4.0 m/s, if a 250mm diameter main is used, then a maximum fire flow of 185 L/s can be provided. If a 300 mm diameter main is used, then based on velocity, a theoretical maximum flow of 270 L/s can be provided to the site, however this flow is limited by fire storage capacity to 225 L/s.

The service water main would have to be routed to a central location on-site, likely to a mechanical room where it could pass through a PRV station to drop the HGL so that pressures are not excessive at the lowest service elevations. It is likely that the pressure only has to be dropped by 20 m of head. From the central on-site location, the water could be routed through to the on-site hydrants.

For water main installation down the steep hillside off of Solly Road, a HDPE fused pipe or a fully joint restrained pipe should be considered to reduce the risk of pipe joint separation on the silt bluff slope.

Results of pressure drop versus flow for this option is presented in Figure 3.2 and summarized in Table 3.2.

Figure 3.1 - Residual HGL and Unit Head loss



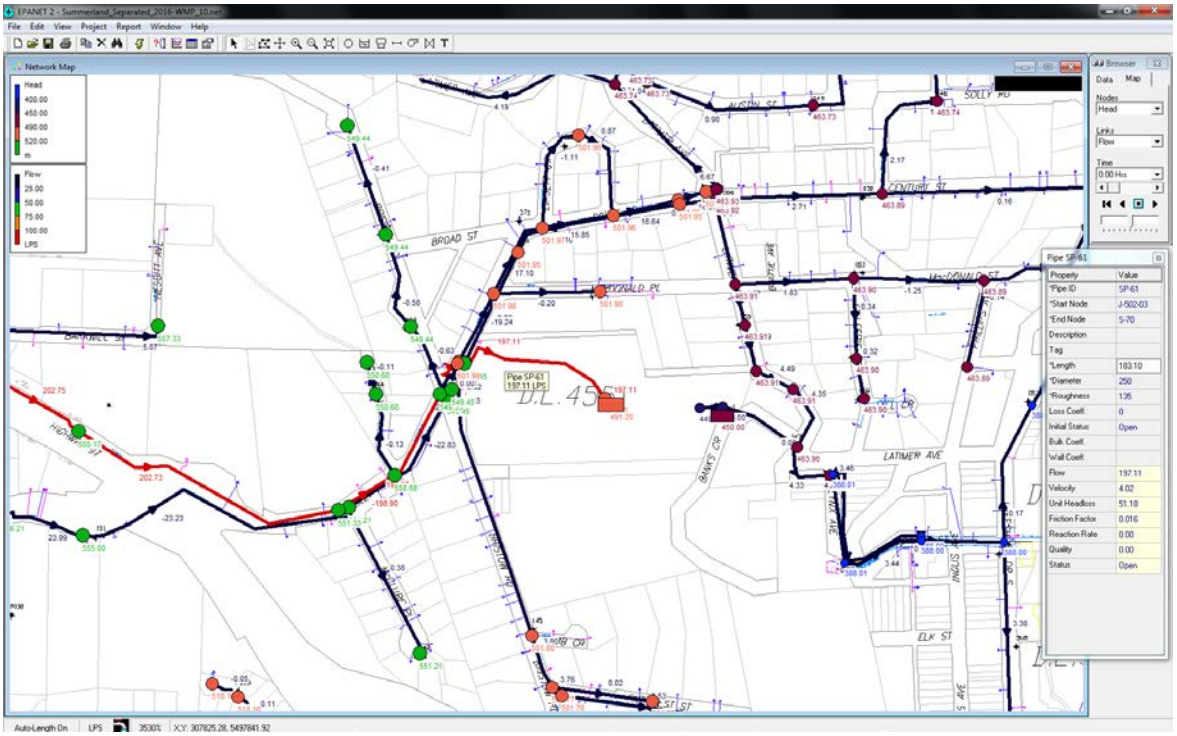
MODELLING SUMMARY	Table 3.1					
Water System	District of Summerland					
EPANET Model version	Summerland_2016_WMP_10.net					
Analysis Date	October 24, 2016					
Demand Condition	Maximum Day Demand (0:00 hours)					
Special Condition Description	Simulated demand to provide maximum of 4.0 L/s through 250mm main from Solly Road to development site					
Node Analyzed, Description	Node at centre of development buildings					
Node Elevation	404 m (Estimated)					
Node Hydraulic Grade Line	Static condition	463m under static conditions (59 m head or 84 psi)				
Est. Residual HGL (metres)	463	500	495	**491.2**	485	480
psi	84	80	65	**52**	37*	23*
Est. Total Flow (L/s)	0 L/s	67	142	**194**	236*	272*

** Exceeds maximum velocity criteria of 4.0m/s in 250 mm diameter water main*
Reduce total flow by 11.3 L/s to determine available Fire Flow

3.3 SERVICING FROM PZ 563 (SOLLY ROAD)

Supplying water to the site from the high side of PRV 8 on Solly Road was not modelled as pressures at the site are too high. Water pressures would have to be reduced from the 563m pressure zone.

Figure 3.2 – Available HGL at Development Site



MODELLING SUMMARY	Table 3.2					
Water System	District of Summerland					
EPANET Model version	Summerland_2016_WMP_10.net					
Analysis Date	October 24, 2016					
Demand Condition	Maximum Day Demand (0:00 hours)					
Special Condition Description	Simulated demand to provide maximum of 4.0 L/s through 250mm main from Solly Road to development site					
Node Analyzed, Description	Location at Centre of Buildings					
Node Elevation	404 m (Estimated)					
Node Hydraulic Grade Line	Static condition	502m under static conditions (98 m head or 139 psi)				
Est. Residual HGL (metres) psi	503 141	500 136	495 129	**491.2** **124**	485 115*	480 108*
Est. Total Flow (L/s)	0 L/s	79.2	156	**197**	327*	349*

*' * model run with 300mm diameter main due to max. velocity achieved at 197 L/s for 250 main subtract 11.3 L/s from Total Flow to estimate water available for Fire Flow*

If a 300 mm diameter main were utilized, the 4.0 m/s velocity criteria would not be exceeded until the flows were at 280 L/s. To be consistent with the 2008 Water Master Plan, it was identified that the maximum fire flow available to the downtown core was 225 L/s for a duration of 2.875 hours. The fire flow to this site cannot exceed that rate and duration of flow. As a precaution, Summerland staff have checked and confirmed that there is typically more than 2328 m^3 of water storage in the WTP clear well during normal operations.

4.0 SUMMARY

Based on our initial review, the following points are provided to assist in directing water service development for this site:

- The maximum daily design demand for the 346 multi-family unit development, based on a domestic demand of 1000 L/ca/day, is estimated to be 9.41 L/s. The criteria for MF development is not clearly defined within the subdivision bylaw but is conservative estimate for multi-family water demand;
- The seasonal outdoor irrigation demand is for an area of approximately 0.69 acres. We are recommending a maximum design flow of 1.89 L/s (30 USgpm) be permitted as this would allow the area to have up to two sprinkler zones running at any one time during the permitted irrigation times;
- The total maximum daily demand including domestic and irrigation is 11.30 L/s;
- Fire protection is the critical design factor for the water system. For the design fire demand, we would recommend that a maximum fire flow of 190 L/s be set if the source is originate from Solly Road. If the source is from Latimer Road, then we would recommend a maximum flow of 183 L/s be the design number as additional flow is required through the main on Latimer Avenue to service lower town;
- The maximum design fire flow from the Summerland Water Treatment Plant is 225 L/s for a duration of 2.875 hours. This is the design fire flow to the downtown core. Development to this development cannot exceed that amount. Summerland staff have verified that the water storage volume at the WTP does not drop below 2328 m^3 at any time;
- Two options were reviewed for providing water service to the development. The lower capacity water supply option via Latimer Road is presented in Figure 3.1 and Table 3.1. Capacity is constrained by the flow through PRV 8 and PRV 7 and then through the 250mm main to the site;
- The higher capacity option for supplying water is to access the 350mm main on Solly Road directly west of the development site. A water main installation would be required off of Solly Road down the steep slope to the site with either a 250 or 300mm main being required. Joint restrained pipe or fused HDPE pipe is required on the silt slope to reduce the chance of pipe failure and/or a significant wash-out. The route for this option is presented in Figure 3.2. Flow data is presented in Table 3.2;
- It is foreseen that due to floor area size and building code requirements, all of the larger multi-family buildings will be sprinkler protected. It is recommended that the design engineer provide a Fire Underwriters Survey calculation for the buildings to provide an indication of the design fire flow for the development. The calculation document should be sealed by the Professional Engineer;
- To provide fire flow to the development, the design flow would include the sprinkler system demand plus up to 3 hydrants. These would be privately owned and maintained. Provided there is adequate supply pressure and flow, the maximum flow from any one hydrant is 90 L/s;
- The addition of a fire flow will result in PRV upgrades being required. The existing PRV 8 has a 200mm diameter Cla-Val which has a recommended high flow of 145 L/s. The existing MDD flow through PRV 8 is in the range of 50 L/s. This leaves insufficient fire flow volume through the PRV for fire flow for the magnitude size of development as proposed;
- The recommendation of Agua is to develop a connection to the site from Solly Road from just below PRV 8. PRV 8 would require reconstruction to a larger valve size that would service the development fire flow plus an existing MDD flow below PRV 8 of 50 L/s. From the PRV a joint restrained for fused line is recommended down the steep silt slope to the development area.

- The developer must determine whether they wish to install on-site pressure boosting and a fire pump/emergency generator, or a PRV station to reduce operating pressures and provide fire suppression to the highest building floors of the development by gravity. The PRV option is the less expensive and more reliable than an emergency generator and fire pump. The developer should review the options and communicate to Summerland their proposed plan for meeting the development requirements.

Please contact us if you any questions regarding this report.

Yours truly,

Agua Consulting Inc.

Robert Hrasko, P.Eng.
Principal