Our File: 2221-49305

TECHNICAL MEMO

To	From
Mike Adama, Owner	John Sorenson, Division Manager Campbell River Branch
Re	**Date**
Kelsey Bay Multi-Phase Development	June 12, 2020

McElhanney Ltd. has been retained by Mike Adama to complete a preliminary servicing review of the water, sanitary, and storm systems with respect to the proposed multi-phase single-family strata and campground development located near Kelsey Bay in Sayward BC. The intent of this design review is to confirm the capacity within the existing systems and make recommendations as to required upgrades to accommodate the proposed subdivision.

A preliminary layout of the subdivision is provided in **Figures 1 and 2** overleaf. Please note that the layout is preliminary and may be subject to revisions moving forward. As such, the analyses within are based on a preliminary subdivision layout and may need to be revised should the layout change.

This technical memorandum summarizes the results of the waterworks, sanitary and stormwater systems and are highlighted below.

1. Waterworks

The existing water distribution system consists of a reservoir located south of the village with the terminal end and low point at the Port of Kelsey Bay as shown on **Figure 3** below. Please note that the diameters and lengths of the water piping was based on available record drawings as well as follow up discussions with the Town's Operations Staff.

The system was modeled to confirm the existing capacity and to determine if there is adequate capacity to accommodate the estimated domestic and fire flows associated with the proposed multi-phase development.

LOT 20
AREA: 912m²

LOT 19
AREA: 1183m²

LOT 18
AREA: 1225m²

LOT 17
AREA: 1295m²

LOT 16
AREA: 1408m²

LOT 15
AREA: 1275m²

LOT 14
AREA: 820m²

LOT 13 AREA: 2106m²

LOT 12
AREA: 1766m²

LOT 11
AREA: 711m²

LOT 10
AREA: 816m²

LOT 9
AREA: 1213m²

LOT 8
AREA: 869m²

LOT 7
AREA: 695m²

LOT 6
AREA: 695m²

LOT 5
AREA: 742m²

LOT 4
AREA: 1213m²

LOT 3
AREA: 3912m²

LOT 2
AREA: 2400m²

LOT 1
AREA: 2067m²

R-1 Zoning

R-1 Zoning

R-1 Zoning

C-2 Zoning
(RV Park)

I-1 Zoning

AREA:
900m²

ROAD A

ROAD B

ROAD C

ROAD D

ROAD E

8.00 ROAD WIDTH
10.00 ROW

6.00 ROAD WIDTH
10.00 ROW

6.00 ROAD WIDTH

6.00 ROAD WIDTH

6m x 15m

6m x 10m

6m x 11m

PR. RV SITE

EX. CREEK

EX. CREEK

EX. PROPERTY LINE

A PLAN 41428
D.L.1439

KELSEY BAY

N

SITE PLAN
0 5 10 15 20 25
SCALE: 1:500

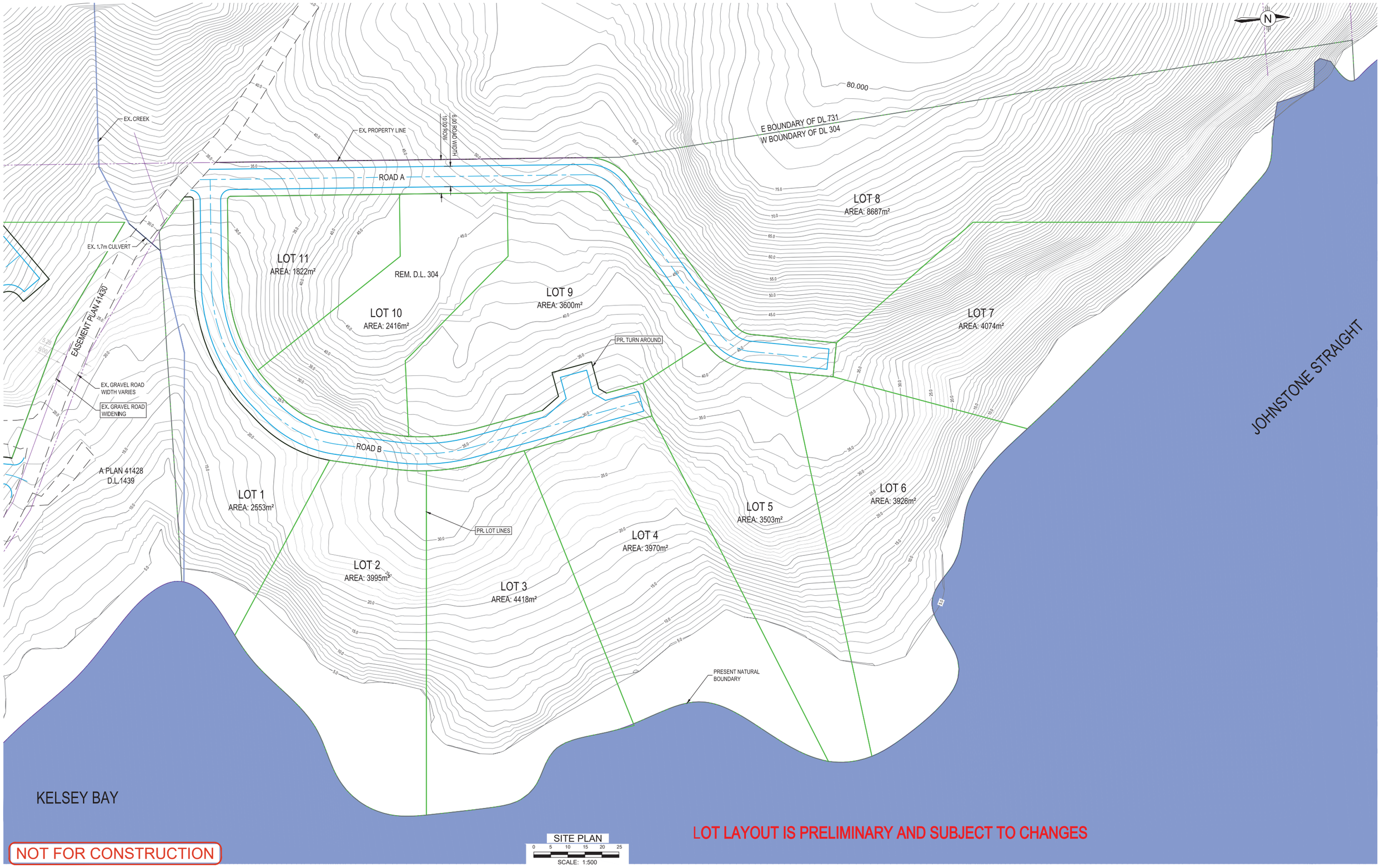
NOT FOR CONSTRUCTION

LOT LAYOUT IS PRELIMINARY AND SUBJECT TO CHANGES

						T	U/G TELUS	T	S	SANITARY SEWER	S		SWALE		DESIGNED: ADH	A1 SCALE: 1:500	McElhanney	PRELIMINARY NOT FOR CONSTRUCTION	MIKE ADAMA
						C	U/G SHAW	C	D	STORM DRAIN	D	SMH	DMH	SAN. SEWER / STORM DRAIN MANHOLE	SMH DMH	DRAWN: ADH	DATE: 20/03/10	1196 Dogwood Street Campbell River BC Canada V9W 3A2 T 250 287 7799	SOUTH LOT LAYOUT PLAN
						H	U/G HYDRO	H	W	WATER MAIN	W	SIDE INLET	TOP INLET	CATCH BASIN	SIDE INLET TOP INLET	CHECKED: JLS	DATE: 20/03/10	THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS	ADAMA SUBDIVISION CAMPBELL RIVER, BC
						G	NATURAL GAS	G		PAVEMENT		HYD		FIRE HYDRANT	HYD	APPROVED: JLS	DATE: 20/03/10		CITY PROJECT #: -
						FM	SANITARY - FORCEMAIN	FM		CURB & GUTTER		WV		WATER VALVE	WV				SHEET REF: FIGURE 1
							LAWN DRAIN			SIDEWALK		UP		UTILITY POLE	UP				McELHANNEY PROJECT #: 2221-49305
PA	PRELIMINARY CONCEPT	ADH	20/06/11	JLS	20/06/11		INSPECTION CHAMBER			STREET LIGHTS		ANC		GUY LINE ANCHOR	ANC				SHEET 1 OF 1
NO.	REVISION	DRAWN	DATE	CHECKED	DATE	EXISTING	LEGEND	DESIGN	EXISTING	LEGEND	DESIGN	EXISTING	LEGEND	DESIGN					REV. PA

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DESTROY PRINTS OF PREVIOUS REVISION



SITE PLAN

0 5 10 15 20 25

SCALE: 1:500

NOT FOR CONSTRUCTION

LOT LAYOUT IS PRELIMINARY AND SUBJECT TO CHANGES

NO.	REVISION	DRAWN	DATE	CHECKED	DATE
PB	PRELIMINARY CONCEPT	ADH	20/06/11	JLS	20/06/11
PA	PRELIMINARY CONCEPT	ADH	20/03/26	JLS	20/03/26

EXISTING	LEGEND	DESIGN
T	U/G TELUS	T
C	U/G SHAW	C
H	U/G HYDRO	H
G	NATURAL GAS	G
FM	SANITARY - FORCEMAIN	FM
Ⓛ	LAWN DRAIN	Ⓛ
Ⓘ	INSPECTION CHAMBER	Ⓘ

EXISTING	LEGEND	DESIGN
S	SANITARY SEWER	S
D	STORM DRAIN	D
W	WATER MAIN	W
	PAVEMENT	
	CURB & GUTTER	
	SIDEWALK	
	STREET LIGHTS	

EXISTING	LEGEND	DESIGN
	SWALE	
SMH / DMH	SAN. SEWER / STORM DRAIN MANHOLE	SMH / DMH
SIDE INLET / TOP INLET	CATCH BASIN	SIDE INLET / TOP INLET
HYD	FIRE HYDRANT	HYD
WV	WATER VALVE	WV
UP	UTILITY POLE	UP
ANC	GUY LINE ANCHOR	ANC

DESIGNED:	ADH	A1 SCALE: 1:500
DRAWN:	ADH	DATE: 20/03/10
CHECKED:	JLS	DATE: 20/03/10
APPROVED:	JLS	DATE: 20/03/10

McElhanney
1196 Dogwood Street
Campbell River BC
Canada V9W 3A2
T 250 287 7799

PRELIMINARY NOT FOR CONSTRUCTION

THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS

MIKE ADAMA

NORTH LOT LAYOUT PLAN

ADAMA SUBDIVISION

CAMPBELL RIVER, BC

CITY PROJECT #	-
SHEET REF:	FIGURE 2
McELHANNEY PROJECT #:	2221-49305
SHEET	1 OF 1
REV.	PB

DESTROY PRINTS OF PREVIOUS REVISION

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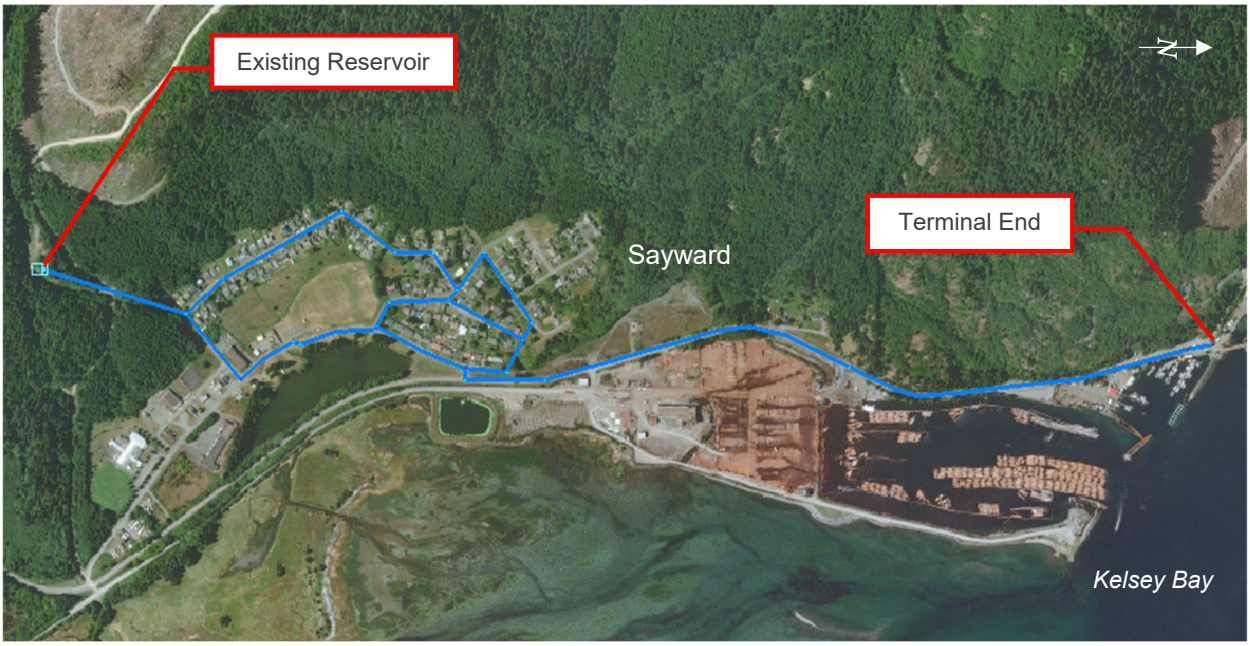


Figure 3: Existing Sayward Water System

1.1. DOMESTIC AND INDUSTRIAL DEMANDS

The existing and proposed average Annual Daily Demand (ADD), Maximum Day Demand (MDD), and Peak Hour Demand (PHD) for Sayward were estimated based on the demands outlined in the MMCD Design Guidelines. These MMCD demands are shown according to the land use type in **Table 1** below. It should be noted that MMCD does not provide design ADD and PHD flow rates for non-residential properties.

Table 1: MMCD Water Demand Design Rates

Land Use Type	Annual Daily Demand (ADD)	Maximum Day Demand (MDD)	Peak Hour Demand (PHD)
Residential	450 litres/capita/day	900 litres/capita/day	1350 litres/capita/day
Commercial or Institutional*	NA	22,500 litres/hectare/day	NA
Industrial*	NA	10,000 – 100,000 litres/hectare/day	NA

**MMCD Non- Residential design flow rates only provided for Maximum Day Demand*

Given the above per capita/area demand rates, the estimated results for the Village's existing and proposed demands are summarized in **Table 2** below. Note that for the Island Timberlands log sort facility, an estimated per hectare flow rate of 50,000 litres/hectare/day was assumed. This was based on the fact that they are a moderately heavy water user in the Town.

Table 2: Sayward Estimated Existing and Proposed Water System Domestic Demands

Land Use Type	Dwellings / Area	ADD (L/s)	MDD (L/s)	PHD (L/s)
Residential Dwellings	167 Dwellings	1.54	3.08	4.62
Non-Residential Sites	23.73 ha	NA	10.86	NA
Proposed North & South Dwellings and Campsites	64	0.83	1.67	2.50

1.2. FIRE FLOW

As per the MMCD design criteria, the system must have the capacity to provide the peak hour demands with a residual pressure of between 300 to 850 kPa while providing the required fire flow with max day demands and a pressure of 150 kPa.

A summary of the required fire flows as per the MMCD are summarized in **Table 3** below.

Table 3: MMCD Minimum Fire Flow Requirements

Developments	Minimum Fire Flow (L/s)
Single Family Residential	60
Apartments / Townhouses	90
Commercial	150
Institutional	150
Industrial	225

As this proposed development is a single-family development, a fire flow of 60 litres/second was required while maintaining a minimum residual pressure target of 150 psi under maximum day demand.

To verify the available fire flow and residual pressures in the existing system, a hydrant flow test was conducted by Sayward Public Works staff in late May 2020. An average flow of **61.4 litres/second (974 gal/min)** was reported at the hydrant adjacent to the Kelsey Bay Government Marina, and a residual pressure of **552 kPa (80psi)** was measured in the system at the upstream hydrant across the 40 Sayward Road.

The hydrant flow and pressure test results were used as means of model verification, which are discussed in the subsequent section.

Please note that prior to construction, an additional flow test should be performed to verify the results provided by the Village.

1.3. WATER MODEL VERIFICATION

Record drawings, field data, and flow & pressure test results, provided by Sayward Public Works staff, were used to develop, and verify the *WaterCAD* computer model. According to the Public Works department, the Village's water tank reservoir typically remains at 90% full. Given the tank is approximately 11m deep with a base elevation at 69.3m, the water surface elevation at 90% full is estimated at **79.2m**. This water surface elevation was entered into the model to set the static head in the system.

To verify the model, the reported hydrant flow and the estimated existing demands were assigned to their respective nodes and a steady state simulation was ran. The result was an estimated residual pressure of **529 kPa (77 psi)** at the hydrant near 40 Sayward Road. The percent difference comparing the measured and estimated pressures is 4.3% which is acceptable and will result in the model estimates being slightly conservative. **Table 4** highlights the model verification results.

Table 4: Model Verification with Residual Pressures at Hydrant Adjacent to 40 Sayward Road

	Measured	Model Result	Percent Difference
Residual Pressure	552kPa	529 kPa	4.3%

1.4. WATER MODELING RESULTS

Available topographical data was used to establish a preliminary design and layout for the on-site water system. This data was entered into the computer model. The computer water model was then used to confirm the available flows for the proposed development and establish which of the proposed lots could be serviced by the existing Village reservoir.

Based on a cursory review of the elevations of the proposed development, it was established that the lower portions of the development could be serviced by the existing reservoir while upper portions of the development would require the addition of a private booster pump to ensure adequate fire flows.

As a result, it was established that with the installation of a 50m section of 200mm diameter watermain in Sayward Road as well as a proposed 200mm diameter watermain on-site and 3 proposed hydrants, 10 of the proposed lots of the southern parcel and 5 of the proposed lots of the northern parcel could be serviced without an additional booster pump. Essentially, lots with fire protection provided by a hydrant installed at a maximum elevation of 35m can be serviced by the reservoir. The proposed lots (shown with white hatching) and hydrants are illustrated in **Figures 4 & 5**. The red circles around the hydrants represent the 75m radius coverage as required in the MMCD.

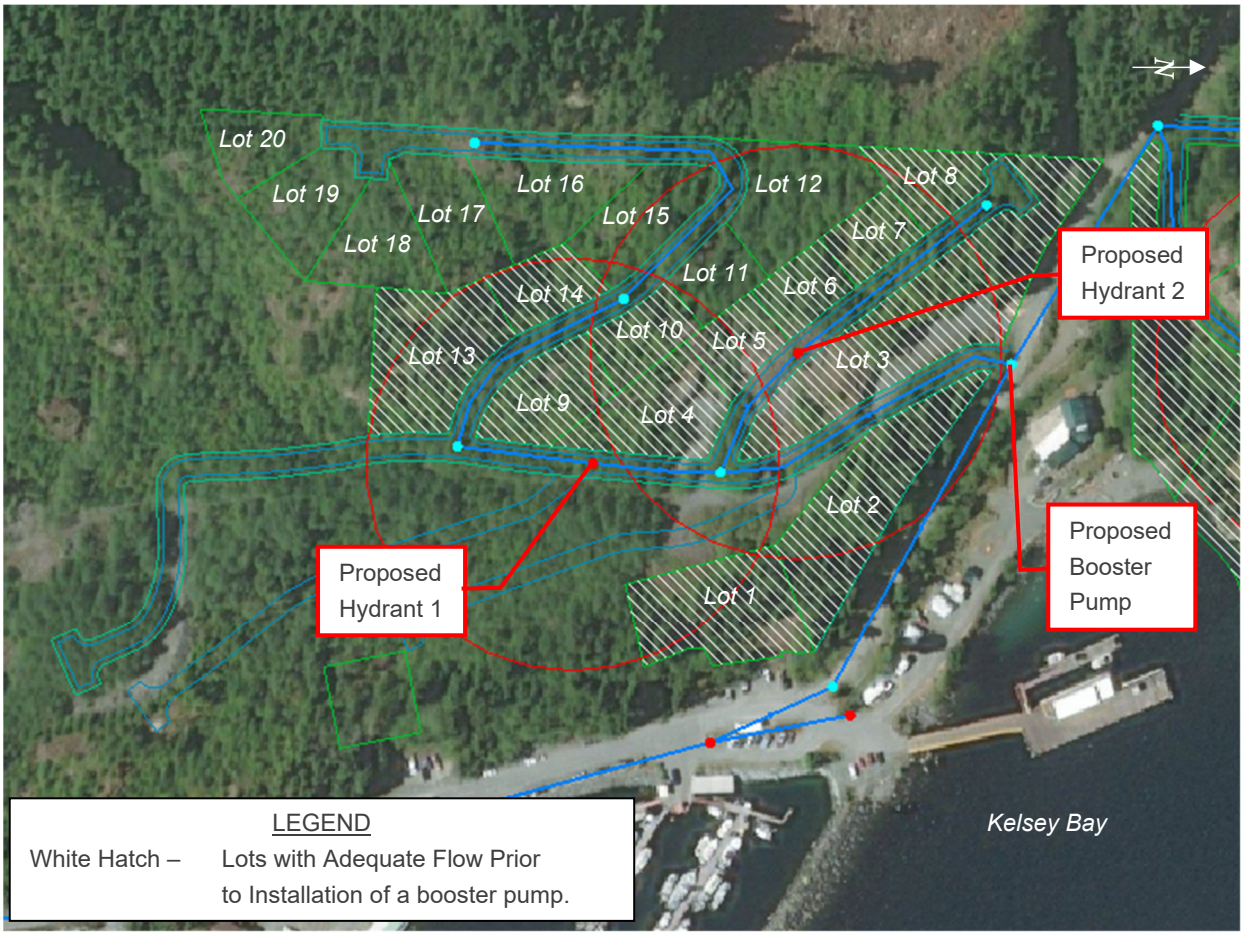


Figure 4: Southern Development Proposed Servicing Without Booster Pumps

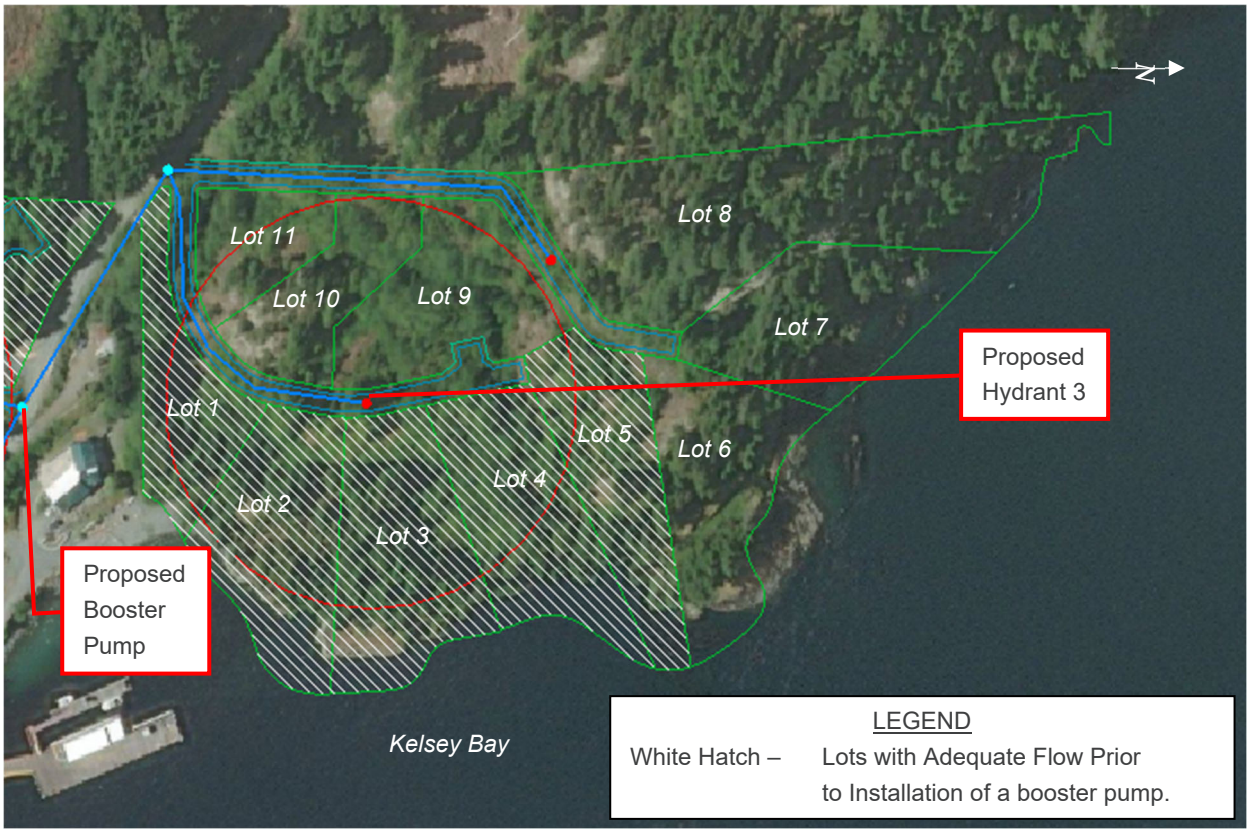


Figure 5: Northern Development Proposed Servicing Without Booster Pumps

To service the remaining proposed lots on the north and south parcels, booster pumps will need to be installed to ensure adequate fire and domestic flows are provided. The location of the potential booster pump is illustrated on **Figures 4 & 5**. Pump options will be explored at the detailed design stage.

2. Sanitary Analysis

The existing sanitary system was analyzed to establish if there is capacity to handle the additional flows from the proposed development. The HDPE force main system, as shown on the **Figure 6** below, consists of two lift stations. Lift Station 1 is located along Sayward Road at Kelsey Lane and services 3 existing residential properties on the lane. Lift Station 2 is located on the east side of Sayward Road near the government marina and services the primarily non-residential properties north from 40 Sayward Road including the marina, RV campsites and the Port of Kelsey Bay Dock.

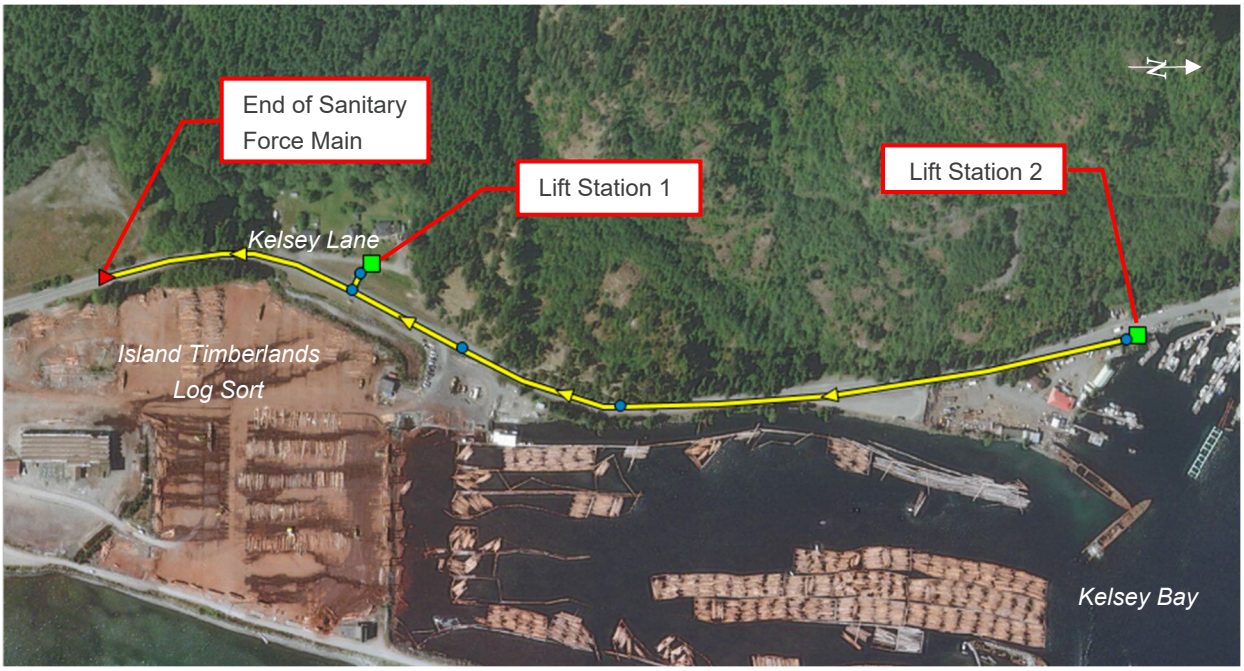


Figure 6: Existing Sanitary Force Main System

2.1. SANITARY DESIGN FLOWS

The existing and proposed estimated sanitary design flow rates were based on MMCD design guidelines. The estimated Peak Wet Weather Flows are used for design purposes. The estimated existing sanitary flows coming into Lift Station 1 are outlined in **Table 5**.

Table 5: Lift Station 1 Estimated Existing Sanitary Flow Rates

Parameter	Value
Total Residential Area	0.78 ha
Dwellings	3
People per Dwelling*	1.8
Dry Weather Demand**	350 litres/capita/day
Average Dry Weather Flow	0.022 litres/second
Peaking Factor**	3.2
Peak Dry Weather Flow	0.070 litres/second
Inflow and Infiltration Allowance**	0.12 litres/second/hectare
Wet Weather Flow	0.094 litres/second
Peak Wet Weather Flow	**0.16 litres/second**

**Based on the 2016 Canada Census Profile for Sayward*
***Based on MMCD Design Guidelines 2014*

The existing non-residential sanitary demands, factors, and calculated flows contributing to Lift Station 2 are listed in **Table 6**.

Table 6: Lift Station 2 Existing Sanitary Flow Rates

Parameter	Value
Total Non-Residential Area	5.88 ha
Dry Weather Demand*	25000 litres/ha/day
Average Dry Weather Flow	1.7 litres/second
Peaking Factor*	3.2
Peak Dry Weather Flow	5.4 litres/second
Inflow and Infiltration Allowance*	0.12 litres/second/hectare
Wet Weather Flow	0.71 litres/second
Peak Wet Weather Flow	**6.2 litres/second**

**Based on MMCD Design Guidelines 2014*

The additional flows from all phases of the development were estimate and the results are shown in **Table 7**.

Table 7: Lift Station 2 Proposed Sanitary Flow Rates

Parameter	Value
Development Area	7.3 ha
Dwellings	56
People per Dwelling	2.5
Dry Weather Demand	350 litres/capita/day
Average Dry Weather Flow	0.57 litres/second
Peaking Factor	3.2
Peak Dry Weather Flow	1.81 litres/second
Inflow and Infiltration Allowance	0.12 litres/second/hectare
Wet Weather Flow	0.88 litres/second
Peak Wet Weather Flow	**2.7 litres/second**

Therefore, combining the existing and proposed estimated flows, the total design sanitary flow for Lift Station 2 is **8.8 litres/second**.

2.2. SANITARY LIFT STATION AND FORCE MAIN MODELING

Analyzing a force main system with multiple lift stations is relatively complicated, and as such, *PCSMM* computer modelling software was utilized. Record drawings, manufacturer supplied pump information, and field data were used to create the model. The design flows were inputted, and a steady state simulation was ran.

Figure 7 below shows the pumping capacity of lift station 2. As noted, the pump station starts with an initial pumping rate of **9.5 litres/second** which decreases to **9.0 litres/second** as the level in the wet well drops.

The reduced pumping rates which range between **8.4 to 9.3 litres/second** are shown as small dips in the curve and coincide with lift station 1 & 2 pumping simultaneously.

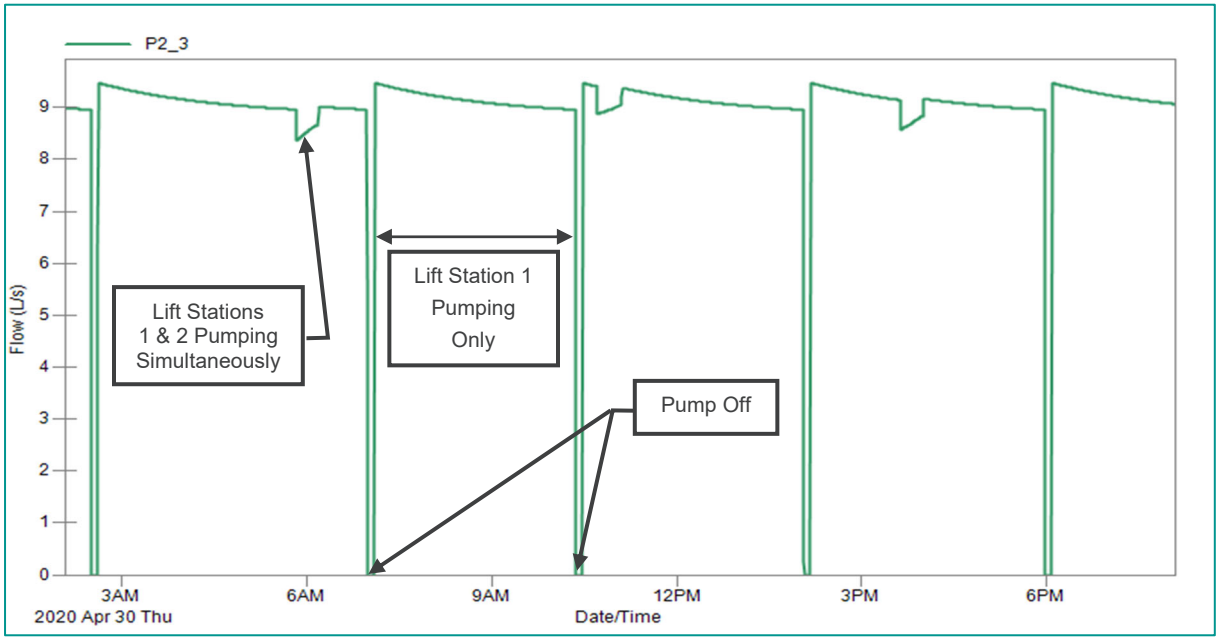


Figure 7: Lift Station 2 Flow vs Time Graph

It should be noted that a steady state analysis assumes a constant peak inflow which is very conservative compared to the more realistic variable rates of a diurnal demand curve. Given real world conditions, the pump-off periods would have a much greater duration. Based on this, it is safe to say the existing system has ample capacity to handle the additional flows from the proposed development.

2.3. FORCE MAIN MODEL VERIFICATION

To ensure the model was producing accurate estimates, an analysis of Lift Station 2 operating independently of Lift Station 1 was performed manually. The Hazen-Williams equation was used in the manual calculation to confirm the model results.

The model reports a peak pumping rate at Lift Station 2 of 9.5 litres/second with a total dynamic head (TDH) head of 20.4m. When the flow rate of 9.5 litres/second is entered into the Hazen-Williams analysis, the resulting TDH is estimated at 21.0m. The percent difference between the TDH of the model and *the* Hazen-Williams Equation is 2.9% which is acceptable and verifies that the model is operating correctly.

Table 8: Sanitary Model Verification Results

	Excel Result	Model Result	Percent Difference
System Head at 9.5 L/s	21.0 m	20.4 m	2.9%

3. Stormwater Management

Due to the fact that the site has a direct discharge to the ocean, the site is rocky and does not promote infiltration, we are proposing that targets related to on-site detention be exempted. This said, due to the proximity to the ocean, we would recommend that targets pertaining to water quality be implemented.

As there is no formal stormwater conveyance system in the area, stormwater will be discharged to the Kelsey Bay marine environment. As such, permitting and approvals will be acquired based on a subsequent environmental assessment as part of the detailed design.

4. Conclusion and Recommendations

Based on the established fire flows and domestic demands, the existing water system (without the addition of a booster pump) has adequate capacity to provide fire protection to lots within 75m of the proposed hydrants shown on **Figures 4 & 5**. Additionally, 3 proposed hydrants will be required. For the higher elevations of the development, booster pumps will be needed to provide the necessary fire flows.

A review of sanitary lift stations and the force main determined the peak inflow including the proposed development is 8.8 litres/second and the capacity of existing Lift Station 1, near the marina, ranges from 9.0 to 9.5 litres/second. When Lift Station 2, near Kelsey Lane, is pumping concurrently, pumping rates are reduced to 8.4 litres/second, but these are relatively short durations which do not limit the overall system capacity. Therefore, there is adequate capacity to handle the additional demands from the proposed development.

The stormwater system will be designed to MMCD Standards and adhere to best management practices pertaining to water quality. Given the necessary permits and approvals, runoff will be safely conveyed and ultimately, discharged via an ocean outfall into Kelsey Bay.

As this is based on a preliminary lot layout, the number and location of the lots are subject to change. Therefore, we confirm that the municipal system can handle an additional 5 lots, above what is currently proposed. Should the number of lots increase by greater than 5, further analysis will be required to confirm if there is adequate capacity. We trust that this meets the Village's requirements. Please contact the undersigned if you have any questions.

Sincerely, McElhanney Ltd.

Prepared by

Dwayne Cybak, EIT
Project Engineer

Reviewed by

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. SORENSON
#35120

June 15, 2020

John Sorenson, P.Eng.
Division Manager