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Senior Environmental Health Officer

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Attn: Claire Dewar
Senior Planner

RE: Sewer System Capacity Assessment for proposed Residential Complexes on Main Street

Lil'wat Nation is proposing to construct a new housing facility on Lot 1 located on the west side of Main Street just south of the IR10 boundary. Based upon the drawings prepared by S.R. McEwen Architect, the proposed development consists of two buildings: the first, a 36 residential unit, 3-story building; and the second, a 17 residential unit, 2-story building. The buildings also include commercial/retail units and live-in artisanal one-bedroom units on the lower floors.

Vancouver Coastal Health has requested that Lil'wat Nation provide an assessment of the capacity of the existing sewerage system to accept the additional wastewater flows to be generated by this facility.

ESTIMATE OF WASTEWATER FLOW

To estimate the impact on the existing sewerage system, the projected wastewater generation from the facility needs to be determined. The composition of each building and estimated population is as follows:

Unit Type	South Building	North Building	Total Units	Persons/unit	Total persons
Studio	10		10	1.5	15
1 BR	16	12	28	1.5	42
2 BR	5		5	3	15
3 BR	5		5	4	20
Artisan		5	5	1.5	7.5
TOTAL					**99.5**

Turje is currently finalizing the *Mount Currie Wastewater Assessment Report (*the *'Report')*, which includes an assessment of existing wastewater generation rates. That study adopts a per capita wastewater generation rate of 270 L/cap/day. Accordingly, the estimated wastewater generation rate from residential units in the proposed buildings is 26.87 m^3/day (0.31 L/s).

In addition to the residential units, there are six standalone commercial units with a total floor area of 421.1 m^2 (4,533 sq ft) and five artisanal studios with commercial space of 240.6 m^2 (2,950 sq ft). The BC Health Act Sewerage System Standard Practice Manual, V3, recommends a wastewater generation rate of 5 L/day/m^2 for commercial space. Accordingly, the estimated daily flow from the commercial units is 3.31 m^3/day (0.038 L/s).

The combined daily wastewater generation estimate is therefore 30.18 m^3/day (0.35 L/s).

Peak hour flow is estimated by multiplying the Average Dry Weather flow by a peaking factor, f, given by the following equation[1]:

$$f = \frac{18 + \sqrt{\frac{P}{1000}}}{4 + \sqrt{\frac{P}{1000}}}$$

to a maximum of 4;

Where f = peaking factor; and
P = tributary population.

For a population of 100, the value of f is 4.24. Therefore, a peaking factor of 4 is used, yielding a peak flow of 1.40 L/s (5.0 m^3/hr).

SEWERAGE SYSTEM CAPACITY

The capacity of the existing Mount Currie wastewater collection and treatment system to accept the additional flows projected from the proposed development can be evaluated according to three conditions:

1. Pumping Capacity.
2. Treatment Capacity, and
3. Hydraulic Capacity.

Pumping Capacity

All sewage discharged to the Mount Currie collection system flows toward Lift Station No. 1, which then pumps flow to the wastewater treatment lagoon facility (see Figure 1). Flow measurement at Lift Station No. 1 has been operating

[1] Equation 2-2, Design Guidelines for Wastewater Systems, British Columbia Region, Third Edition, 2010.

since March 2020. Dataloggers track the pump run times on an hourly basis. By multiplying the run time by the pump discharge rate, the total flow can be calculated. However, there are short duration periods where inflow exceeds the capacity of the operating lead pump, causing startup of the lag pump.

Pump No. 1 has a measured discharge rate of 6.09 L/s (21.9 m^3/hr). Pump No. 2 has a measured discharge rate of 4.75 L/s (17.1 m^3/hr). The combined pumping rate when both pumps are operating is presently unknown but is likely to be in the range of 7.5 L/s to 8.0 L/s (27 m^3/hr to 28.8 m^3/hr). For this analysis, the lower value is assumed.

A summary of hourly flow data for the months of March through November 2020 is presented in Table 1. From this summary, we note that the highest average flows occur in June and July when river levels are high due to spring freshet. The highest hourly flows tend to occur in the fall/winter, in association with heavy rainfall storm events. The maximum hourly flow in November is an estimate only. It is associated with a single event on November 17 when both pumps operated continuously for nine hours. The reason for the high flow rates on this date are unknown, though precipitation was moderately high that day.

Table 1 Lift Station No. 1 Hourly Flow Records

Month	Hourly Flow, m3/h		
	Min.	Max.	Avg.
March	2.52	8.53	5.31
April	2.74	9.25	5.78
May	2.73	15.59	9.48
June	6.12	18.61	11.64
July	5.58	20.2	10.71
August	3.42	15.16	7.05
September	2.98	12.66	6.23
October	3.33	21.18	6.99
November	4.48	24*	9.92

* Flow rate is estimated.

The proposed development is estimated to produce a maximum hourly discharge of about 5.0 m^3/hr. Due to frictional attenuation in the conveyance piping system, the magnitude of this flow contribution at the Lift Station will be lower, but this establishes a conservative maximum flow. Therefore, under average flow conditions during any month, the additional flow from the proposed complex can be handled by a single operating pump.

For seasonal higher flow periods, there will be intervals during which the lag pump must start to handle the maximum flows developed in the sewer system. For most of the year, this is expected to be infrequent, though during spring freshet or during heavy autumn precipitation events, lag pump operation will be

more common. In all but the most severe periods of Inflow and Infiltration (I&I), the pumps will be capable of handling the additional flow. In the rare instance where inflow exceeds the maximum pumping rate of both pumps, there is approximately 14 m^3 of storage capacity inside the Rancheree Street sewer that can be filled without risk of surcharging.

Lil'wat Nation is currently in the planning stages for improvements to the gravity collection system to reduce the I&I contribution. In addition, the work will entail the replacement of Lift Station No. 1, which will have higher capacity pumps. If both measures are successfully implemented, then the pumping system will have sufficient capacity to handle all additional flows from the proposed development.

Treatment Capacity

Treatment is currently provided by a two-cell aerated lagoon located at the southern boundary of IR1, on the north bank of the Lillooet River. The discharge is subject to a Provincial Permit that authorizes discharge of 1,560 m^3/day, with a maximum 5-day biochemical oxygen demand (BOD5) of 45 mg/L and maximum total suspended solids (TSS) of 60 mg/L. The discharge is also subject to the federal Wastewater Systems Effluent Regulation (WSER), which limits CBOD5 to 25 mg/L, TSS to 25 mg/L and unionized ammonia (NH_3) to 1 mg/L averaged over a calendar year. The treatment system consistently performs at or below these limits. For calendar year 2020, the following test results were observed over five sampling events:

SAMPLING DATE	INFLUENT		EFFLUENT					
	BOD_5 (mg/L)	TSS (mg/L)	Lab pH	Ammonia Nitrogen (mg/L-N)	Calculated NH_3 (mg/L-N)	BOD_5 (mg/L)	$CBOD_5$ (mg/L)	TSS (mg/L)
Average 2020	251	76.2	6.9	5.28	0.027	7	5	10
Maximum 2020	410	120	7.3	12	0.067	13	7	25
Minimum 2020	75	36	6.4	0.4	0.0001	4	2	3

Since the WSER regulation authorizes discharges of TSS and CBOD based upon an annual average, the 2020 data indicate that the system complies. Influent flow into the treatment lagoon ranged from 120 m^3/day to 375 m^3/day between March 3 and December 5, 2020.[2] The addition of 30.18 m^3/day increases daily flow by 8% to 25%. While a detailed analysis has not been performed with this

[2] One event of short duration on November 17, 2020 resulted in a flow that may have exceeded 375 m^3/day, but a total flow could not be calculated because of a nine-hour period where both pumps were running continuously. It was potentially caused by a unique inflow event associated with heavy rains on that day.

report, the significant margins available between the actual levels and the authorized limits indicates that the additional flow is unlikely to cause exceedance.

Hydraulic Conveyance Capacity

Hydraulic conveyance capacity refers to the capability of the gravity sewer system to convey the additional flow without causing conditions that may compromise public health. Notably, a surcharging sewer can cause backup of sewage leading to flooding of basements or overflow from manhole lids. However, normally, non-pipe-full flow conditions are preferred. New systems are typically designed for maximum 50% pipe full flow.

Due to the age of the existing sewer system and due to deficiencies in construction, there are several notable downstream constraints on the hydraulic capacity of the system. First, the system is experiencing significant inflow and infiltration (I&I), particularly within the pipe sections downstream of the proposed development. The Report documents that during periods of high river levels, up to 80% of sewer system flow is estimated to be derived from I&I, which takes up a considerable portion of the available hydraulic capacity and reduces the available capacity for additional domestic flows.

Second, there are grade issues with the piping at several points downstream of the proposed development (see Figure 1). In particular, the CCTV inspection of the system revealed pipe sagging or low slopes at several points that cause backwatering effects. These areas are highlighted in red on Figure 1.

In some sections persistent standing water results in accumulation of grease on the pipe walls that can obstruct flow.

Between MH11 and MH11A, the sewer pipe is adversely graded, meaning that it slopes upward in the downstream direction. Therefore, sewage in this section backs up behind MH11A.

These grading issues are primarily a maintenance issue, rather than a capacity issue. The sewer system was designed with minimum slopes of 0.4%, though through faulty construction practices or subsequent subsidence, lower grades are present in the system. The average slope between MH12 and MH4 is approximately 0.5%. A 200 mm asbestos cement concrete pipe has a pipe-full capacity of approximately 68 m^3/hr at 0.4% slope and 77 m^3/hr at 0.5% slope. Flow in the sewer along Main Street will be less than the flows seen at Lift Station No. 1 because they receive contribution from just a portion of the total catchment area of Lift Station No. 1.

One confounding factor is that Lift Station No. 2, which captures all flow from the northwest sector of Mount Currie (around IR10 Road and the U'll' us Community Complex), discharges upstream of the proposed development. When the pumps are running, they introduce short-duration flow spikes in the

Main Street sewer when the pumps. The CCTV inspection of the sewer downstream of this discharge point (i.e., between MH15 and MH11) indicate that, where the pipe is properly sloped, there is no evidence of flows that exceed 30% of pipe capacity (as assessed from pipe wall staining). Therefore, there appears to be sufficient capacity to accept the flows from the proposed development even when Lift Station No. 2 pumps are operating.

Given that the peak estimated flow from 2020 is 24 m^3/hr, the additional 5.0 m^3/hr from the proposed development can be conveyed in the existing sewer system. It will cause some additional backwatering at those locations where pipe grading is problematic, but it will not cause any capacity limits so long as the pipes are cleaned on a regular basis. Surcharging of the sewers to a point where it causes a public health concern is not expected.

CONCLUSION

The proposed residential development on Main Street is estimated to contribute up to 30.18 m^3/day, with peak flows of approximately 5.0 m^3/hr. The analysis of this contribution has identified the impact of this additional flow contribution on the pumping capacity, treatment capacity and hydraulic conveyance capacity of the system.

It is assessed that there is presently sufficient pumping capacity at Lift Station No. 1 to manage the additional flows generated from the development, even during periods of high Inflow and Infiltration (I&I). However, it will result in two pump operation more frequently than at present. In rare circumstances, the storage of sewage in the Rancheree Street sewer will be necessary to manage very high flow conditions. With future upgrades to the system to address I&I and to replace the lift station, these limitations will be alleviated.

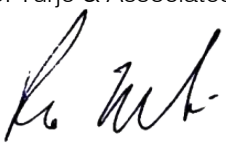
The wastewater treatment lagoon is operating in a compliance with its provincial Permit, and in compliance with the Wastewater System Effluent Regulation. The proposed development is not expected to cause violation of the conditions of the Permit or WSER.

In terms of overall capacity, the existing sewer system has sufficient hydraulic conveyance capacity to accommodate the additional flows from the proposed development. However, there are localized sections within the system that are characterized by adverse pipe grading or pipe sagging that result in backwatering. These sections need to be monitored and should be regularly cleaned to maintain flow through these pipes. The projected flows from the proposed development may cause additional backwatering beyond what is presently observed, but it will not be sufficient to cause surcharging to the extent that it becomes a public health hazard.

CLOSURE

We trust that this satisfies your requirements for re-zoning application. Please contact the undersigned if you have any concerns or questions.

Yours truly,
P.S. Turje & Associates Ltd.



Rob Tamaki, M.A.Sc., P.Eng.
Senior Project Engineer

Study Limitations:

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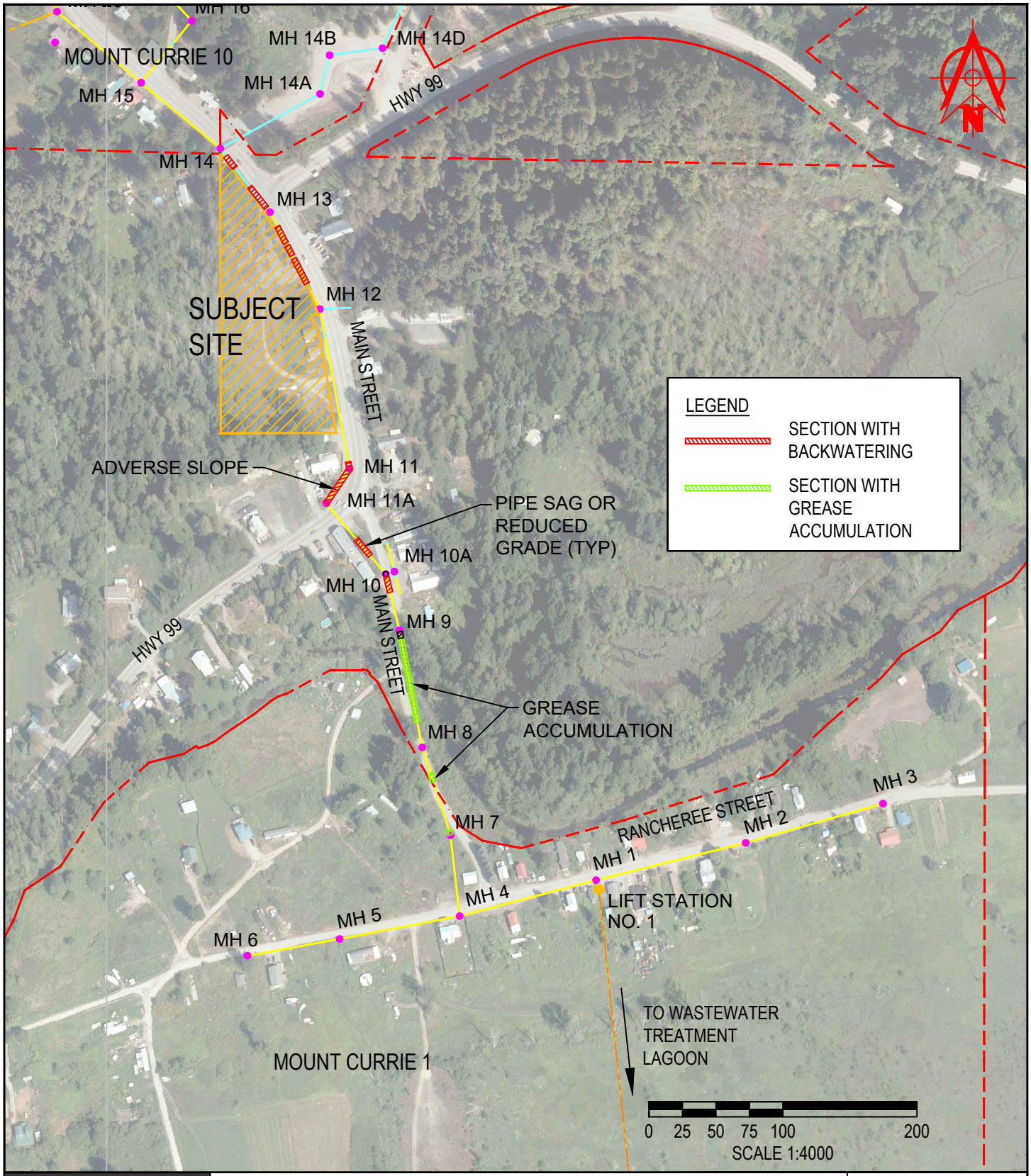
FIGURES



Lil'wat Nation

MOUNT CURRIE SEWER SYSTEM FOR PROPOSED RESIDENTIAL COMPLEX ON MAIN STREET

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FIGURE NO. 1