BROADVIEW

5260, 5280 & 5300 TANYA DRIVE

Official Community Plan Amendment and Rezoning
Civil Servicing Report

November 1, 2016

WESTBROOK Consulting Ltd.
115-866 Goldstream Avenue, Victoria BC, V9B 0J3

EXECUTIVE SUMMARY

Westbrook Consulting has been retained to prepare a servicing report for the proposed development of 5260, 5280 and 5300 Tanya Drive.

The development is seeking an Official Community Plan amendment to remove the properties from the Urban Reserve. The proposed development will also require a rezoning. The proposed zone is the Steep Slope (R10) Residential Zone.

The objective of this report is to determine whether existing underground services have the capacity to service the subject properties. The following report will evaluate the existing watershed and drainage characteristics. We will provide recommendations on the drainage network as it would be impacted by the proposed development. The report will also look at the water supply in terms of domestic distribution and fire suppression. Lastly, the report will assess the capacity of the sewer system downstream in terms of its current capacity and future capacity, considering the land use density that has been proposed.

As part of the new development the following offsite improvements will be required.

- The existing reservoir will require upgrades
  - A new tank
  - A domestic pump system
  - A fire flow pump
- The sanitary sewer will require one upgrade at Laguna Road.
- The existing drain network has sufficient capacity to handle the pre-development 5 year runoff event.

With the above-mentioned improvements, the proposed subdivision will have no negative effects on the existing storm water, sanitary sewer and water systems.

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INTRODUCTION

Westbrook Consulting Ltd. has been retained to provide a civil servicing report on the capacity and necessary upgrades for the proposed development of Tanya Drive. This brief has been prepared to support an Official Community Plan Amendment and rezoning application.

The owners of the proposed development are also applying for a rezoning to a steep slope site (R10) zoning. With the proposed zoning the proposed development could see the construction of 469 units. This servicing report considers the maximum possible units for an R10 zoning (16 units per hectare).

The proposed development is neighboured by park on the south and east sides, R10 zoned residential properties to the north and park and AR2 zoned residential properties to the west.

There are existing low-lying areas and water courses through the proposed development. The site is currently forested with rock outcrops.

The proposed development will be accessed from Tanya Drive.

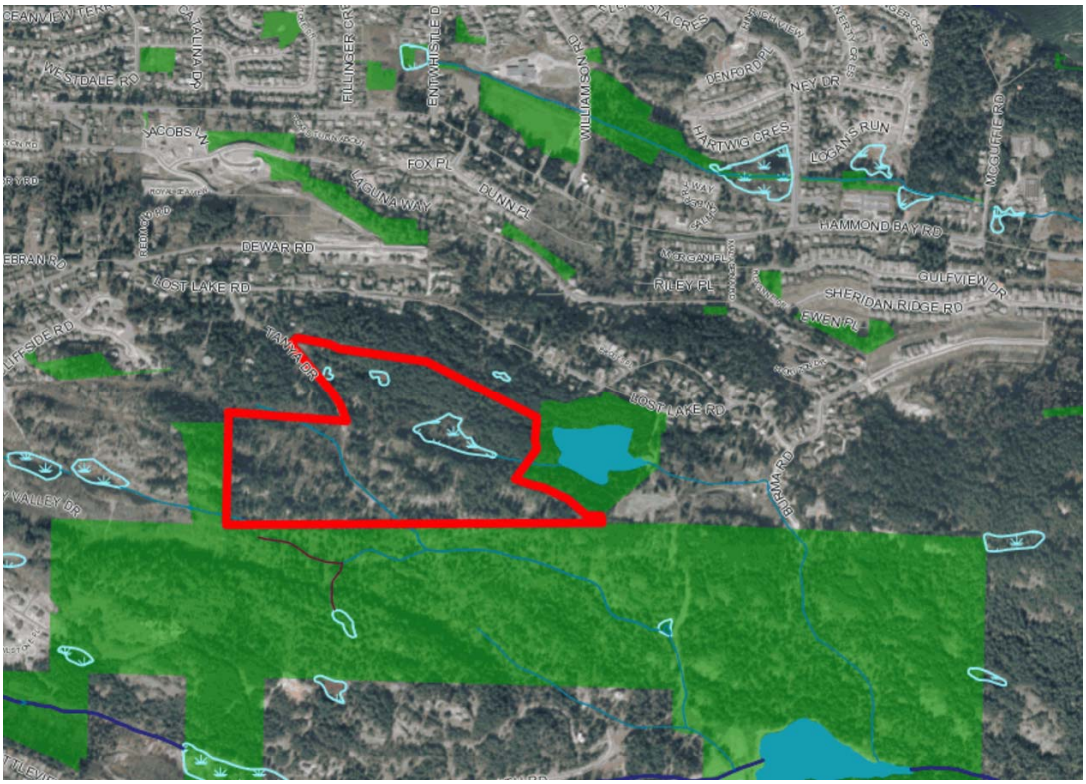

Figure 1: Site Location

STUDY AREA

The study area for this civil servicing report includes the future servicing requirements for 5260, 5280, 5291, 5300 and 5311 Tanya Drive. 5291 and 5311 Tanya Drive are not included in this Official Community Plan Amendment and Rezoning application but the infrastructure will be sized for the future development of these lots.

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FIGURE 2: Lot Layout

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STORM WATER MANAGEMENT

EXISTING OFFSITE DRAINAGE SYSTEM

There are three drain systems servicing the proposed development.

- Southern Park

  - There is an existing low-lying area on 5260 Tanya Drive at the entrance of the property from Tanya Drive.
  - There is an existing water course entering the low lying area from the southwest corner of the property and 5291 Tanya Drive.
  - The low-lying area drains south through 5260 Tanya Drive to a wetland with within the Park.
  - The water then drains to Cottle Lake before being discharged in the Ocean.

- Lost Lake

  - The northeast corner of 5260 Tanya Drive, and the east half of 5280 and 5300 Tanya Drive contribute runoff to a low-lying area between 5260 and 5280 Tanya Drive.
  - The runoff then drains to Lost Lake.
  - Lost Lake has an overflow to Cottle Lake.

- Tanya Drive

  - There are existing ditches along both sides of Tanya Drive from the high point flowing north.
  - The is an existing culvert across Tanya Drive adjacent to 5330 Tanya Drive that directs all the storm water to the 450mm diameter drain main along the west side of the road.
  - The storm water is conveyed north through a piped system to an outlet at the northwest corner of Fillinger Crescent.

STORM WATER MODEL

EPA SWMM

The flow from the proposed development and the neighbouring properties on Tanya Drive was determined using EPA SWMM. The model results can be found in the attached Table 9. EPA SWMM is a hydrology-hydraulic simulation model produced by the United States Environmental Protection Agency. The model allows the user to define catchment areas, links, nodes, reservoirs and outlets to simulate a storm event within an existing or proposed storm water network. Since the catchment is so large the Chicago design storm method was used to obtain a more realistic result of the offsite system than if the rational method was used.

ASSUMPTIONS

The following assumptions were made to develop the EPA SWMM model:

- The Manning Coefficient of the all the drainage courses is 0.05
- All the drainage courses have the following dimensions
    - 0.5m wide base
    - 0.5m maximum depth
    - 3:1 side slopes
- The road is 90% impervious
- The forested area is 30% impervious
- All runoff flows into the drainage courses shown on the Nanaimo GIS map

MODEL INPUT VALUES

The following tables illustrate the input values used to build the storm water model using EPA SWMM.

Refer to Figure 3 for subcatchment locations.

Table 1: Subcatchment Properties

ID	Area(ha)	Outlet	Width(m)	% Slope	% Imperv	N-Imperv	N-Perv
1	4.14	15	154	21	30	0.01	0.1
2	3.07	15	92	17	30	0.01	0.1
3	3.59	21	315	23	30	0.01	0.1
4	6.06	22	365	20	30	0.01	0.1
5	2.03	24	170	24	30	0.01	0.1
6	3.37	16	300	17	30	0.01	0.1
7	4.14	16	300	15	30	0.01	0.1
8	0.71	20	94	3.5	30	0.01	0.1
9	0.17	18	40	40	30	0.01	0.1
10	3.02	16	200	10	30	0.01	0.1
11	1.01	17	80	10	30	0.01	0.1
12	1.43	18	62	16	30	0.01	0.1
13	0.57	17	52	25	30	0.01	0.1
14	0.35	18	18	6	90	0.01	0.1
25	0.16	17	18	6	90	0.01	0.1

Refer to Figure 4 for link and node locations.

Table 2: Link Input Properties

ID	Inlet Node	Outlet Node	Shape	Max Depth (m)	Length (m)	Roughness	Slope (%)
1	18	15	Trapezoidal	0.5	186.20	0.05	6.46
2	17	19	Trapezoidal	0.5	85.56	0.05	1.17
3	16	20	Trapezoidal	0.5	302.72	0.05	1.32
4	15	22	Trapezoidal	0.5	369.50	0.05	8.15
5	21	22	Trapezoidal	0.5	491.24	0.05	3.46
6	22	23	Trapezoidal	0.5	130.50	0.05	2.30
7	24	15	Trapezoidal	0.5	240.17	0.05	1.25

The shape and depth of the existing watercourses has been assumed based on previous studies.

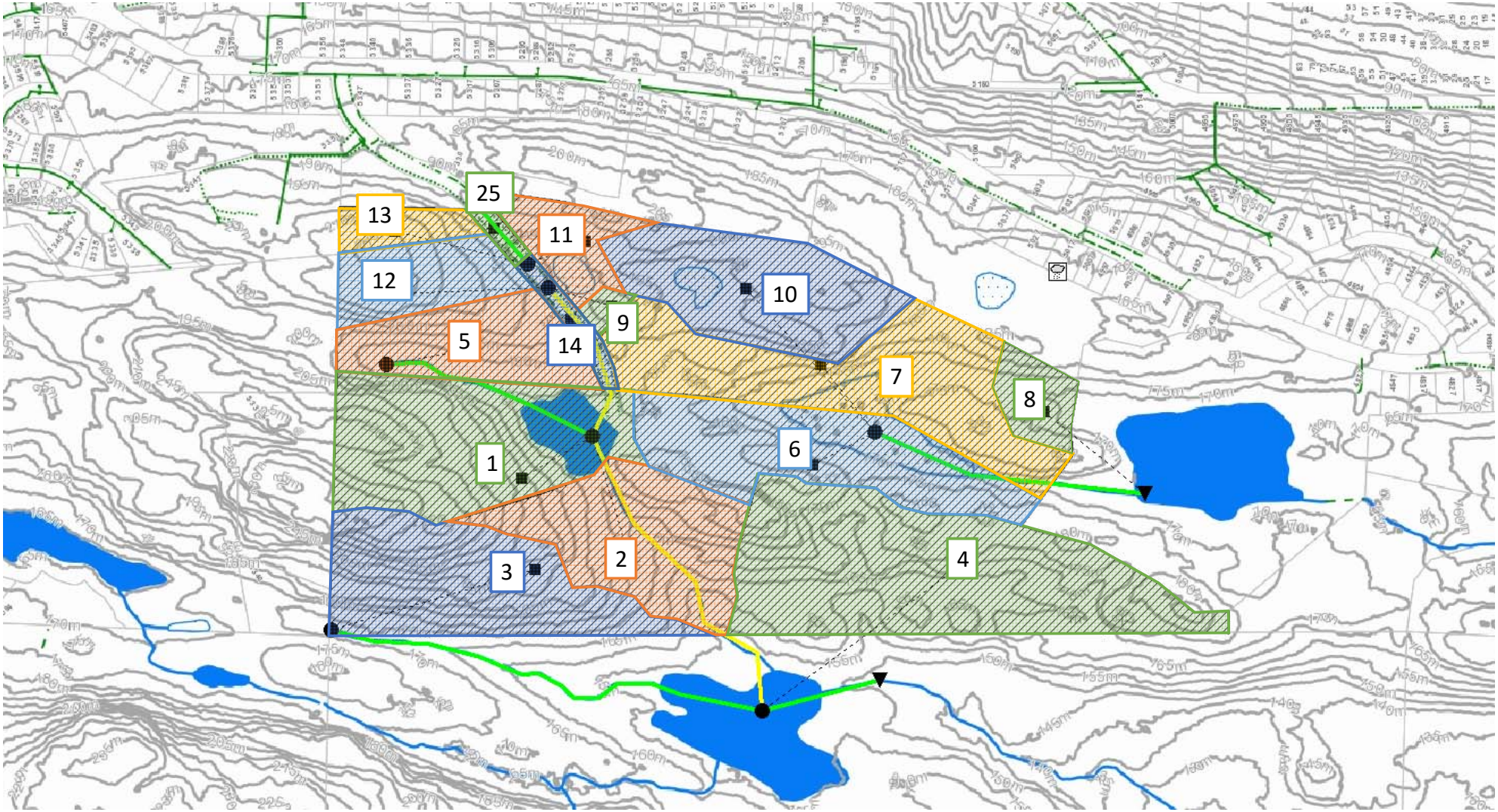

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FIGURE 3: Drainage – Subcatchments Locations

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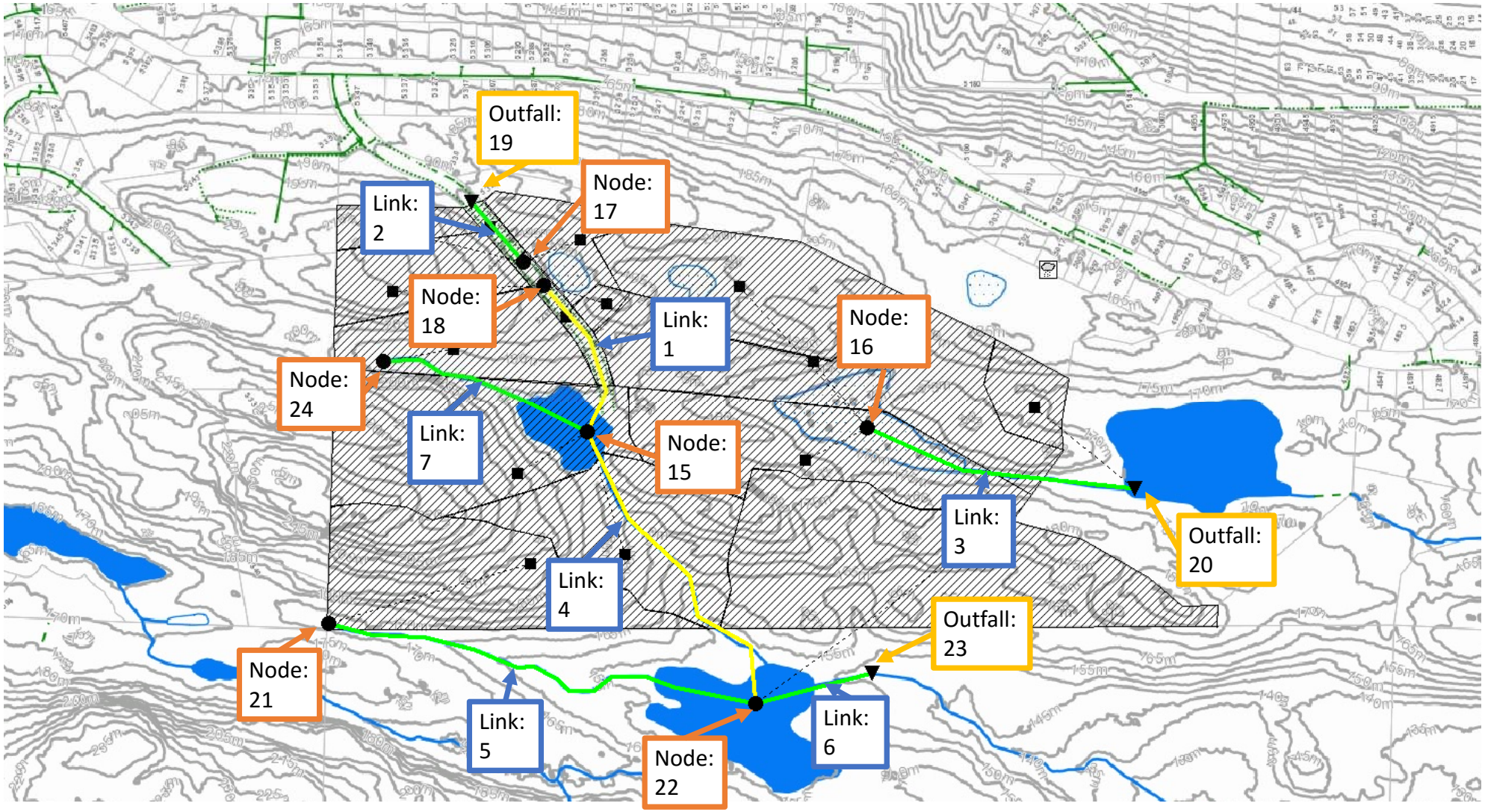

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FIGURE 4: Drainage – Node and Link Locations

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CHICAGO STORM

From the City of Nanaimo IDF Curves the following coefficients were determined for the 5 and 10 year design storm.

$$i_{mean} = \frac{a}{(t_d + b)^c}$$

$$Where,$$

$$\rightarrow i_{mean} = average\ intensity\ over\ the\ duration\ of\ the\ storm, mm/hr$$

$$\rightarrow a, b, c = parameters\ function\ of\ the\ location\ and\ frequency$$

$$\rightarrow t_d = duration, min$$

Table 3: Chicago Storm Properties

	a	b	c
5 year	135.61	0.1	0.529
10 year	177.16	0.1	0.551

The peaking time, r, is 0.333 for all three storms.

The peak intensity at $r \times t_d$, is calculated using the following formula.

$$i_p = \frac{a}{(\Delta t + b)^c}$$

$$Where,$$

$$\rightarrow i_p = peak\ intensity, mm/hr$$

$$\rightarrow a, b, c = parameters\ function\ of\ the\ location\ and\ frequency$$

$$\rightarrow \Delta t = selected\ time\ interval, min$$

The right branch of the hyetograph was calculated using the following formula.

$$y = \frac{\left(\left(\frac{a \times t_{a2}}{\left(b + \frac{t_{a2}}{1-r}\right)^c}\right) - \left(\frac{a \times t_{a1}}{\left(b + \frac{t_{a1}}{r}\right)^c}\right)\right)}{\Delta t}$$

$$Where,$$

$$\rightarrow y = rain\ intensity\ between\ t_{a1}\ and\ t_{a2}, mm/hr$$

$$\rightarrow a, b, c = parameters\ function\ of\ the\ location\ and\ frequency$$

$$\rightarrow \Delta t = selected\ time\ interval, min$$

$$\rightarrow t_{a1} = time\ at\ the\ begining\ of\ the\ time\ interval\ \Delta t, min$$

$$\rightarrow t_{a2} = time\ at\ the\ end\ of\ the\ time\ interval\ \Delta t, min$$

The left branch of the hyetograph was calculated using the following formula.

$$y = \frac{\left(\left(\frac{a \times t_{a2}}{\left(b + \frac{t_{a2}}{r}\right)^{c}}\right) - \left(\frac{a \times t_{a1}}{\left(b + \frac{t_{a1}}{1-r}\right)^{c}}\right)\right)}{\Delta t}$$

$$Where,$$

$$\rightarrow y = rain\ intensity\ between\ t_{a1}\ and\ t_{a2}, mm/hr$$

$$\rightarrow a, b, c = parameters\ function\ of\ the\ location\ and\ frequency$$

$$\rightarrow \Delta t = selected\ time\ interval, min$$

$$\rightarrow t_{a1} = time\ at\ the\ begining\ of\ the\ time\ interval\ \Delta t, min$$

$$\rightarrow t_{a2} = time\ at\ the\ end\ of\ the\ time\ interval\ \Delta t, min$$

RESULTS

The following results are for the 5 year design storm.

Table 4: EPA SWMM Results

Link ID	Max Flow (L/s)	Max Capacity (%)	Max Velocity (m/s)
1	116.42	5	1.04
2	105.92	12	0.54
3	643.64	67	0.96
4	651.54	27	1.79
5	226.47	14	1.12
6	1219.04	0.95	1.27
7	127.06	0.14	0.64

Based on the assumptions stated above the existing drainage system has sufficient capacity to accommodate the 5-year pre-development runoff.

ONSITE STORAGE

DESIGN CRITERIA

The storm water management plan will be designed to meet the City of Nanaimo Manual of Engineering Standards and Specifications for areas drawing to watercourses.

- Volume Reduction
  - Retain or infiltrate the post development runoff from the 6 month 24hour design storm.
- Detention
  - Ensure the post development runoff from the proposed development site is less than or equal to the pre-development conditions.
    - Release the pre-development 6 month 24-hour storm runoff
    - Detain all runoff beyond the 6 month 24-hour storm runoff

TREATMENT

DESIGN CRITERIA

The storm water runoff will be treated to meet the City of Nanaimo Manual of Engineering Standards and Specifications, Edition No. 11.

- Treat 90% of the average annual runoff for impervious surfaces exposed to vehicle traffic.
- Remove 80% of Total Suspended Solids over 50µm particle size.

The design of the treatment methods will be completed as part of the detailed design phase.

MAJOR SYSTEM

A major system will be designed to safely convey the 100-year design storm. The major system may include piped and overland flow routes.

Figure 5 shows potential storm water detention and treatment areas.

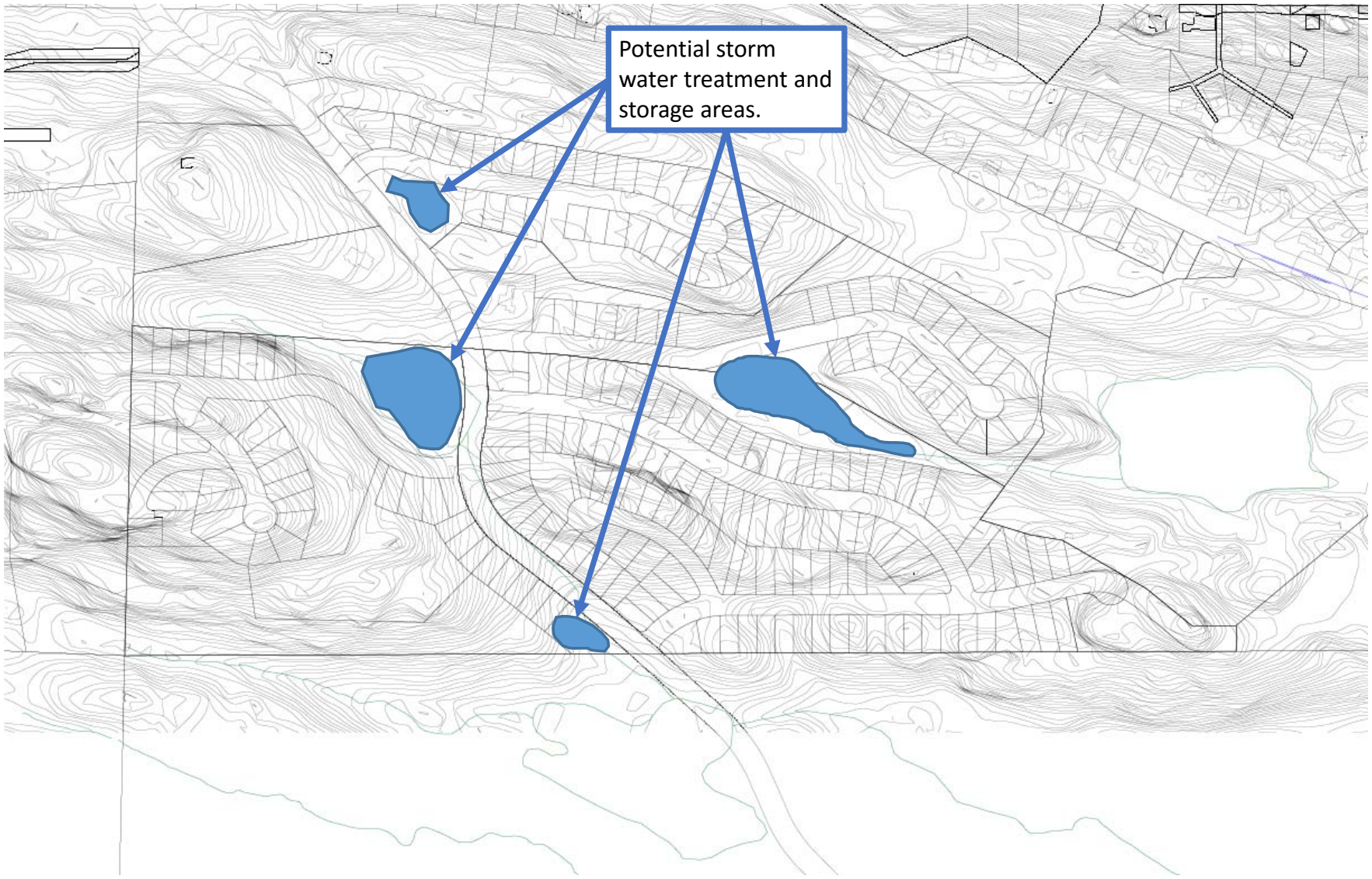

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FIGURE 5: Drainage – Potential Onsite Storage Areas

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WATER NETWORK

The existing water system will need to be upgraded to service the proposed development.

We have reviewed the Linley Valley Pump Station Review Final Report by Koers & Associates Engineering Ltd. dated October 17, 2014. The reports makes the following recommendations and statements:

- The existing Tanya Reservoir is a 4,500m3 steel tank.
- A new pump station will be required to service any development above the 185m contour.
- The proposed pump station will be required to supply Fire and Domestic Demands
- 3 Phase power will need to be extended from Lost Lake Road.
- Pressure reducing valves will be required between the proposed pressure zone and the existing zones.
- The maximum fire flow velocity is 3.0 m/s.

The report assumed that 5260 Tanya Drive would be acquired by the City of Nanaimo as park and therefore revisions to the proposed pump/reservoir will be required to service the new development.

The design of the pump station and reservoir will be completed as part of the detailed design phase.

FIRE FLOW

DESIGN CRITERIA

The following design criteria was used in the determination of the fire flows required for the proposed development. The proposed development will be designed to meet both the City of Nanaimo and Fire Underwriters Survey required fire flows.

- Fire Underwriters Survey (FUS), Water Supply for Public Fire Protection 1999

  - Fire flow required is estimated by the equation, $F = 220C\sqrt{A}$
    $Where,$
    $\rightarrow F = Fire\ Flow, L/min$
    $\rightarrow C = Construction\ Type$
    $\rightarrow A = Floor\ Area, m^2$
  - $Or, the\ Short\ method\ as\ per\ Note\ J$

- City of Nanaimo

  - 150 kPa residual pressure under fire flow conditions
  - 75 L/s for Steep Slope Residential SFD
  - 175 L/s for Steep Slope Residential Multi Family

CALCULATIONS

Based on the FUS design criteria and proposed development, the total required fire flows and the related assumptions are stated below.

The floor area has been estimated based on the maximum lot coverage identified in Bylaw 4500 for the Steep Slope Residential (R10) zone.

- Maximum lot coverage is 40%
- 7.5 m from any rear lot line
- 4.0 m from any front lot line
- 1.5 m from any interior lot line
- 4.0 m from any exterior side lot line

SINGLE FAMILY

The proposed development is considered a grouping of detached one family and small two family dwellings not exceeding 2 stories in height and therefore the short method, as per Note J in the Fire Underwriters Survey can be used to determine the fire flow. The recommended fire flow is 4,000 L/min (67 L/s) for wood frame construction with exposure distances of 3m to 10m.

The required FUS fire flow is less than the available fire flow provided within the water mains by the City of Nanaimo and therefore no modifications to proposed single family lots will be required.

MULTI-FAMILY

The proposed multi-family lots will be designed to meet the available fire flow within the main.

The area for the multifamily buildings will be governed by the flow available in the main at the hydrant (175 L/s). The maximum area within a fire flow area was determined using the FUS equation and based on the following assumptions.

- Exposure Charge is 65% (E)
- Limited Combustible Occupancy is -15% (O)
- Allowable Fire Flow is 175 L/s (F)

A sample calculation for scenario 1 is seen below.

$$A = \left(\frac{F}{220C(1+O)(1+E+S)}\right)^2$$

$$A = \left(\frac{175 \times 60\ L/min}{220(1.5)(1-0.15)(1+0.65-0)}\right)^2$$

$$A = 515m^2$$

Scenario	Type of Construction	Sprinklers (S)	Maximum Area (A)
1	Wood Frame (1.5)	None (0%)	515 m^2
2	Wood Frame (1.5)	Automatic (-40%)	897 m^2
3	Hardi Plank (1.3)	None (0%)	685 m^2
4	Hardi Plank (1.3)	Automatic (-40%)	1194 m^2

DOMESTIC WATER

The City of Nanaimo Engineering Standards & Specifications, Nov 2016 Edition were used to determine the domestic flows for the proposed development.

- For single family residential the population density is 36 persons per hectare.
- For low density multi-family the population density is 48 persons per hectare.
- The average day demand (ADD) is 455 Litres/capita/day.
- The maximum day demand (MDD) is 1135 Litres/capita/day.
- The peak hour demand (PHD) is 1820 Litres/capita/day.

Table 5: Domestic Water Demands

Scenario	1 (100% Single Family)	2 (50% Single Family)	3 (100% Multi-Family)
Single Family Area	33.31 ha	16.66 ha	0 ha
Multi-Family Area	0 ha	16.66 ha	33.31 ha
Total Area	33.31 ha	31.31 ha	33.31 ha
Population	1199	1399	1599
ADD	6.32 L/s	7.37 L/s	8.42 L/s
MDD	15.75 L/s	18.38 L/s	21.00 L/s
PHD	25.26 L/s	29.47 L/s	33.68 L/s

DESIGN

The proposed onsite water system will included looped connections to allow for increased water pressure and flow to the hydrants and buildings. The majority of the watermains will be 200mm diameter.

The design of the water main location will be completed as part of the detailed design. The looped water main design will be similar to the proposed network seen in the Koers & Associates Engineering Ltd. report Linley Valley Station Review Final Report Figure 2 Proposed Watermains and Pressure Zones.

SANITARY SEWER SYSTEM

The sanitary sewer will be directed to an onsite lift station and it will be pumped to the gravity system along Lost Lake Road.

The capacity of the downstream sewer system has been determined for the following three scenarios as illustrated in Table 6 below.

1. The existing conditions.
2. The maximum load conditions based on the current zoning.
3. The current zoning plus the proposed development.

The sanitary sewer connection will either be to the existing stub fronting 5348 Lost Lake Road flowing west or to the existing stub fronting 5377 Lost Lake Road flowing east.

The sanitary sewer system is routed towards the north and then towards the east to the Regional District of Nanaimo Water Pollution Control Centre at 4600 Hammond Bay Road.

SANITARY SEWER FLOW

As per the City of Nanaimo Engineering Specifications the following criteria and equations were used to determine the sanitary sewer loading

- $Single\ Family\ Dwelling \rightarrow 2.8\ persons/unit$
- $Multiple\ Family\ Dwelling \rightarrow 1.7\ persons/unit$
- $Average\ Dry\ Weather\ Flow\ (ADWF) = 230\ Liters/persons/day$
- $Peaking\ Factor\ (PF) = 1 + 14/(4 + 0.5(Population))$
- $Peak\ Dry\ Weather\ Flow = ADWF\ \times PF$
- $Peak\ Inflow\ and\ Infiltration\ (I\&I) = 25000\ Liters/hectare/day$
- $Peak\ Wet\ Weather\ Flow(PWWF) = PDWF + (I\&I)$

Table 6: Sanitary Sewer Flow

Scenario	1	2	3
Total Area	27.08	35.92	65.23
Total Single Family Dwellings	209	234	234
Total Multi-Family Units	0	302	771
Population	585.2	1198.8	2043
ADWF	1.56	3.19	5.44
PDWF	2.72	4.60	6.91
I & I	7.84	10.39	18.88
PWWF	10.56	10.99	25.79

CAPACITY

The following route was analysed as the proposed sanitary sewer route from the proposed development. Refer to the attached Figure 5.

- West on Lost Lake Road
- North between 5316 and 5366 Lost Lake Road
- North between 5373 and 5363 Dewar Road
- East on Dewar Road
- North between 5310 and 5149 Laguna Way
- North between 5211 and 5201 Laguna Way
- East on Laguna Way
- North between 5200 and 5190 Laguna Way
- North between 5210 Fox Place and 5194 Dunn Pl
- North on Dunn Place
- West on Hammond Bay Road
- North on Entwhistle Drive

The majority of the existing sanitary sewer infrastructure is 200mm diameter pipe with varying grades.

We received a memo from the City of Nanaimo indicating that based on projected 2031 populations the section of existing 5201 and 5189 Laguna Way will need to be replaced and upgraded. The remaining existing infrastructure has enough capacity to accommodate the existing conditions, the maximum density already zoned and the proposed development.

Alternatively there may be a possibility to direct sanitary sewer load to a different downstream connection and these options will be considered during the detailed design stage.

ONSITE DESIGN

The onsite sanitary sewer design will include a gravity and pumped systems. We anticipate that there will be two lift stations one located at the south end of 5260 Tanya Drive and the other within 5280 Tanya Lane. Both will pump to a gravity main along Tanya Drive.

Addition pumps may be required and the location will be determined when the grading plan is prepared.

A full detailed design of the onsite sanitary sewer infrastructure will be included in a future design brief.

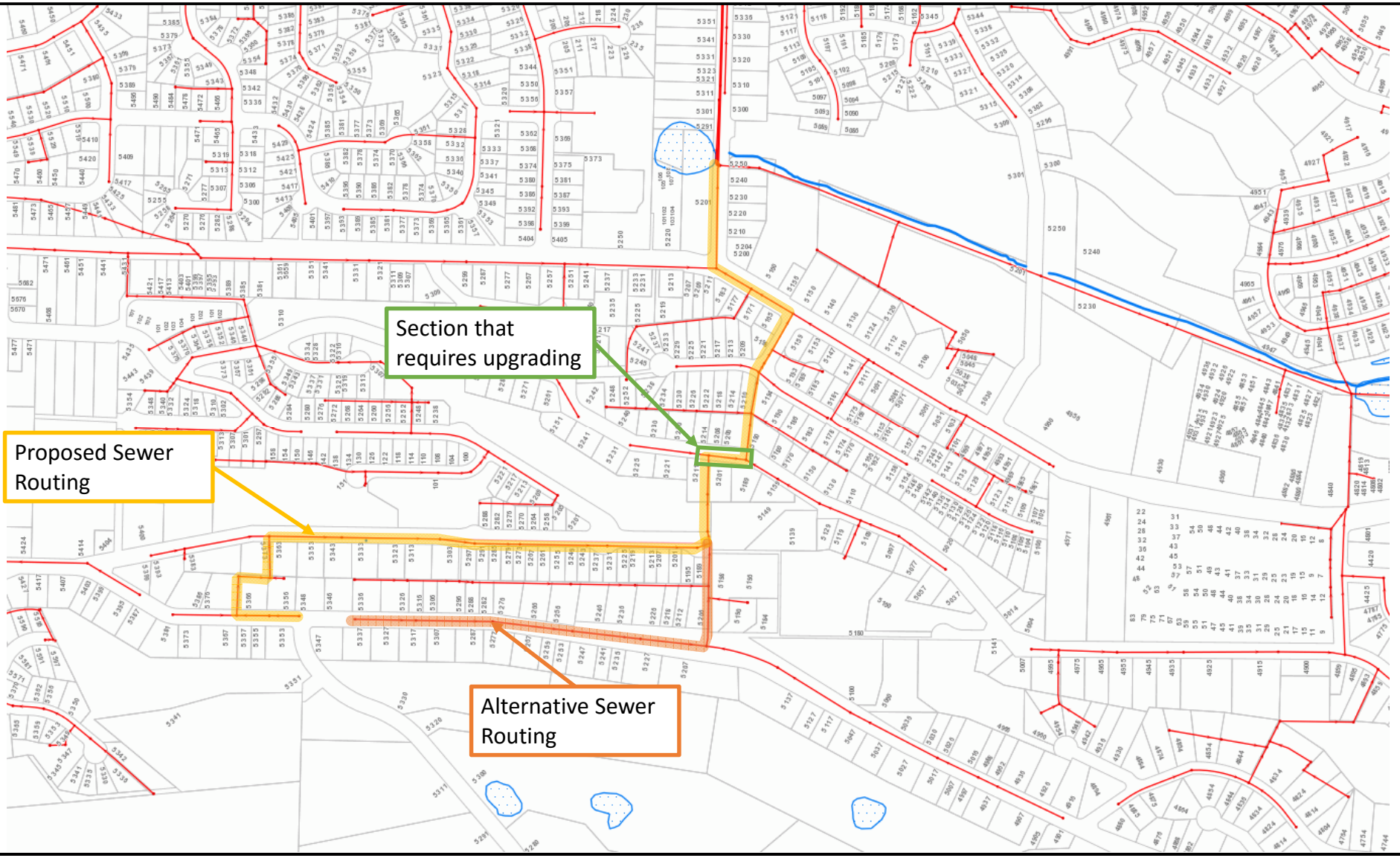

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FIGURE 6: Sanitary Sewer – Offsite Route

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SUMMARY

The existing water, sewer and storm water systems that will service the proposed development have been analyzed as part of this servicing report.

The existing systems will require the following upgrades to accommodate the proposed development.

Table 7: Required Upgrades

Utility	Comments
Storm Water	▪ Onsite storm water detention and treatment will be required. ▪ The runoff from the proposed development will be restricted to the pre development flows and therefore no downstream infrastructure will need to be upgraded.
Sanitary Sewer	▪ The onsite sanitary sewer will contribute flow to the existing system along Lost Lake Road fronting the site. ▪ With the expected population growth and the proposed development a portion of the sewer network along Laguna Way will need to be upgraded.
Water	▪ The existing reservoir will need to be upgraded to include a new tank and pump. ▪ The onsite network will be designed with looped connections.

Westbrook Consulting Ltd. will prepare water, sewer and storm water design briefs for the proposed system upgrades and design as part of the detailed design phase.

If you require any further information on the capacity and proposed improvements to the existing water, sewer and storm water systems, please contact Westbrook Consulting Ltd.

Prepared by:

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Project Manager, Engineer of Record

APPENDIX A

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Project Name:	**Broadview**	Calculation By:	Nicole Fischer, EIT	Date:	October 31, 2016
Project File Number:	3057-03	Checked By:	Jared Steingard, P. Eng.	Date:	

CITY OF NANAIMO IDF

Duration	5 Year	10 Year
min	mm/hr	mm/hr
5	58	71
10	40	50
15	32	40
30	22	28
60	16	18
120	11	13
360	6	7
720	4.1	4.8
1440	2.9	3.1

CHICAGO TYPE DESIGN STORM COEFFICIENTS

	5 Year	10 Year
a	135.61	177.16
b	0.1	0.1
c	0.529	0.551
r	0.333	0.333

CHICAGO TYPE DESIGN STORM

	5 Year	10 Year
0:00	1.38574	1.47163
0:30	1.43554	1.52675
1:00	1.49088	1.58811
1:30	1.55289	1.65696
2:00	1.62299	1.73495
2:30	1.7031	1.82424
3:00	1.79583	1.92781
3:30	1.90486	2.04988
4:00	2.03554	2.19657
4:30	2.19608	2.37732
5:00	2.3998	2.60746
5:30	2.67011	2.9141
6:00	3.05326	3.35097
6:30	3.65825	4.04544
7:00	4.84324	5.41968
7:30	12.5318	14.8277
8:00	22.3939	27.1441
8:30	6.99725	7.95116
9:00	5.28421	5.9337
9:30	4.40997	4.91463
10:00	3.85641	4.27371
10:30	3.4659	3.82387
11:00	3.17163	3.48629
11:30	2.93973	3.22118
12:00	2.75097	3.00603
12:30	2.59349	2.827
13:00	2.45955	2.67509
13:30	2.34385	2.54414
14:00	2.2426	2.42977
14:30	2.15305	2.32879
15:00	2.07312	2.23881
15:30	2.0012	2.15797
16:00	1.93605	2.08485
16:30	1.87669	2.0183
17:00	1.82229	1.9574
17:30	1.77222	1.90141
18:00	1.72593	1.84971
18:30	1.68297	1.80178
19:00	1.64296	1.75719
19:30	1.60559	1.71557
20:00	1.57057	1.67662
20:30	1.53767	1.64005
21:00	1.50669	1.60565
21:30	1.47744	1.5732
22:00	1.44978	1.54253
22:30	1.42357	1.51349
23:00	1.39868	1.48594
23:30	1.37501	1.45975