January 2, 2019

Prepared for:

VIEW ROYAL SANITARY MASTER PLAN

FINAL REPORT

McElhanney

McElhanney Consulting Services Ltd.
500 – 3960 Quadra Street
Victoria, BC
V8X 4A3

Contact: Ian Whitehead, PEng,
Project Manager
Phone: 778-746-7411
Email: iwhitehead@mcelhanney.com

2243-17101-00

OQM | Organizational Quality Management Program

Certified ISO 9001:2008

Contents

Tables

Figures

Appendices

1. Introduction

The Town of View Royal (the Town) sanitary sewer system is comprised of a gravity collection pipe network and 17 pumping stations. The system discharges either directly or indirectly to the Capital Regional District (CRD) Craigflower pumping station, and thence via the CRD Esquimalt trunk sewer, to Macaulay Point.

The Town wishes to update past system assessments and capacity analyses, both to reflect system extensions since modeling was last undertaken and to anticipate future needs over a 20-year planning horizon.

Pump station upgrades recommended in the prior, 2005 study have all been undertaken since by the Town. We understand Council has been supportive of system upgrading, since the 2005 report was published, and this has resulted in a system with few operational issues presently. Inflow and Infiltration (I&I), is generally quite low, with most of the collection network being relatively new and composed of PVC pipe material.

As development proceeds within the municipality, the Town wants to ensure an equitable means of cost recovery for new sanitation system construction and for upgrading of existing infrastructure. An updated sanitary master plan study is needed to achieve this, in support of development cost charge (DCC) bylaw updates - occurring concurrent with this sanitation system planning report.

1.1. Project Goals

The goals for this project are as follows:

- Update system computer models to reflect current operating conditions;
- Assess existing system condition and expected service life of operating components;
- Develop an understanding of probable growth rates and areas of expected development within the municipality;
- Prepare an itemized capital plan list, broken out/prioritized as short term (5-year capital plan) and longer-term (20-year, long range planning horizon) requirements, in turn resulting from:
    - Component condition/service life expiration – limited to pumping stations, as no operational issues have been reported for the Town's relatively new, gravity pipe collection network.
    - Existing and/or future system capacity shortfalls.

1.2. Scope of Work

The agreed upon scope of work for this project is as follows:

- Develop a steady state sanitary model, initially, reflecting up to date system geometry, calibrated to known flows at the Town's pumping stations.
    - Modeled stations are based on best available data including pumping equipment, wet well volumes and geometries.
- Gather data for model generation from a variety of sources:

  - GIS data obtained from CRD
  - Town of View Royal as built records and pumping station data
  - Field surveys of specific manholes/nodes
  - Existing SANSYS models

- Derive spatial population and loading based on Census data and zoning, in conjunction with Town planner input.
  - Institutional, commercial and industrial loading to be converted to equivalent residential population
- Model Validation – compare model outputs to expected values.
- Prepare prioritized capital plan lists, based on capacity deficiency, existing system condition and expected new development rates.
- Prepare Class 'D' capital cost estimates for identified upgrading works.
- Develop interim recommendations as a 2017 scope, suitable for inclusion in the Town's DCC bylaw now being prepared.
  - Provide recommendations and direction as to any additional (future) scope that should be considered, toward refinement of the findings herein.

1.3. Background

The Town's sanitary sewer master plan was last updated in 2005. Since then, the Town has undergone significant growth in several areas of the municipality.

For the 2005 study update, the software 'SANSYS' was utilized. This software is quite simple to set up but has limitations in the sophistication of the model output. Dynamic simulations are not possible with SANSYS, as the model represents a worst-case instant in time whereby all pumping stations are pumping, and peak instantaneous gravity flows are conveyed, combined with concurrent peak I&I allowance in the system.

The Town recognized this limitation and wishes to update to a more robust software platform. SWMM was selected due to its widespread industry adoption. In addition, the Town sought to develop a model which is geometrically correct, to the extent possible. This meant gathering existing system data from a variety of sources.

The Town wanted to ensure a reasonable forecast of future population growth was accounted for in the models. To this end, we met with the Town's planner and established expected rates of population growth as well as site specific areas of probable growth. Infill growth, expected as secondary suites and reconstruction, was also accounted for.

2. Design Criteria

2.1. Hydraulics

Model results were evaluated based on two separate criteria:

1. In determining whether an upgrade of the existing infrastructure was required, thresholds were used as described in *Table 1*.

2. Once an upgrade was deemed required, the Master Municipal Construction Documents (MMCD) Design Guideline Manual (2005) was referenced to establish the size/capacity of required upgrades such that they meet MMCD standards. Upgrades were sized by evaluating the proposed system against the projected future population's Peak Wet Weather Flow (PWWF), with 5-year Inflow and Infiltration (I&I) rates. Existing sewers were assessed and upgraded sewers were sized to flow at less than full depth, as shown in *Table 2*.

Table 1: Thresholds for Recommended Upgrades

Scenario	Threshold for Recommended Gravity Main Upgrade or Monitoring	Threshold for Recommended Pump Station Upgrade or Monitoring
Existing and Future Q_5	d/D >= 100%: **Upgrade Required**	1 pump operating cannot meet inflow demands: **Upgrade Required**
Existing and Future Q_{100}	d/D >= 100% and significant surcharging: **Monitoring Required**	2 pumps operating cannot meet inflow demands: **Monitoring Required**

Recommended monitoring activities for these locations would be active monitoring of the Town's SCADA data and field inspections of areas of concern during large storms with the purpose of inspecting for surcharges.

Note: Infrastructure is only flagged for "monitoring" if it could not meet the existing or future Q_{100} demand due to the infrequency of such rainfall events and the difficulty in accurately predicting the actual resulting impact on flows to be conveyed within the system. Conversely, any infrastructure not meeting the existing or future Q_5 demand is recommended to be upgraded.

Table 2: Maximum Allowable Depth of Flow for Gravity Sewers

Sewer Diameter	Percentage of Diameter
150mm and 200mm	50% D
250mm	60% D
300mm and larger	70% D

Additional criteria related to sizing of upgraded sewers; from the MMCD are provided in *Table 3*.

Table 3: Relevant Criteria from MMCD Design Guideline Manual (2005)

Name	Design Criterion
Minimum Velocity	Gravity Main: 0.60 m/s Force Main: 0.75 m/s
Maximum Velocity	Gravity Main: 6.0 m/s Force Main: see below
Hazen-Williams Force Main Friction Coefficient	C = 120
Minimum Pipe Diameter	Gravity Main: 200mm (except for upstream section of residential sewer where future extension not possible, 150mm is acceptable) Force Main: 100mm
Maximum Cover Depth	4.5m
Maximum Manhole Spacing	150m
Manhole Drops[1]	Straight run: 5mm drop Deflection up to 45 degrees: 20mm drop Deflections 45 to 90 degrees: 30mm drop

Notes:

1 – It was noted that many straight through manholes in View Royal do not have any manhole drop; this was adopted for design upgrade purposes. Also, since determining deflection angles at manholes is difficult within the model, a drop of 30mm was incorporated at any manhole where a deflection was noted.

Further to the above, the following additional design criteria were agreed upon by the design team:

- Maximum force main velocities should remain below 3 m/s to reduce head losses in the system and maintain reasonable hydraulic efficiency;
- No surcharging should occur at the manholes when evaluating the future population's PWWF with 100-year return period I&I rates.

2.2. Sanitary Loading

Sanitary loading was broken into two separate components: Base Sanitary Flow (BSF) and I&I as described below.

2.2.1. Base Sanitary Flow

The per capita BSF loads have been developed based on a review of pump station SCADA data obtained from the CRD for extended periods of little or no precipitation. Graphs of hourly pump station discharge data are presented in *Appendix A*.

The per capita BSF data used in the model was developed by reviewing the data from the pump stations listed in *Table 4*. Pump stations with small contributing populations (less than 100) or significant ICI components have been excluded from this analysis. Instead, Industrial, Commercial and Institutional (ICI) flows from specific areas of the Town have been converted to equivalent residential flows, but the magnitude of these flows is less

certain that that of residential areas. Per capita residential flows were established based on catchment areas that exclude significant ICI flows.

Table 4: Base Sanitary Flow Summary

Catchment	GWI (L/s)[2]	ADWF minus GWI (L/s)[3]	PDWF minus GWI (L/s)[4]	Peaking Factor[5]	BSF (L/cap/day)[6]
Atkins Pump Station	0.3	2.51[1]	7.19	2.9	144
Packers Pump Station	0.4	2.20	7.23	3.3	210
Helmcken Park Pump Station	0.4	1.65	3.57	2.2	213
Helmcken Bay Pump Station	0.3	1.18	2.81	2.4	184
Price Bay Pump Station	0.2	2.23	5.58	2.5	301
Hallowell Pump Station	0.5	1.19	3.11	2.6	215
Talcott Pump Station	0.1	0.56	1.58	2.8	153
Midwood Pump Station	0.1	0.32	0.77	2.4	141
Heddle Pump Station	0.0	0.24	0.74	3.1	194

Notes:
1 – Summer 2016 average flow used since July data was not typical.
2 – GWI – Groundwater Infiltration (summer). Approximately 80% of minimum night time flow.
3 – ADWF (Average Dry Weather Flow) minus GWI. Also referred to as the Average Base Sanitary Flow (ABSF)
4 – PDWF (Peak (hour) Dry Weather Flow) minus GWI. Also referred to as the Peak Base Sanitary Flow (PBSF)
5 – Peaking factor is the PDWF / ADWF.
6 – BSF (Base Sanitary Flow).
Tables are sorted from largest to smallest equivalent residential population tributary to the stations

Based on the above data, the recommended per capita base sanitary flow to be used for all catchments is 215 L/cap/day, except for the Price Bay catchment for which a value of 300 L/cap/day is recommended. This catchment is a candidate for flow monitoring to confirm flow rates due to its significantly higher BSF.

These values apply to residential populations and ICI population equivalents. Two modified BSF were used for modelling purposes for the following two locations within the Town:

1. 900 L/bed/day for Victoria General Hospital
2. 180 L/site/day for the existing RV Park

2.2.2. Peaking Factor

The loading patterns used in the analysis to account for hourly peaks are summarized in *Table 5*.

Table 5: Loading Patterns

Hour	Residential	Industrial	Commercial	Institutional
0:00	0.60	0.6	0.6	0.4
1:00	0.40	0.6	0.4	0.3

Hour	Residential	Industrial	Commercial	Institutional
2:00	0.30	0.5	0.3	0.1
3:00	0.10	0.5	0.2	0.2
4:00	0.10	0.6	0.1	0.1
5:00	0.20	0.6	0.2	0.2
6:00	0.30	0.8	0.3	0.4
7:00	1.00	1.2	0.4	1.0
8:00	1.60	1.4	0.6	1.6
9:00	3.00	1.5	0.8	1.9
10:00	2.20	1.6	1.1	2.0
11:00	1.60	1.6	1.4	1.8
12:00	1.00	1.6	1.6	1.6
13:00	0.80	1.6	1.7	1.3
14:00	0.70	1.5	1.7	1.2
15:00	0.60	1.4	1.7	1.1
16:00	0.70	1.1	1.6	1.2
17:00	0.80	0.9	1.6	1.3
18:00	1.00	0.8	1.5	1.3
19:00	1.20	0.8	1.5	1.2
20:00	1.50	0.8	1.4	1.1
21:00	1.80	0.7	1.3	1.1
22:00	1.60	0.7	1.2	1.0
23:00	0.90	0.6	0.8	0.6

9 A.M. was selected as the peak increment of time for the purpose of modelling the system under steady state. As the majority of the Town is zoned as residential, this was assumed to create the highest peak flows in the system. Other zonings within the Town received appropriate 9 A.M. peaking factors to model the time of day as accurately as possible.

2.2.3. Existing Population Estimates

2016 Census data was used to populate the model by determining populations for each Census area and cross-referencing these locations with the Town's pump station catchment areas. With this method, pump station catchment area-specific population totals and population densities were estimated. Population densities and corresponding estimated populations are shown in *Table 6*.

Table 6: 2016 Estimated Population Densities and Total Population per Catchment Area

Pump Station	Population Density (Avg People/Dwelling)	Residential Population	ICI Population	Total Population
View Royal Pump Station Net	4.23	2,738	718	3,456
Craigflower Pump Station Net[1]	2.30	1,485	259	1,744
Atkins Pump Station	2.84	1,472	31	1,503
Packers Pump Station	2.95	934	43	977
Helmcken Park Pump Station	2.75	919	19	939
Wilfert Pump Station	2.32	302	515	817
Hospital PS and Flume Chamber	1.93	318	446	764
Helmcken Bay Pump Station Net	2.16	580	121	701
Price Bay Pump Station	2.34	591	84	675
Hallowell Pump Station	1.94	252	106	358
Talcott Pump Station Net	2.93	211	90	301
Midwood Pump Station	2.68	185	0	185
Stoneridge Pump Station	3.04	143	0	143
Heddle Pump Station	2.29	99	0	99
Stewart Pump Station	2.35	73	0	73
Thetis Cove Pump Station	2.21	44	0	44
Glenairlie Pump Station	2.77	36	0	36
Norquay Pump Station	2.36	28	0	28
Total Estimated Population		**10,409**	**2,433**	**12,842**

Notes:
1 – CRD pumping station

While *Table 6* represents the estimated population per dwelling for residential properties, population equivalents were also added to adequately model ICI areas. These were based on factors specific to each Industrial, Commercial and Institutional (ICI) property such as lot area, number of students for schools, and number of beds for Victoria General Hospital. These conversion factors are shown in *Table 7*.

Table 7: ICI Population Equivalent Conversions

Zoning	Population Equivalent
Industrial	25 Population Equivalent (PE)/hectare (ha)
Commercial	60 PE/ha
Institutional (School)	0.1 PE x Number of Students
Institutional (Hospital)	1 PE x Number of Beds
Institutional (Other)	50 PE/ha
RV Park	1 PE x Number of Sites

Multiplying the BSF by the residential population (or ICI population equivalent) and appropriate peaking factor resulted in the Peak Base Sanitary Flow (or Peak Dry Weather Flow (PDWF)) at the peak time of day.

2.2.4. Inflow and Infiltration

Model loads include pump station discharge flow data obtained from the CRD. With some exceptions, the data covers the period from June 2012 to July 2016.

The analysis makes use of I&I calculations completed by the CRD as part of their I&I Management Program and the 2016 Annual Report. The Town of View Royal provides the base data to the CRD on a regular basis, for regional compilation.

The CRD has calculated the 5-year return period I&I rates for municipalities within the region. We have extrapolated this data to also calculate the approximate 100-year return period I&I rate. There is some uncertainty in this estimate and the use of this peak wet weather flow to evaluate system performance is likely conservative; its applicability in the initial steady state models has been discussed with the Town. It has been agreed that, following the outcome of recommended in-stream flow monitoring and I&I estimates resulting from in-stream flow monitoring, the Q_{100} storm suitability can be further evaluated in planned model updates. This is covered in the recommendations section herein, at the end of the report.

The system was analyzed using the 5-year and 100-year peak 1-hour I&I rates. The 5-year I&I rates are used to evaluate pump station capacity while a single pump is operating (or two pumps operating in the case of the triplex station) and to evaluate the flow depth/diameter (d/D) ratio of gravity mains.

The 100-year I&I rates are used to evaluate the potential for overflows from the pump stations with all pumps in operation, and to assess surcharge potential within gravity mains.

The I&I rates are summarized in *Table 8*. The ratio between the 100-year and 5-year I&I rate is reasonably consistent across the individual catchments and is approximately 1.47 on average for all catchments within the Town.

Table 8: I&I Rate Summary

Catchment	Average Pipe Age (Years)[4]	Peak 5-year, 1-Hour I&I Rate (L/ha/day)	Peak 100-year, 1-Hour I&I Rate (L/ha/day)
View Royal Pump Station	32	17,400	25,700
Craigflower (CRD)	31	23,000	33,900
Atkins Pump Station	14	38,300	56,500
Packers Pump Station	24	22,100	30,400
Helmcken Park Pump Station	33	22,900	32,500
Wilfert Pump Station	14	10,000	14,800
Hospital Pump Station[1]	35	10,000	14,800
Helmcken Bay Pump Station	32	18,900	25,300
Price Bay Pump Station	32	47,100	76,200
Hallowell Pump Station	15	31,500	46,500
Talcott Pump Station	13	18,100	27,100
Midwood Pump Station	33	17,800	26,300

Catchment	Average Pipe Age (Years)[4]	Peak 5-year, 1-Hour I&I Rate (L/ha/day)	Peak 100-year, 1-Hour I&I Rate (L/ha/day)
Stoneridge Pump Station[2]	13	18,100	26,700
Heddle Pump Station	32	9,500	14,000
Stewart Pump Station	32	28,700	46,200
Thetis Cove Pump Station[3]	32	23,000	33,900
Glenairlie Pump Station	32	24,500	36,200
Norquay Pump Station	32	10,500	15,500
	Average	**21,744**	**32,361**

Notes:
Flow data and base I&I calculations from the CRD as part of the 2016 I&I Management Program. The data has been extrapolated for additional catchments as required.
1 - I&I analysis did not detect I&I for Hospital catchment. 10,000 L/ha/day has been used for five-year I&I rate (approximate minimum for any other catchment).
2 - Stoneridge Pump Station is within the Talcott Pump Station. The Talcott Pump Station I&I rates have been used.
3 - Thetis Cove Pump Station I&I data is not available. 23,000 L/ha/day has been used for the five-year I&I rate (approximately the average I&I rate of all other catchments).
4 - Pipe age for Glenairlie, Heddle, Norquay and Stewart is thought to be 32 years, Hallowell 15 years, and Stoneridge 13 years.

2.2.5. Peak Wet Weather Flow

Combining the PDWF and I&I (5-year or 100-year per scenario) yields the PWWF, which is the full flow the system must effectively convey and pump. For the remainder of the report, the BSF plus the 5 year I&I will be referenced as the Q_5, while the BSF plus the 100 year I&I will be referenced as the Q_{100}.

2.3. Recommendation Prioritization (Capacity Shortfall Criterion)

Priority in system upgrading recommendations – due to shortfalls in capacity – is based on the predicted depth of surcharge for the mains/manholes and the scenario at which the infrastructure cannot meet the demand. For example, an upgrade will be recommended for a main that cannot meet the existing Q_5 demand before recommending a main that cannot meet the future Q_5 demand, because the latter has more capacity and is not showing issues for the current population.

3. Field Inspections and Testing Outcomes (System Condition Criterion)

3.1. Known Operational Issues

No existing gravity collection system operational issues (i.e.: need for frequent flushing, known system capacity short-falls, etc.) were brought to our attention during this study. The Town's piped collection system is relatively new and largely comprised of PVC pipe. This is contrasted with systems found in other municipalities in the CRD region, where pipe age and material condition is a significant capital planning issue.

3.2. Lift Station Condition Assessment Outcomes

A standard condition assessment form was prepared for the project and pre-circulated to the Town for acceptance. Five major components were identified, namely:

- Civil/structural: wet wells, valve chambers, hatches, etc.
- Pumps and motors.
- Electrical components: starters and controls, etc.
- Back-up power: if permanent, on-site system.
- Mechanical components: valves, and piping.

Field assessments were undertaken in late August 2017.

Data was captured, where available, covering the date of original lift station installation, year of upgrading – if applicable, size and manufacturer of pumps and other equipment, pump capacities, etc. Photographs of particular interest at each station were compiled.

Assessment of each of the above components was made, based on a 4 level 'rating scale':

- Excellent condition — Green colour
- Good condition — Blue colour
- Fair condition — Yellow colour
- Poor condition — Red colour

The following table summarized the outcome of these assessments. Please also refer to *Table 22*, Page 45, which includes the date of last significant retro-fit or upgrading at lift stations.

Table 9: Lift Station Conditions

Lift Station		Civil / Structural	Pumps and Motors	Electrical	Back-up Power	Mechanical
1	View Royal					
2	Atkins					
3	Packers					

	Lift Station	Civil / Structural	Pumps and Motors	Electrical	Back-up Power	Mechanical
4	Helmcken Park	Good	Good	Good	Excellent	Fair
5	Wilfert	Good	Good	Good	Good	Good
6	Hospital	Good	Good	Fair	Excellent	Good
7	Helmcken Bay	Fair	Excellent	Poor	Excellent	Fair
8	Price Bay	N/A - unknown	N/A - unknown	N/A - unknown	N/A - unknown	N/A - unknown
9	Hallowell	Good	Good	Fair	N/A - unknown	Good
10	Talcott	Good	Good	Good	Excellent	Good
11	Midwood	Good	Good	Good	Excellent	Good
12	Stoneridge	Good	Good	Good	N/A - unknown	Fair
13	Heddle	Excellent	Excellent	Excellent	Excellent	Excellent
14	Stewart	Good	Good	Excellent	Excellent	Excellent
15	Thetis Cove	Fair	Fair	Fair	N/A - unknown	Fair
16	Glenairlie	Good	Good	Fair	N/A - unknown	Good
17	Norquay	Fair	Good	Fair	N/A - unknown	Fair

Legend: Excellent, Good, Fair, Poor, N/A - unknown

Note that during the on-site condition assessments, the Price Bay lift station was under construction and therefore, was not assessed.

Thetis Cove is planned for by the Town as next to be upgraded, likely in the year 2020.

Detailed assessment reports are attached as *Appendix B*.

3.3. Pump Station Drawdown Testing Results

Concurrent with pump station condition assessments, a drawdown test was performed at each of the stations. In the interests of expedience, only one pump was tested and, at some stations, the drawdown did not represent one full lag pump cycle but, rather, was achieved through manually operating the pump over a portion of what would normally be the full lag pump operating range. Theoretical pump capacities were also calculated for purposes of results validation/comparison.

Refer to *Table 10*, which shows the pumping station capacity summaries for each station.

Table 10: Pumping Station Capacity Summary

Pump Station	Static Head (m)	Theoretical Capacity (L/s)			Draw Down Estimate (L/s)	2005 MSP Capacity (L/s)
		1 Pump[3]	2 Pumps	3 Pumps	1 Pump[3]	1 Pump
View Royal	11.7[1]	94	137	-	63	90[8]
Atkins[4]	20.5[1]	34	44	-	45	25[8]
Packers	10.6	14	21	-	18	17[8]
Helmcken Park	14.1[2]	28	45	-	33	30[8]
Wilfert	19.9[1]	19	35	-	29	32
Hospital	10.4[2]	34	53	62	26[6]	55
Helmcken Bay	17.0[1,2]	41	50	-	13	21[8]
Price Bay[7]	25.2	20	28	-	-	13[8]
Hallowell	7.1	17	20	-	10	8
Talcott	6.6	16	25	-	10	15[8]
Midwood	0.9[2]	14	20	-	9	11[8]
Stoneridge	10.8	6	7	-	5	10[8]
Heddle	6.9	12	18	-	5[5]	8[8]
Stewart	4.6	8	10	-	1.8[5,9]	7[8]
Thetis Cove	16.8	6	ND	-	5	3[8]
Glenairlie	4.4	13	-	-	9	3[8]
Norquay	13.7	9	12	-	5	3[8]

Notes:
UK – Unknown
ND – No pump curve data
1 – Pump station discharges to CRD main.
2 – Pump has a common forcemain. Capacity is for this pump in operation only.
3 – The one pump capacity is for the Flygt pump if there are different pumps at the station.
4 – 10" impeller Hydromatic pumps – upgraded recently - per the 2005 study recommendations.
5 – Flow rate from Ultrasonic flow meter.
6 – Inflow rate was highly variable during the draw down test.
7 – Price Bay is under construction. No draw down test was completed.
8 – Pump station upgraded since 2005 MSP.
9 – The flow rate at the time of inspection was 0.2 L/s. The Town has since confirmed a flow rate of 1.8 L/s.

3.3.1. Standby Power Discussion

The following four smaller sized pump stations do not have on-site back-up power and, instead, are reliant on the Town to connect their portable generator in the event of a power failure:

- Glenairlie
- Hallowell
- Norquay
- Stoneridge

We have confirmed with the Town it is acceptable for these pump stations to remain without back-up, a scenario wherein the following assumptions and criteria have been applied:

- Power outage at all of the pump stations;
- A 5-year return period I&I event;
- BSF at the average (not peaked) rate as sanitary flows are reduced a power outage with clothes washers, dishwashers and many hot water tanks not functional;
- Assumed 10-minute trip and connection time for portable generator between pump stations;
- It is assumed that both pumps can be manually run to draw down the pump stations;
- The available storage at the pump station is from the minimum level to the overflow level or obvert of the incoming pipe (whichever is lower); and
- Vactor truck availability.

In summary, there is no need for backup gensets at the above locations, on basis of a cost/risk/benefit assessment.

Thetis Cove is slated for a back-up genset in the year 2020, thus the Town's operations staff remain confident they are able to jockey between the remaining 4 stations in event of protracted power failure.

Lastly, we also believe the Town's operational procedure is sufficient to meet the standard municipal operations practice. This said, future modelling should be conducted to determine pump on/off cycle durations at these locations. The results should be compared to the Town's decided ability to operate mobile generators at the above locations in times of power failure.

4. System Modelling

PC-SWMM 2017 Professional 2D was used for the model creation, with files imported from the Town's GIS inventory. Attribute data such as manhole invert elevations and pipe slopes were also extracted from the Town's previous sanitary modelling software, SANSYS, and were supplemented by direct field survey for manholes that were not found in the SANSYS data and as-builts.

An initial model was built with the appropriate geometry and data depicting the Town's existing population and infrastructure conditions. This model was then copied, creating two distinct files, so that the existing Q_5 and Q_{100} storm contributions could be modelled and compared easily. A future model was created that included projected future properties, populations, and land use, based on the future 20-year growth projection. This model was also broken into two separate I&I models, leading to a total of four model files, covering existing and future conditions. I&I rates are kept consistent between the existing and future models with the assumption that the system will continue to be maintained and repairs be made as necessary.

Model geometry was reviewed and suspected errors in the data (e.g. manholes with depths much deeper than the surrounding area, short sections of negative slopes) were modified to match the surrounding infrastructure, as further described in Section 4.2.2.

4.1. Growth Projections

The Town requested we evaluate system operating conditions with both existing and future (20-year) projected populations. In consultation with the Town Planning Department, it was estimated that the population growth over the next 5 years will be approximately 700 people per year. Consistent with the OCP, after the first 5 years, it is believed that growth will then reduce to an annual average growth rate similar to that experienced in recent history (approximately 187 people per year). With these values, an estimated population of 16,900 for 2037 is arrived at, matching the Town's criteria for future anticipated population.

As an alternate means of assessing total short- and long-term future service populations, the Town highlighted locations (probable growth nodes) where future land use changes are expected to occur, incorporating a number of new multi-family or mixed-use residential properties. Information was received for expected number of units or Floor Space Ratios (FSR) for these areas. A range of FSRs were provided (e.g. 1.2 - 1.5) and the lowest value was used to estimate the size of the dwelling during the model build. Using this alternate population projection methodology, the equivalent residential service population sums to 20,488.

A total equivalent service population in the order of 20,500 is suitable for modeling purposes on a catchment by catchment basis, allowing a reasonable margin of safety in system planning and capital projects timing/forecasting. This population is therefore suitable for evaluating capacities on a local or neighbourhood level. By contrast, a total population of 16,900 is entirely appropriate for purposes of OCP application and related bylaws, and suitable for looking at the Town system as a whole.

4.2. Existing Conditions

4.2.1. Existing System

Refer to *Figures 1* and *2*, showing the Town's existing sanitary infrastructure and the existing pump station catchment areas respectively.

4.2.2. Population

Existing cadastral shape files were received from the Town. Once imported into the model, each parcel was assigned a number of dwellings for single family homes and multi-family residences, while the ICI locations calculated equivalent populations based on the lot area or other factors as described in *Section 2.2.1*. The number of dwellings were then multiplied by the catchment-specific population density to yield the total population for that parcel.

Refer to *Figure 3* for the Town's current land use map.

4.2.3. System Age

The Town's sanitary infrastructure ranges from 5 to 46 years old, with the majority of it having been installed between 1971 and 1981. *Figure 4* provides further details on the age of the Town's sanitary sewers.

Sanitary Master Plan

VIEW ROYAL

Legend

Zone

- A-1
- A-3
- C-1
- C-3
- C-4
- C-5
- C-6
- C-7
- C-7A
- C-8
- CD-1
- CD-10 (A)
- CD-10 (B)
- CD-10 (C)
- CD-10 (PARK)
- CD-12
- CD-13
- CD-14
- CD-15
- CD-16
- CD-17
- CD-18
- CD-19 (A)
- CD-19 (B)
- CD-19 (PARK)
- CD-20
- CD-21
- RM-1
- CD-3
- CD-4
- CD-5
- CD-5A
- CD-6
- CD-7
- CD-8 (A)
- CD-8 (B)
- CD-8 (C)
- CD-8 (D)
- CD-8 (E)
- CD-9 (A)
- CD-9 (B)
- CD-9 (C)
- CD-9 (CS)
- CD-9 (D)
- I-1
- LUC BL421
- P-1
- P-2
- P-3
- P-4
- P-5
- P-6
- P-7
- P-8
- R-1
- R-1A
- R-1B
- R-2
- RM-1
- RM-2
- RM-3
- RT-1

Major

Railway

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Zoning Map

Figure 1

Document Path: M:\Proj\2243-17101-00 View Royal\Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 1 - Zoning Map.mxd Author: hshin

Sanitary Master Plan

N

Trans Canada Hwy

Trans Canada Hwy

Stoneridge

Hospital

Talcott

Packers

Helmcken Park

Price Bay

Norquay

View Royal

Midwood

Atkins

Wilfert

Glenairlie

Heddle

Helmcken Bay

Craigflower

Stewart

Thetis Cove

Kosapsum Cres

Craigflower Rd

Hallowell

Legend

- Discharge Point
- Pump Station
- Manholes & Cleanouts
- CRD Gravity Main
- Gravity Main
- Force Main

McElhanney

0 160 320 640 960 (m)

1:15,000

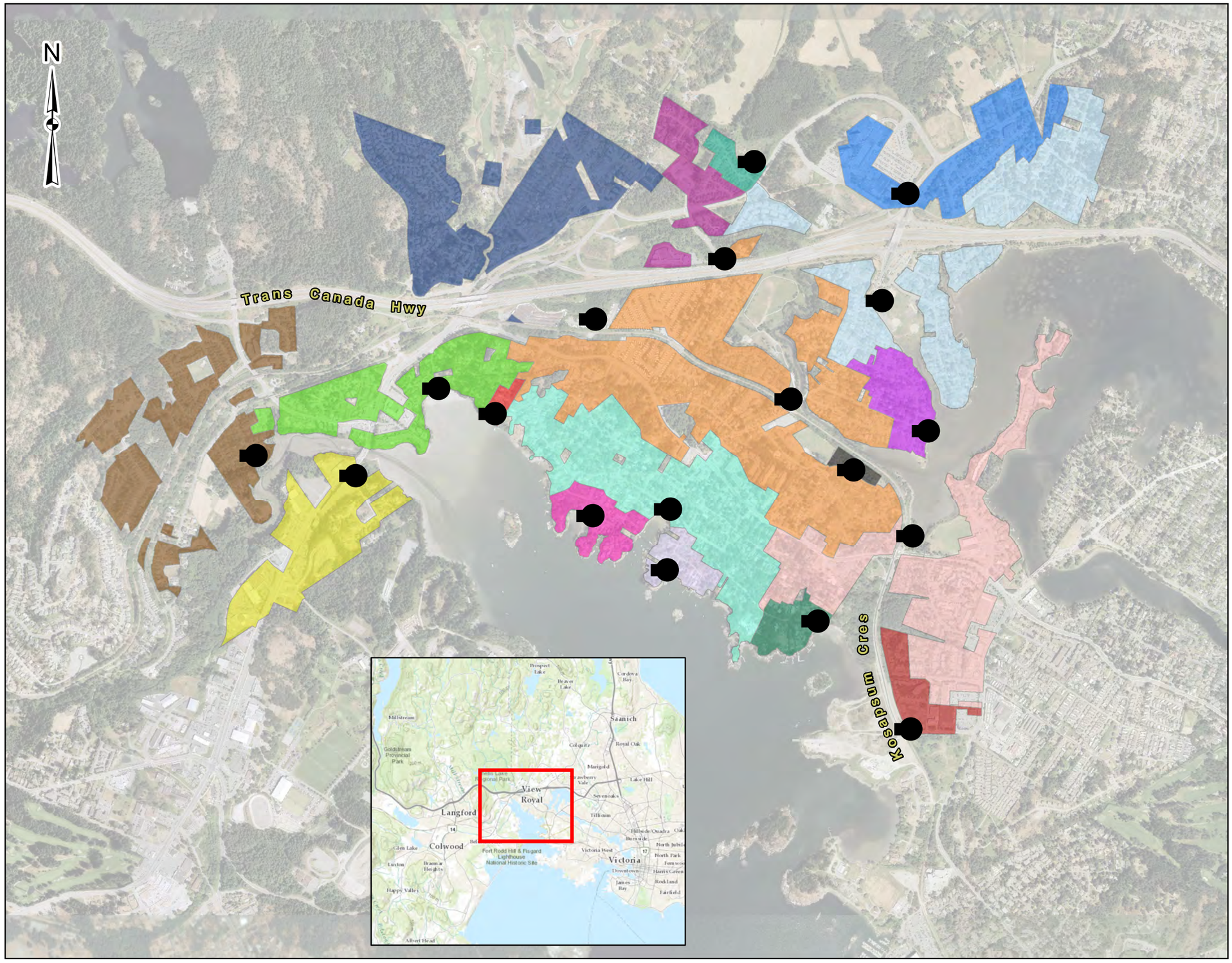
Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Jan 02, 2019

Existing Sanitary System

Figure 2

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 2 - Ex Infrastruct.mxd Author: BRoberts



Sanitary Master Plan

Legend

- Pump Station
- Wilfert
- View Royal Net
- Thetis Cove
- Talcott Net
- Stoneridge
- Stewart
- Price Bay
- Packers
- Norquay
- Midwood
- Hospital
- Helmcken Park
- Helmcken Bay Net
- Heddle
- Hallowell
- Glenairlie
- Craigflower Net
- Atkins

McElhanney

0 160 320 640 960 (m)

1:15,000

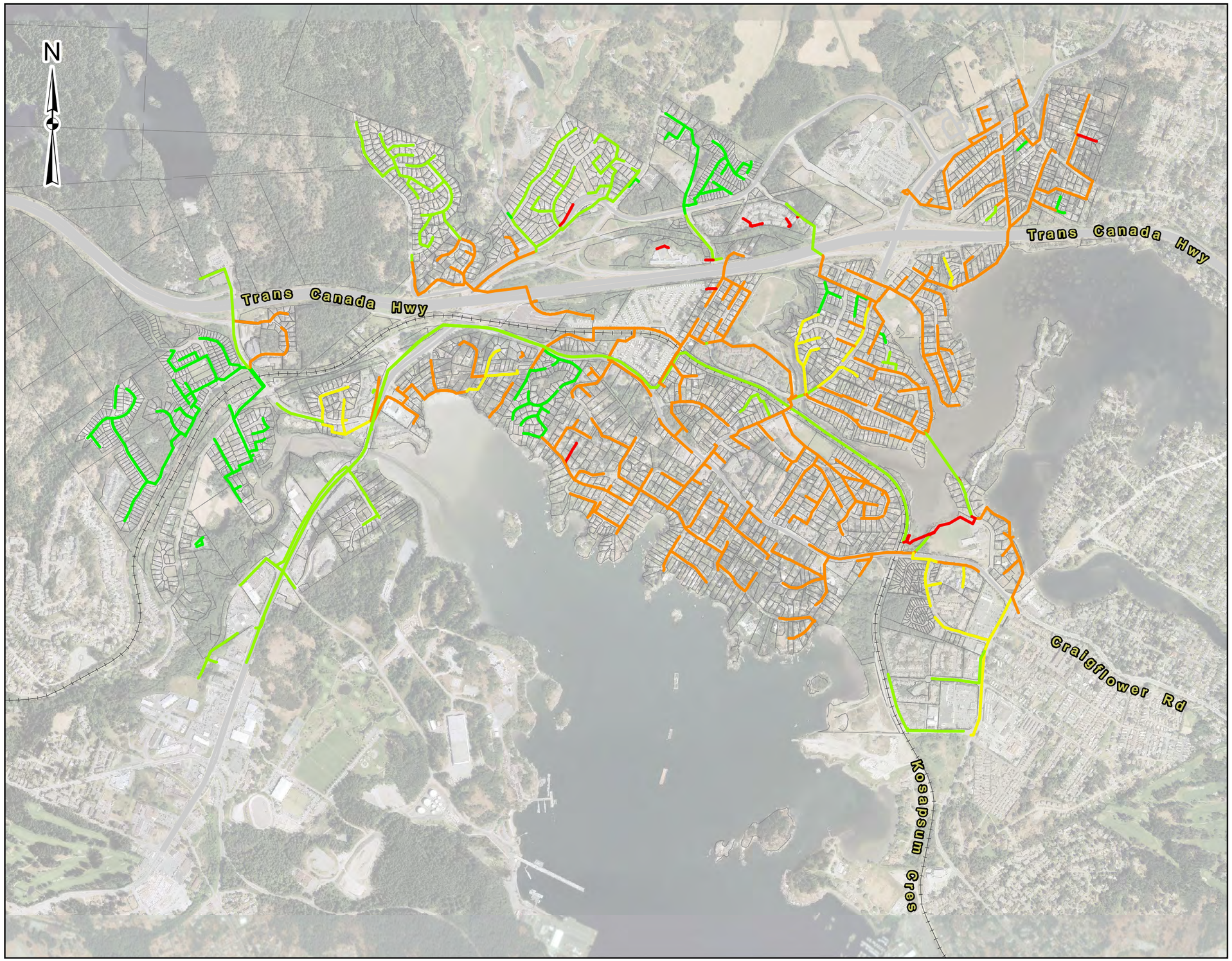
Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Jan 02, 2019

Pump Station Catchment Areas

Figure 3

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 3 - Existing PS Catch Areas.mxd Author: BRoberts



Sanitary Master Plan

Legend

Year of Install

- Unknown
- 1971 - 1981
- 1982 - 1991
- 1992 - 2002
- 2003 - 2012

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Age of Sanitary Sewers

Figure 4

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 4 - Age of Sanitary Sewers.mxd Author: hshin

4.3. Future Conditions

A future land use shape file was received from the Town in modifying the model for future conditions. Zonings were changed for some existing properties and new parcels were added in some areas as per the future land use file. Number of units and building sizes were estimated as described in Section 3.3 in finalizing the future demands. Refer to *Appendix C* for the Town's future land use map.

No changes were made to the rest of the system and the I&I rates were kept the same as with the existing model as described in Section 4. Overall, I&I demands at some pump stations increased due to increased land uses.

4.4. Assumptions and Limitations

Since this is a steady state model, the system was evaluated for peak flow conditions during a typical day (e.g. at 9 A.M.) which provided the PDWF demands, as described in Section 2.2.1. I&I loads were also assumed continuous throughout the model run. Using this method provides the most conservative evaluation of the system's performance but does not allow for daily patterns to be evaluated, which would provide a better understanding of the system's performance as a whole. This would also give more insight into the operation of the pump stations and surface level fluctuations within the wet wells. Refinement of the models is possible, and an extended period simulation is recommended at the end of this report.

4.5. Model Validation

Model outputs during PDWFs were compared to estimated peak flows - as extracted from flow monitoring data available for each pump station.

Table 11 shows the modelled and monitored PDWF values and the percent difference for flows entering each pump station.

Table 11: Modelled and Monitored PDWF for each Pump Station

		Peak BSF (L/s)		
Pump Station	**Contributing Areas**	**Modelled**	**Monitored**	**Difference[1]**
View Royal	Price Bay, Norquay, Helmcken Bay, Glenairlie	41.26	14.00	99%
Atkins		13.35	7.70	54%
Packers		7.06	8.50	-19%
Helmcken Park		6.96	4.00	54%
Wilfert		3.27	1.30	86%
Hospital		15.9	15.50	3%
Helmcken Bay	Heddle, Stewart, Helmcken Bay	7.17	3.00	82%
Price Bay		6.52	4.20	43%
Hallowell		2.03	3.20	-45%

Pump Station	Contributing Areas	Peak BSF (L/s)		
		Modelled	Monitored	Difference[1]
Talcott	Stoneridge	6.36	1.65	118%
Midwood		1.36	0.80	52%
Stoneridge		1.04	No Info	N/A
Heddle		0.72	0.80	-11%
Stewart		0.56	0.38	38%
Thetis Cove		0.35	No Info	N/A
Glenairlie		0.26	0.35	-30%
Norquay		0.23	0.21	9%

Notes:
1 - Percent difference calculated as: (Modelled – Monitored)/Average of the Two

Ideally, the difference between modelled and monitored BSF is within 10%. However, for View Royal, this is not reasonable due to the small size of many of the Town's pump stations. This should be a focus in future model updates.

For the Atkins pump station, an increased flow was expected here compared to flow monitoring data as the full Thetis Vale development area (including phases 6 and 7 expected to be built out soon) has been included in the existing model, but areas above this will remain undeveloped. Therefore, it was decided to include this area in the existing model as opposed to the 20-year future model.

For Helmcken Bay, Talcott, and View Royal, the excessive flows in the model are believed to be due to the effects of the upstream pump stations discharging into these pump stations. As some contributing pump stations to these locations operate with VFDs, they may be operating at lower outputs than currently used in the model. Since the model currently operates all pumps at maximum outputs, the maximum discharge output may be larger than in reality. Extended period simulations, taking into account the operations of the VFDs would help to clarify these discrepancies, as is recommended at the end of this report.

The model calculations were also validated by comparing model results with calculated expected results. This was done by running the model at the following scenarios:

- PDWF
- 5 year I&I only
- 100 year I&I
- PWWF based on the 5-year I&I (Q_5)

The outputs of the model were then compared to the expected calculated values, with all pump stations except for Helmcken Bay, Talcott, and View Royal showing differences of less than 3%. The higher flows for these three stations was again assumed to be due to the effects of upstream pump stations discharging at higher rates than their inflows. Based on the foregoing assessments, we are comfortable the model reasonably reflects current operating conditions.

A detailed table showing all of these comparisons can be found in *Appendix D.*

Further refinement and model calibration should be undertaken when future flow data becomes available:

- Future pump station data
- Drawdown tests
- In-stream flow monitoring
- Continuous simulation

5. Results

Refer to *Appendix E* for detailed model output covering the existing and future conditions as analyzed, and the following recommended infrastructure upgrades. Only results for areas of concern are shown.

Note that junctions at upstream and downstream ends of each force main will be 'red' in the results figures below, signifying that they are surcharging. This is due to the junctions being connected to the pressure sewer and is to be expected (no actual surcharges occur). Red junctions not connected to force mains are gravity manholes and are the areas of surcharging concern.

5.1. Gravity Pipe Network

5.1.1. Existing Conditions

Q_5 (PDWF with 5 Year Storm I&I)

Figure 5 shows the model results for the Q_5 with an existing population; the three locations within View Royal where the existing Q_5 results in surcharging at the junctions are boxed in red. *Table 12* outlines each area of concern, describing approximate location, main issue, and the effect it has on the surrounding infrastructure.

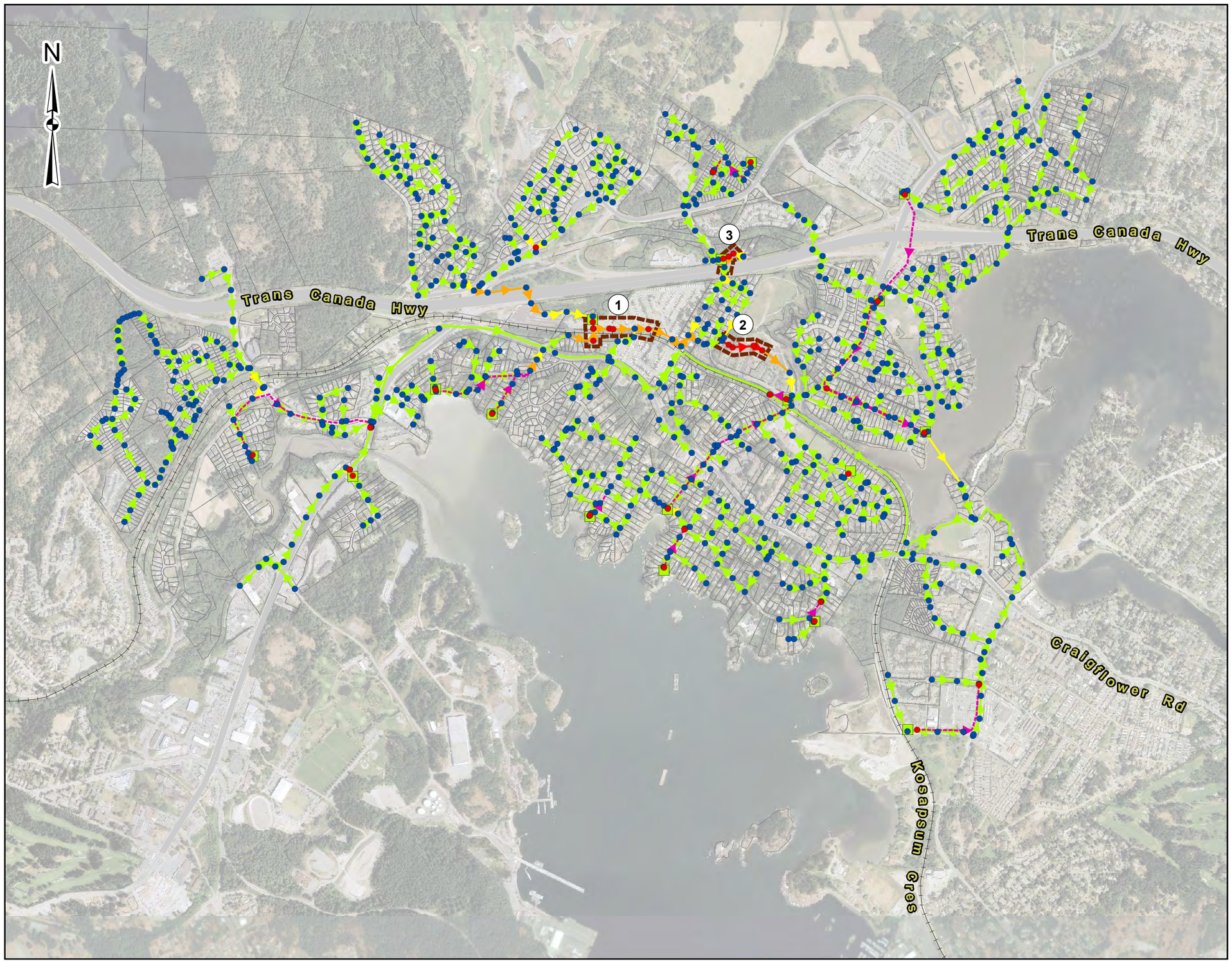
Table 12: Model Results for Existing Q_5

Map Location	Approximate Location	Issue	Number of Pipe Segments 100% Full	Number of Manholes Surcharging	Theoretical Maximum Surcharge Depth (m)	Surcharge Freeboard from Manhole Rim (m)[1]
1	Fort Victoria RV Park, north of E&N Rail Trail	Low slopes	1	4	0.31	1.08
2	Border of View Royal Park and Helmcken Meadows/Pheasant Meadows townhomes	Low slopes	4	4	0.54	2.36
3	Talcott Road, downstream of Talcott Pump Station	Low slopes Undersized main	1	2	4.35	0

Notes:
1 – Surcharge depth to connected developments along mains of concern should also be checked. Direct field surveys recommended to establish Minimum Building Elevations (MBE).

Note that the surcharging manholes should all be surveyed, so accurate rim to invert depths, as well as freeboard can be confirmed. This applies to *Tables 12 to 15.*

At Location 1, the capacity issues stem from low pipe slopes in several pipe segments. One segment has a slope of 0%, while others are near 0%. Note that manhole VRMH000000000000144A had no invert elevation within the GIS data provided and could not be accessed in the field so an invert elevation was estimated based on upstream and downstream grades. The sewer discharging into this manhole is one of the areas of concern. A detailed assessment of the invert elevations along this main should be conducted – and this data then inputted into updated models. In addition, MHFEs should be checked against anticipated surcharge surface elevations. These two future work elements are included in the recommendations section which follows.



Sanitary Master Plan

VIEW ROYAL

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

Areas of Concern (1)

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Model Results - Existing Population with 5 Year I&I

Figure 5

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 5 - Model Result - Ex 5.mxd Author: hshin

A similar issue is noted for Location 2, with slopes varying from 0.29% to 2.26%. Invert elevations for two manholes must be confirmed (via survey), as these were missing from the GIS data. However, the constant slope between the known upstream and downstream inverts resulted in a slope of 0.36%, which is higher than the lowest slope along this segment. This would be of relevance to surcharge calculations for this segment.

For Location 3, the force main from the Talcott pump station discharges to a 150mm gravity main at manhole VRMH0000000000000156. Due to the low slope and size of this gravity sewer, low capacity results in surcharging of this manhole.

Note that for Locations 1 and 3, both areas are downstream of a pump station. For steady state modelling purposes, maximum flow outputs from the pumps are being utilized, which leads to approximately double the outflow from the pump station when compared to the inflow.

The Packers and Talcott pump stations are not fitted with a Variable-Frequency Drive (VFD). With VFDs, station output peak flows would typically be reduced. With VFDs, surcharges in the areas described above are still expected to occur but may not be as severe (maximum surcharge depth for Location 3 reduces to 0.45m and is 0.78m from the rim).

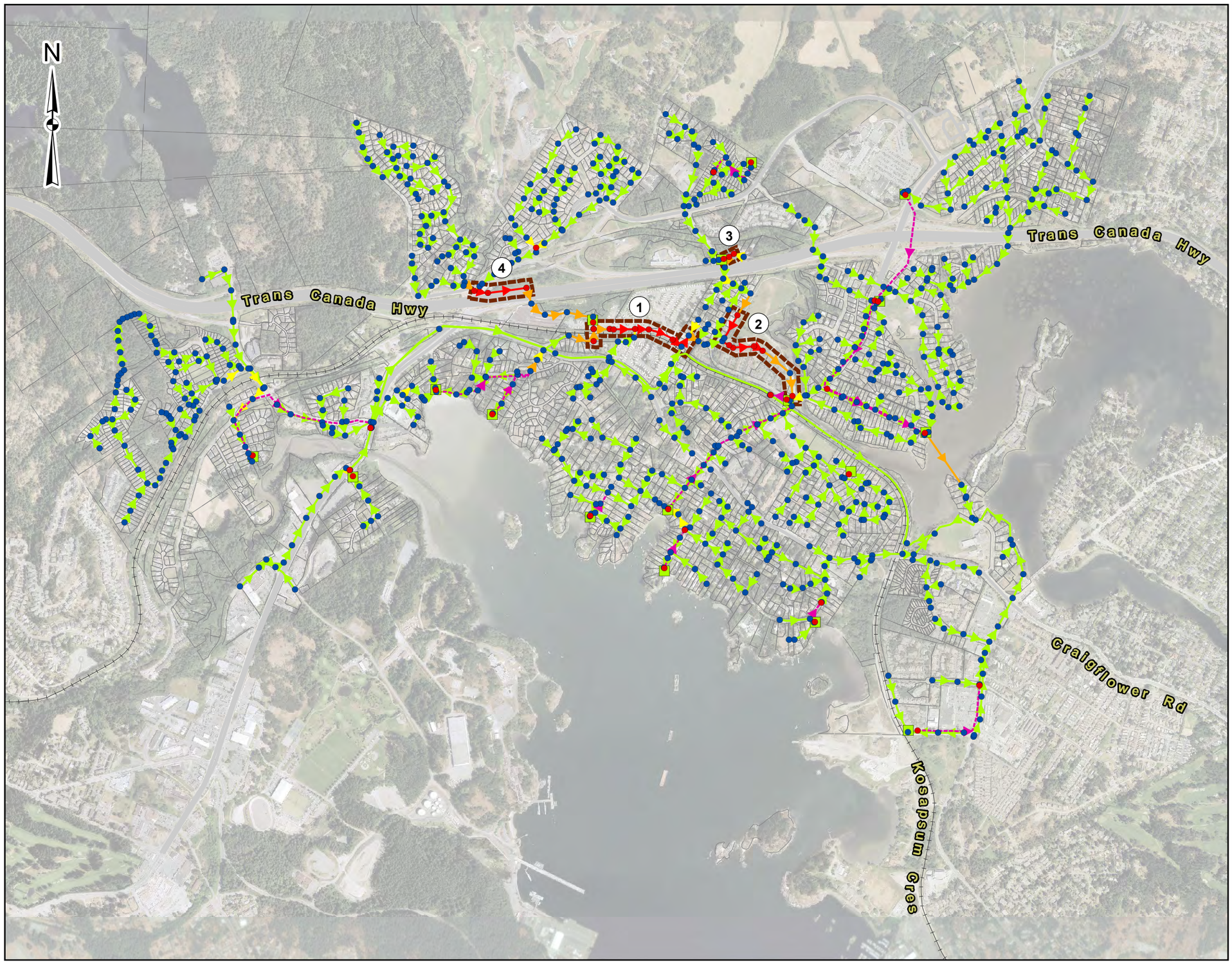
Q_{100} (PDWF with 100 Year Storm I&I)

Refer to *Figure 6* which shows the model results for the Q_{100} with an existing population. There are four locations within View Royal where the existing Q_{100} results in surcharging at the junctions, boxed in red in *Figure 6*. Note that the first three are the same areas described for Q_5. *Table 13* outlines each area of concern, describing the approximate location, the main issue, and the effect it has on the surrounding infrastructure.

Table 13: Model Results for Existing Q_{100}

Map Location	Approximate Location	Issue	Number of Pipe Segments 100% Full	Number of Manholes Surcharging	Theoretical Maximum Surcharge Depth (m)	Surcharge Freeboard from Manhole Rim (m)
1	Fort Victoria RV Park, north of E&N Rail Trail	Low slopes	6	7	1.60	0
2	Border of View Royal Park and Helmcken Meadows / Pheasant Meadows Townhomes	Low slopes	4	6	0.83	2.02
3	Talcott Road, downstream of Talcott Pump Station	Low slopes Undersized main	1	2	4.50	0
4	North of “Adam’s Storage View Royal”	Undersized main	2	3	1.29	0.13

Location 4 is also noted to include low slopes in areas, with the lowest slope being 0.09%, while all others in the area range from 0.26% to 0.40%. Since capacity issues are only noted for the Q_{100} at this location, monitoring is recommended here as opposed to an upgrade.



Sanitary Master Plan

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

Areas of Concern (1)

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Model Results - Existing Population with 100 Year I&I

Figure 6

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 6 - Model Result - Ex 100.mxd Author: hshin

5.1.2. Future Conditions (20 Year Horizon)

Q_5 (PDWF with 5 Year Storm I&I)

Refer to *Figure 7* which shows the model results for the Q_5 with the projected future population.

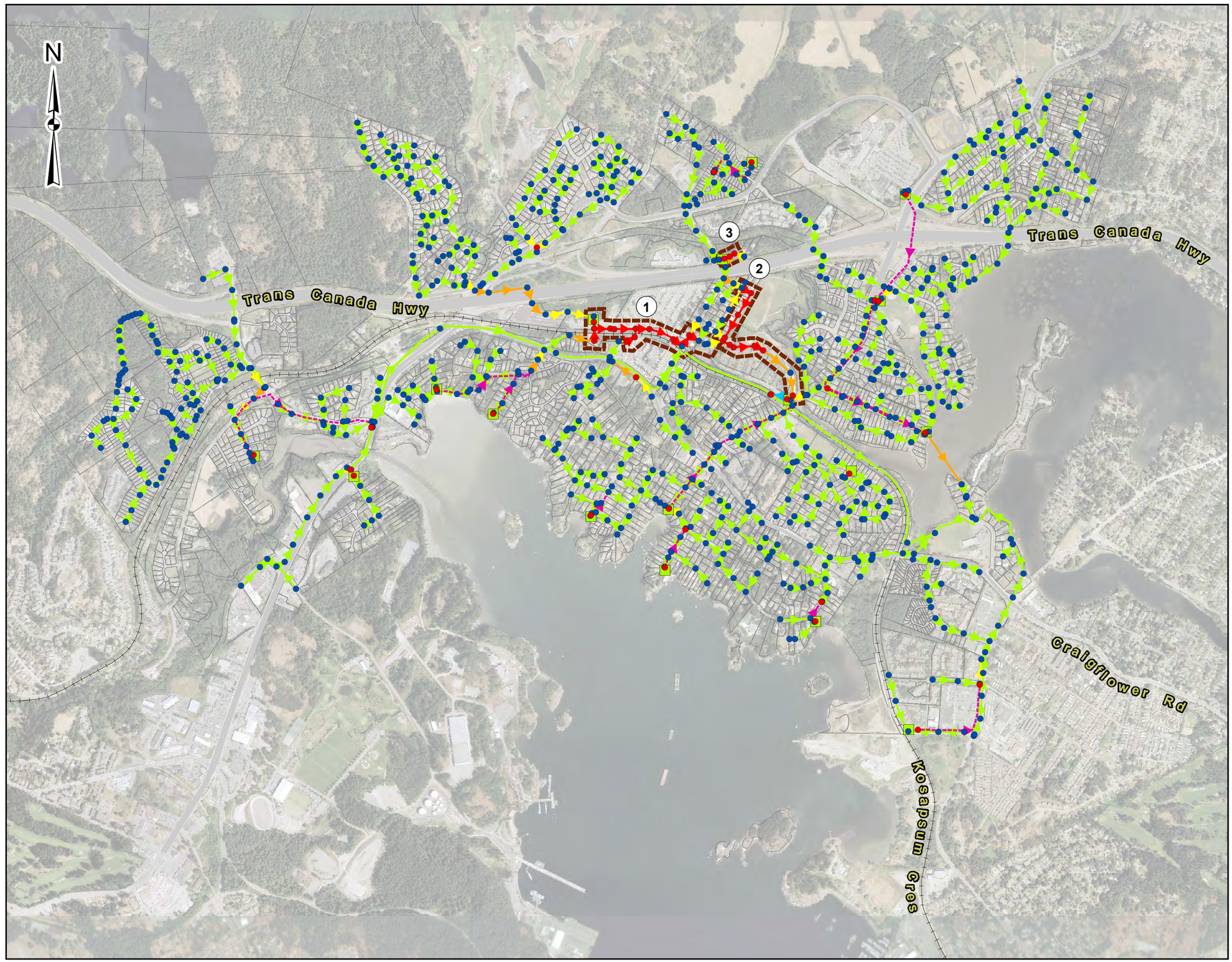
The same three areas are subject to issues as with the existing Q_5; however, the effects will be exacerbated due to the additional loadings. *Table 14* outlines each area of concern, describing the approximate location, the main issue, and the effect it has on the surrounding infrastructure.

Table 14: Model Results for Future Q5

Map Location	Approximate Location	Issue	Number of Pipe Segments 100% Full	Number of Manholes Surcharging	Theoretical Maximum Surcharge Depth (m)	Surcharge Freeboard from Manhole Rim (m)
1	Fort Victoria RV Park, north of E&N Rail Trail	Low slopes	9	10	5.27	0
2	Border of View Royal Park and Helmcken Meadows / Pheasant Meadows Townhomes	Low slopes	6	9	3.18	0
3	Talcott Road, downstream of Talcott Pump Station	Low slopes Undersized main	1	2	4.54	0

Table 14 reveals that all surcharges now reach the manhole rim and pose flooding concerns under the future Q_5 storm.

Sanitary Master Plan



Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

Areas of Concern (1)

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Model Results - Future Population with 5 Year I&I

Figure 7

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 7 - Model Result - FUT 5.mxd Author: hshin

Q_{100} (PDWF with 100 Year Storm I&I)

Refer to *Figure 8* which shows the model results for the Q_{100} with the projected future population.

The same four areas are flagged as problematic as with the existing Q_{100}; however, the effects have again been exacerbated due to the additional loading as with the Q_5. *Table 15* outlines each area of concern, describing the approximate location, the main issue, and the effect it has on the surrounding infrastructure.

Table 15: Model Results for Future Q_{100}

Map Location	Approximate Location	Issue	Number of Pipe Segments 100% Full	Number of Manholes Surcharging	Theoretical Maximum Surcharge Depth (m)	Surcharge Freeboard from Manhole Rim (m)
1	Fort Victoria RV Park, north of E&N Rail Trail	Low slopes	9	10	5.85	0
2	Border of View Royal Park and Helmcken Meadows / Pheasant Meadows Townhomes	Low slopes	6	9	4.55	0
3	Talcott Road, downstream of Talcott Pump Station	Low slopes Undersized main	1	2	4.79	0
4	North of “Adam’s Storage View Royal”	Undersized main	2	3	1.29	0.13

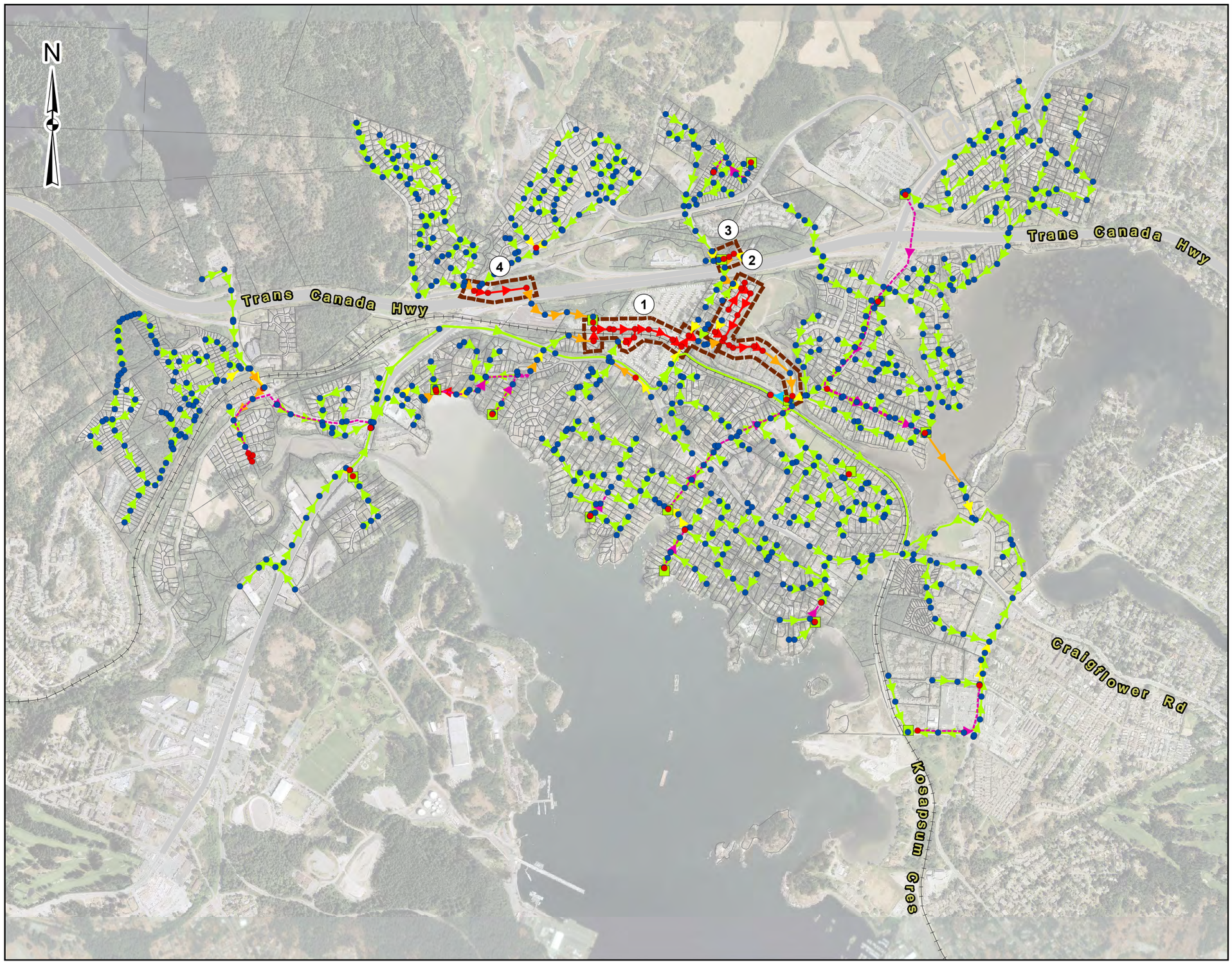
5.1.3. Other Minor Infrastructure Issues

Monitor only

Aside from the major issues described above, there are three areas of lesser concern that should be noted, as they result in minor surcharges in the system. Refer to *Figure 9* which shows these locations.

Firstly, according to the GIS data in the model, a negative slope is believed to exist downstream of Creed Road and Watkiss Way, which results in pooling in manhole VRMH0000000000000500. This is likely not problematic in reality, since the maximum surcharge depth under Future Q_{100} is indicated to be only 0.12m, leaving more than 2m from the modeled HGL surface, up to the rim of the manhole. This area is marked as Location 5 in the figure.

Secondly, at Location 6, along Island Highway, between Burnett Road and Prince Robert Drive, minor surcharging is expected to occur under both the future Q_5 and Q_{100} due to a low slope in main VRMH0000000000000166X. At Manhole VRMH0000000000000166, the max surcharge depth is again low at 0.18m for the Q_{100} event, leaving more than 1.5m from the HGL up to the rim of the manhole.



Sanitary Master Plan

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

Areas of Concern (1)

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Model Results - Future Population with 100 Year I&I

Figure 8

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 8 - Model Result - FUT 100.mxd Author: hshin

Note: Locations 5,6,7 are recommended for on-going monitoring only

N

Trans Canada Hwy

Trans Canada Hwy

Craigflower Rd

Kosapsum Cres

5

6

7

Sanitary Master Plan

VIEW ROYAL

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

Areas of Concern (1)

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Jan 03, 2019

Model Results - Future Population with 100 Year I&I - Minor Infrastructure Issues

Figure 9

Author: BRoberts

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 9 - Model Result Minor Infra - FUT 100.mxd

Finally, minor surcharging occurs at Location 7, at manhole VRMH0000000000000753, located northwest of Six Mile Road and Atkins Road, during the future Q_{100} event. Maximum surcharge here is 0.01m and the expected HGL is more than 2.5m below the rim of the manhole; thus, very unlikely to be an operational issue worthy of attention.

Since each of these issues pose minimal threat of flooding or other negative effects to the surrounding system, they are **not** addressed in the upgrades section of the report which follows.

5.2. Pumping Stations and Pressure Sewers

5.2.1. Existing Conditions

Table 16 provides a summary of the pump station inflows and outflows under existing conditions. The models indicate all pump stations can convey both the existing Q_5 and Q_{100} loading with one pump operating as shown.

Table 16: Pump Station Inflows and Outflows for Q_5 and Q_{100} under Existing Development Conditions

	Q_5		Q_{100}	
Pump Station	**Max Total Inflow (L/s)**	**Max Outflow (L/s)**	**Max Total Inflow (L/s)**	**Max Outflow (L/s)**
View Royal	85.25	99	98.78	99
Atkins	25.46	35.89	31.21	35.97
Packers	16.14	16.14	19.54	29.72
Helmcken Park	16.48	50	20.47	53.7
Wilfert	5.52	9.26	6.6	9.27
Hospital	22.07	47.48	22.65	60
Helmcken Bay	20.2	26.15	24.91	26.66
Price Bay	16.73	24.36	23.04	23.04
Hallowell	4.18	34.7	5.2	34.7
Talcott	9.37	9.37	10.94	27.26
Midwood	3.05	16.78	3.86	16.75
Stoneridge	1.57	7.94	1.82	7.93
Heddle	1.39	10.38	1.71	10.07
Stewart	1.99	9.15	2.86	9.16
Thetis Cove	1.56	6.28	2.13	6.29
Glenairlie	0.64	15.15	0.81	15.16
Norquay	0.41	8.83	0.49	8.29

The maximum outflow values noted in *Tables 10 and 16* differ to some extent. A focus of future model updates should be in calibrating between these sets of values. In-stream monitoring will assist in this regard.

Although Price Bay and View Royal appear to be pumping at or near their maximum capacity for the Q_{100}, this is based on one pump operating during the expected PWWF. Therefore, these specific stations are expected to be able to meet the existing condition Q_{100} demand as the lag pump would be triggered and inflows would eventually reduce after the peak flow is reached. As steady-state modeling was used under this study to model peak flow conditions, continuous operation of the station - characterizing the cycling the pumps - was not assessed. An extended period simulation would be required to more accurately predict the operation of each station. This is recommended at the end of the report. Further investigation should also be completed to confirm flows for View Royal, Talcott, Norquay, and Helmcken Bay.

The modeled force main velocities from each pump station are shown in *Table 17*.

Table 17: Force Main Velocities for Q_5 and Q_{100} under Existing Development Conditions

Pump Station	Q_5 Max Velocity (m/s)	Q_{100} Max Velocity (m/s)
View Royal	2.50	2.55
Atkins	1.14	1.15
Packers	0.91	1.68
Helmcken Park	2.83	3.04
Wilfert	2.09	2.10
Hospital	0.96	1.23
Helmcken Bay	1.88	1.86
Price Bay	1.59	1.30
Hallowell	1.32	1.31
Talcott	0.86	2.11
Midwood	3.80	3.79
Stoneridge	1.02	1.02
Heddle	2.38	2.28
Stewart	2.07	2.07
Thetis Cove	1.42	1.42
Glenairlie	3.88	3.83
Norquay	1.23	1.06

Table 17 reveals that all force mains meet the minimum required velocity of 0.75 m/s under both I&I scenarios, while Glenairlie and Midwood have maximum velocities slightly over 3 m/s for both scenarios, and Helmcken Park has a maximum velocity greater than 3 m/s for the Q_{100}. Since the velocities are only marginally larger than the deemed maximum velocity and their respective pump stations can easily meet the higher frictional losses during peak inflow loading, no pressure sewer upgrades are required. For future model refinement, confirmation of anomalous drawdown tests versus modelled flow rates is recommended. If velocities remain high after the model adjustments, changes to some of the pumps may be recommended.

5.2.2. Future Development Conditions

Table 18 shows that all pump stations can meet the demand for the future Q_5 storm scenario; however, the future Q_{100} storm event scenario results in the Atkins and Price Bay pump stations not being able to keep up with the resulting increased PWWF load. Although the differences between maximum inflow and outflow rates are minimal, the Atkins wet well depth increases by over a metre during the peak hour, but the water depth is still expected to be 3.7m below the top of the well. Price Bay's depth increase is not projected to be as severe, rising by 0.5m over the peak hour, reaching approximately 4.9m below the top of the well, worst case.

Table 18: Pump Station Inflows and Outflows for Q_5 and Q_{100} under Future Development Conditions

	Q_5		Q_{100}	
Pump Station	**Max. Total Inflow (L/s)**	**Max. Outflow (L/s)**	**Max. Total Inflow (L/s)**	**Max. Outflow (L/s)**
View Royal	159.05	185.71	166.37	185.08
Atkins	42.19	45.58	50.86	50.7
Packers	16.14	29.72	19.54	29.51
Helmcken Park	21.05	54.7	25.27	54.79
Wilfert	8	9.31	9.31	9.33
Hospital	27.37	60	28.39	60
Helmcken Bay	21.41	26.33	26.07	26.98
Price Bay	17.52	24.4	24.12	24.01
Hallowell	8.92	34.7	10.47	34.7
Talcott	14.41	27.62	16.56	27.76
Midwood	3.05	16.73	3.86	16.69
Stoneridge	1.57	7.94	1.82	7.93
Heddle	1.39	10.39	1.71	10.07
Stewart	1.99	9.15	2.86	9.16
Thetis Cove	1.56	6.28	2.13	6.29
Glenairlie	0.64	15.15	0.81	15.16
Norquay	0.41	8.83	0.49	8.29

As per the existing conditions scenario above, maximum outflow values in *Tables 10 and 18* should be compared for purposes of future model updates.

Force main velocities from each pump station are shown in *Table 19*.

Table 19: Force Main Velocities for Q_5 and Q_{100} under Future Development Conditions

Pump Station	Q_5 Max Velocity (m/s)	Q_{100} Max Velocity (m/s)	Pump Station	Q_5 Max Velocity (m/s)	Q_{100} Max Velocity (m/s)
View Royal	4.21	4.24	Talcott	2.05	1.96
Atkins	1.45	1.64	Midwood	3.79	3.78
Packers	1.68	1.67	Stoneridge	1.02	1.02
Helmcken Park	3.10	3.10	Heddle	2.39	2.28
Wilfert	2.11	2.11	Stewart	2.07	2.07
Hospital	1.23	1.23	Thetis Cove	1.42	1.42
Helmcken Bay	1.87	1.85	Glenairlie	3.88	3.84
Price Bay	1.59	1.36	Norquay	1.22	1.06
Hallowell	1.285	1.27			

As with the existing development conditions scenario models, all force mains meet the minimum required velocity of 0.75 m/s under both I&I scenarios, while Glenairlie, Helmcken Park, Midwood and View Royal have maximum velocities slightly over 3 m/s for both scenarios. As was concluded for the existing conditions, if these velocities do not translate to operational concerns, no upgrades are necessary. This has been confirmed to be the case, through discussions with Town operation staff.

If future pump upgrades are deemed necessary after additional modeling/analysis, maximum pressure sewer velocities described above will need to be revisited, and VFD units should be considered.

Recall that Q_{100} flows have been extrapolated and further in-stream monitoring, model calibration and continuous simulation modelling is recommended before upgrades based on the Q_{100} take place.

5.3. Observed Capacity Shortfalls

No observed capacity shortfalls have been presented by the Town, based on past operations. In other words, during peak rainfall and high sewage loading experienced in the recent past, there have been no reports of sewer surcharging causing backups or flooding.

5.4. Flows Entering CRD System

Analysis completed also provides the total sewage discharged from the Town to the CRD system and resulting increases due to projected population growth. *Table 20* provides the model results for total flows to the CRD system and the peak discharge rates that View Royal is permitted to discharge into the CRD system as outlined in *CRD Bylaw No. 2312, Dwg. No. 8-S184-1, February 6, 2005*.

The Town should consider how growth will impact the CRD allotment and be aware of the possible need to negotiate adjustments to this agreement.

Table 20: Comparison of Total Existing and Future Maximum Flows

	Existing Max. Flow (L/s)		Future Max. Flow (L/s)	
Discharging Pump Station	**Q_5**	**Q_{100}**	**Q_5**	**Q_{100}**
View Royal + Helmcken Bay	122.89	125.42	206.48	208.06
Craigflower (Total flow from the Town)	211.28	250.06	299.75	342.85
Atkins	35.89	35.97	45.58	50.7
Wilfert	9.26	9.27	9.31	9.33
Shoreline Trunk	11.70	14.32	17.77	21.00
CRD Infrastructure	**Current Allocation (L/s)**		**Future Allocation (L/s)**	
Craigflower Pump Station	173		274	
Shoreline Trunk	10		25	

Notes:

In reviewing the Bylaw, the allocation values above are totals (i.e. for the future allocation VR is not permitted to discharge more than 274 L/s in total since the Shoreline Trunk contributes to the Craigflower Pump Station.

The above results are based on the steady-state model. This model assumes that all of the pump stations are 'on' simultaneously. For the Town, which has a large number of pump stations relative to the population, this likely significantly over estimates the total peak flow to the CRD system. In order to evaluate the flows in relation to the current and future allocation amounts, an extended period model simulation over a number of days is required.

Calibration of the model using in-stream data and continuous flow monitoring data (as is recommended herein) will help to determine if the model outputs (particularly the I&I component of the peak flows) are in fact producing excessive inflows to the CRD trunk. At such point, discussions with the CRD will need to occur, detailing the excessive flows.

6. Recommended Upgrades

The following recommended system upgrades, to address capacity shortfalls, are based on the steady-state models prepared to date. Estimates of cost for these recommended capital projects have been provided in Section 7 which follows. The intent here is to provide a defensible basis for DCC bylaw updating, being undertaken concurrent with this study. Following the recommended in-stream flow monitoring and upgraded 'continuous simulation' computer modeling, the capacity related capital projects list should be revisited. This process of model updating (as more refined input data is made available and as needed to reflect on-going changes to the system), and the resulting 5-year capital plan project list refinement, is not an uncommon practise. DCC bylaw project list updates and associated cost estimates that might be warranted on this basis, should be completed roughly every 3 years.

6.1. Capacity Shortfall

6.1.1. Gravity Mains

As seen in *Table 12* in *Section 5.1.1*, there are three key locations where upgrades are required. Note that for Locations 1 and 2, surcharge depths do not reach the manhole rim; however, backwater effect into directly connected development can be a problem in areas with low Minimum Building Elevations (MBEs). Furthermore, Location 3 also does not reach the ground surface if flow discharges are reduced from the Talcott pump station. Investigation into the benefit of a VFD at the Talcott pump station should take place to further determine the extent of upgrade requirements.

Due to the maximum surcharge depth at Location 1 being significant and Location 3 reaching the surface in the Q_5, these two locations are recommended as the two highest priority upgrades. These should be included in the Town's 5-year Capital Projects Plan. All three locations show significant surcharging when subjected to the future Q_5 loading scenario and thus all should be addressed over the next 20 years.

Location 2 only shows significant surcharging in the **future**, and therefore should be addressed in the 20-Year Capital Plan. Furthermore, Location 4 is indicated as having surcharging concerns during both existing $\mathbf{Q_{100}}$ and future $\mathbf{Q_{100}}$ only. While this should be flagged and recommended as the next location to be addressed, further deliberation is needed, after in-stream monitoring is concluded; to determine whether this should be included in the 20-Year Capital Plan.

Refer to *Figure 10*, which highlights the upgrade locations and describes the recommended upgrades for gravity mains.

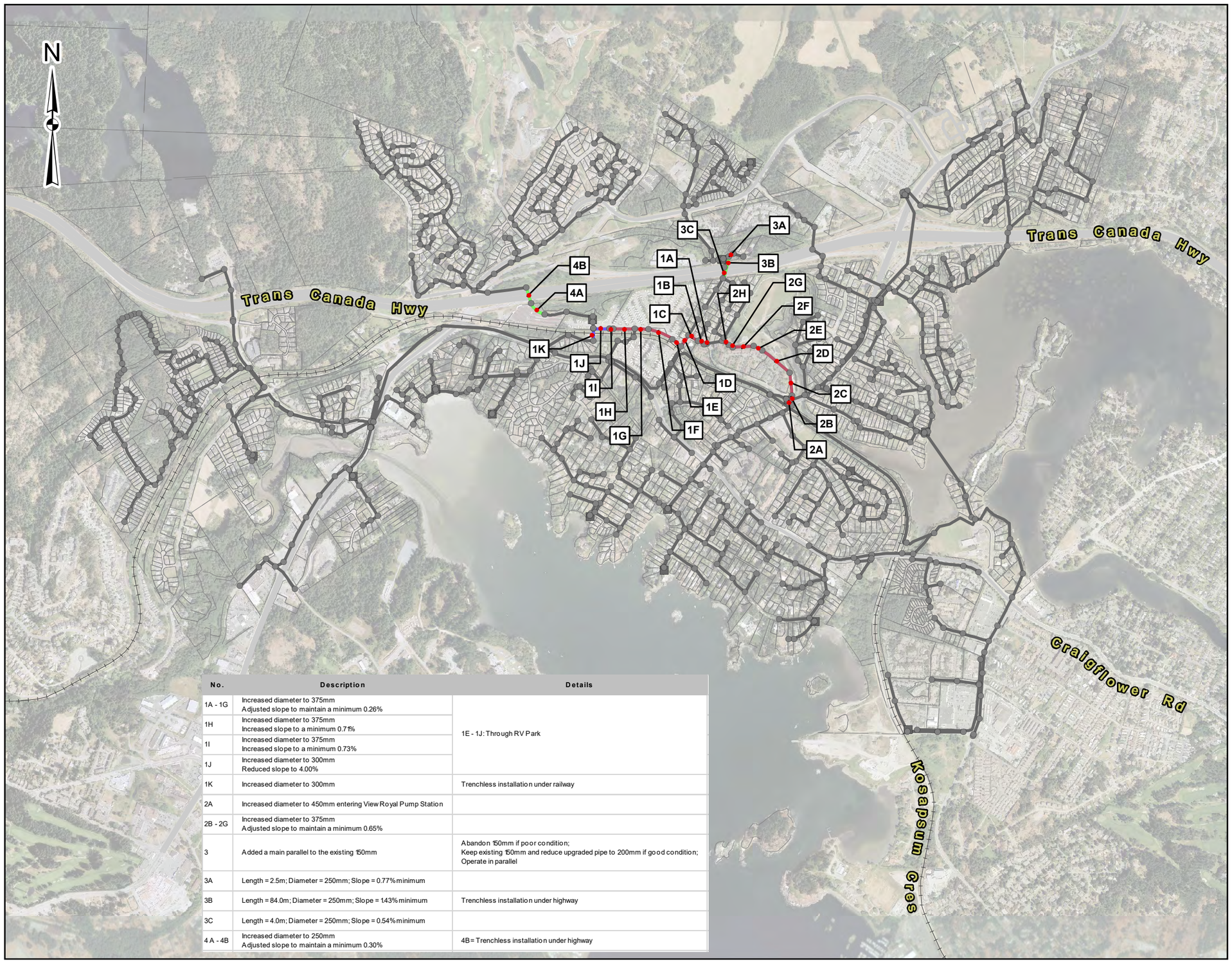
Locations 1,3,4 all have a segment of sewer that will require trenchless installation, as Location 1 requires upgrades underneath the railway and Location 3 and 4 requires upgrades that pass under Highway 1. These construction aspects have been highlighted and accounted for in the detailed cost estimates in *Appendix F.*

Note that all upgrades meet the MMCD's design guidelines for pipe capacity for the future Q_5, except the incoming 450mm main to the View Royal pump station, which is 73% full. This main was not thought necessary to be upsized further, as it is the incoming main to the pump station and does not cause surcharge concerns at its upstream manhole. If the Town wishes to meet the MMCD criteria for this incoming main, upsizing to 525mm

will meet the design criteria for capacity. Refer to *Figure 11* and *Figure 12*, which show model results for the future Q_5 and Q_{100} with upgrades respectively. Some upgraded mains are yellow in the figure (between 50 – 70% full) but meet MMCD guidelines - being 250mm or larger.

Detailed calculations for the upgrades can be found in *Appendix E*.

Condition of existing gravity sewers has been agreed not an issue with the Town. No condition related gravity sewer upgrades are thought necessary, nor cited herein.



No.	Description	Details
1A - 1G	Increased diameter to 375mm Adjusted slope to maintain a minimum 0.26%	1E - 1J: Through RV Park
1H	Increased diameter to 375mm Increased slope to a minimum 0.71%	
1I	Increased diameter to 375mm Increased slope to a minimum 0.73%	
1J	Increased diameter to 300mm Reduced slope to 4.00%	
1K	Increased diameter to 300mm	Trenchless installation under railway
2A	Increased diameter to 450mm entering View Royal Pump Station	
2B - 2G	Increased diameter to 375mm Adjusted slope to maintain a minimum 0.65%	
3	Added a main parallel to the existing 150mm	Abandon 150mm if poor condition; Keep existing 150mm and reduce upgraded pipe to 200mm if good condition; Operate in parallel
3A	Length = 2.5m; Diameter = 250mm; Slope = 0.77% minimum	
3B	Length = 84.0m; Diameter = 250mm; Slope = 143% minimum	Trenchless installation under highway
3C	Length = 4.0m; Diameter = 250mm; Slope = 0.54% minimum	
4 A - 4B	Increased diameter to 250mm Adjusted slope to maintain a minimum 0.30%	4B= Trenchless installation under highway

Sanitary Master Plan

Legend

- Junctions
- Existing Pump Station
- Existing Mains

Upgraded Sanitary Sewer Diameter(mm)

- 250
- 300
- 375
- 450

McElhanney

0 160 320 640 960 (m)

1:15,000

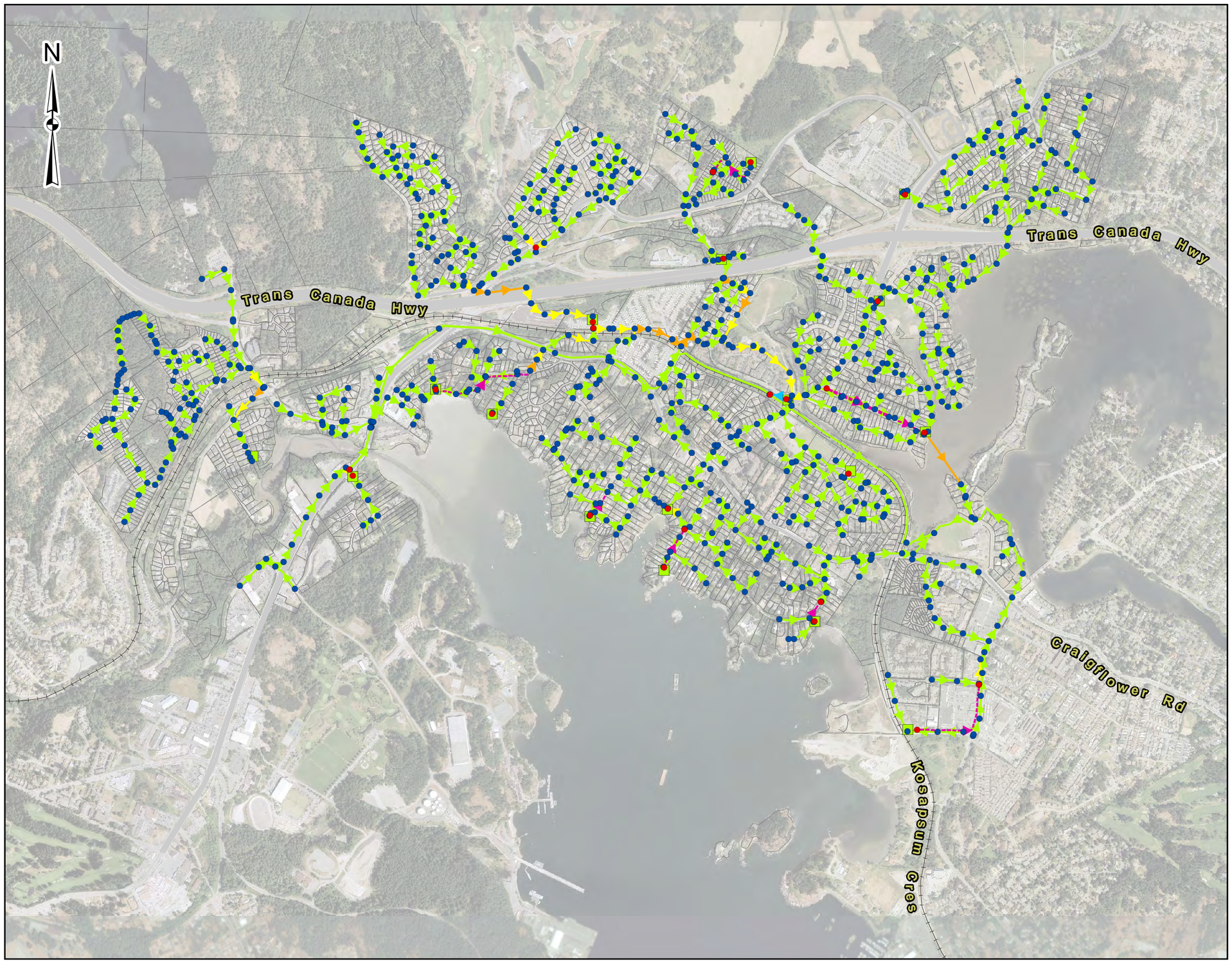
Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 13, 2017

Upgraded Sanitary Sewers

Figure 10

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 10 - Upgraded Sanitary Sewer.mxd Author: hshin



Sanitary Master Plan

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

McElhanney

0 160 320 640 960 (m)

1:15,000

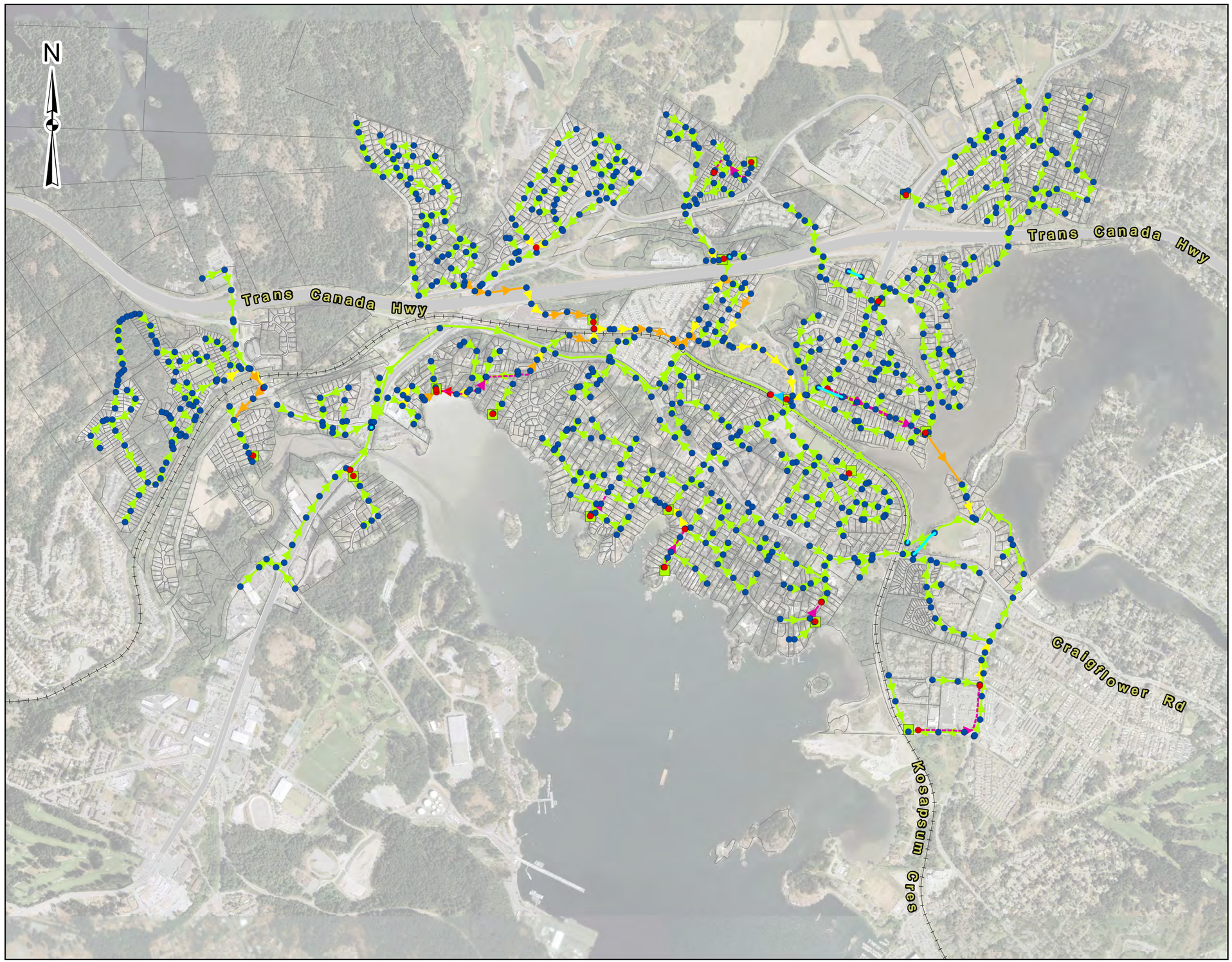
Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Oct 16, 2017

Model Results with Upgrades - Future Population with 5 Year I&I

Figure 11

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 11 - Model Result Upgrade - FUT 5.mxd Author: hshin



Sanitary Master Plan

Legend

Force Main
- Velocity < = 3m/s
- Velocity > 3m/s

Junctions
- No Surcharge
- Surcharge Locations

Wet Well Depth
- < = 0.3m Above Lag Pump Start Depth
- > 0.3m Above Lag Pump Start Depth

Gravity Main - Max/Full Depth
- 0.0 - 0.5
- 0.5 - 0.7
- 0.7 - 1
- 1

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 UTM Zone 10N

Project No.	Date
2243-17101-00	Jan 03, 2019

Model Results with Upgrades - Future Population with 100 Year I&I

Figure 12

Document Path: M:\Proj\2243-17101-00 View Royal Sanitary Master Plan\4.0 ENGINEERING DESIGN\4.13 Sanitary\4.13.2 Reporting\4.13.2.5 Figures\ArcMap\Figure 12 - Model Result Upgrade - FUT 100.mxd Author: BRoberts

6.1.2. Summary of Recommended Pipe Upgrades

Table 21 shows the recommended upgrades and their recommended priority.

Table 21: Recommended Gravity System Capacity Upgrades

Map Location	5-Year Capital Plan	20-Year Capital Plan
1	Yes	-
3	Yes	-
2	No	Yes
4	No	Possibly, after in-stream monitoring is completed

Locations 1 and 3 are recommended to be included in the 5-Year Capital Plan, while Location 2 is recommended to be included in the 20-Year Capital Plan. If Location 4 shows a need for upgrades after recommended further in-steam monitoring and computer modeling, it should also be included in the 20-Year Capital Plan.

6.1.3. Pump Station Recommended Upgrades

Full Replacement Due to Capacity Shortfalls

At the time of modelling, as shown in *Table 18* in *Section 5.2.2*, both the Atkins and Price Bay pump stations are unable to meet demands for the future Q_{100} with both pumps operating.

At Price Bay, new pumps have been installed recently. Future modelling should confirm Q_{100} I&I capacity. In Section 7 below, a very modest allowance has been included in the long-term 20-year cost estimates for replacement pumps as may be required.

At Atkins, the pumps are only just, unable to meet the future Q_{100} load, it is recommended that extended period simulation modelling occur to determine the extent of the shortfall, before pump station upgrades are recommended. If, after subsequent modelling, Atkins is unable to meet the future Q_{100} demands, upgrades should be included in the 20-Year Capital Plan – as capacity shortfall projects (DCC eligible projects). These projects have not been included in the current Capital Plan.

6.2. Component Replacement Due to Service Life Expiration

Table 22 summarizes recommended upgrades, covering each of the 17 existing municipal sewage pumping stations. This table is based on our field inspections and resulting condition assessment reports attached as *Appendix B*. The table includes a number of assumptions and design criteria that guide the priority of recommended upgrading noted therein. These upgrading recommendations are independent of capital works expected to be required for system conveyance capacity increases, in turn required to accommodate new growth.

The Glenairlie pump station is the top short-term priority, as it a simplex station which does not meet Municipal Sewage Regulation (MSR) standards and will be out of commission if the single existing pump fails. Good municipal engineering practice dictates a duplex pump station as a minimum level of service standard. The remaining short-term (5-year plan) priorities deal with minor issues as shown. The longer-term priorities are primarily based on service life/age. For a complete justification on how each priority was determined, refer to *Appendix G*.

Table 22: Pump Station Upgrades Due to Service Life

Station		Existing Conditions			Year of Construction / Latest Retrofit	Short Term 5 Year Capital Plan Applicable		Longer Term 20 Year Build Out (Year 2037) Expectation	
#	Name	Pump HP	External Valve Chamber	Back-Up Power		Major Component	Priority	Major Component	Priority
1	Glenairlie	2	N	N	1980	complete replacement except wet well. Add valve chamber	1	n / a	-
2	Atkins	25	Y	Y	2003	modest upgrade of mech / hvac, elect [scada]	2	all except wet well / valve chamber	3
3	Stoneridge	5	Y	Y	2001	mech / odor issue, single pump required	3	pumps / motors, Elec, genset	2
4	Packers	5	N	Y	1999	pumps / motors	4	Elec, mech, valve chamber, genset	1
5	Helmcken Bay	15	N	Y	1980	Elec, mech, valve chamber	5	pumps / motors	10
6	Norquay	4	N	N	1980	complete replacement except wet well. Add valve chamber	6	n / a	-
7	Thetis Cove	3	N	N	1980	complete replacement except wet well. Add valve chamber	7	n / a	-
8	Wilfert	20	N	Y	1996	pumps / motors, elec, mech, valve chamber	8	genset	7
9	Hallowell	5	N	N	1996?	complete replacement except wet well. Add valve chamber	9	n / a	-
10	View Royal	25	N	Y	1998	Elec, mech, valve chamber	10	pumps / motors, genset	6
11	Talcott	3.9	Y	Y	1999	pumps / motors, elec, mech	11	genset	8
12	Hospital	20	N	Y	2004	Elec	12	pumps / motors, mech, genset	5
13	Helmcken Park	15	Y	Y	2001	mech - minor misc.	-	pumps / motors, Elec, mech, genset	4
14	Midwood	2.4	Y	Y	2011	n / a	-	pumps / motors, Elec, mech	9

Station		Existing Conditions			Year of Construction / Latest Retrofit	Short Term 5 Year Capital Plan Applicable		Longer Term 20 Year Build Out (Year 2037) Expectation	
#	Name	Pump HP	External Valve Chamber	Back-Up Power		Major Component	Priority	Major Component	Priority
15	Stewart	2.2	Y	Y	2013	n / a	-	pumps / motors	11
16	Heddle	4	Y	Y	2015	n / a	-	pumps / motors, Elec	12
17	Price Bay	20	Y	Y	2018	n / a	-	pumps / motors	13

Notes / Assumptions:

1 – Backup gensets, if in place now, are assumed to require replacement at year 20. the 4 stations without backup power are smaller HP and assumed to not require same, through year 20.

2 – Assumption is that on-going wet wells, hatches and / or valve chamber rehab costs - to remedy leakage and minor structural issues - will be attended to as O&M budget issues.

3 – New valve chambers are assumed desired / expected, as part of the 20-year plan, where separate chambers do not yet exist.

4 – Expectation that all stations will be re-built in component parts, not reconstructed in full, i.e.: wet wells will be rehabilitated and reused - 20-year models suggest capacity requirements do not warrant larger wet wells

5 – Short term - 5-year plan to include replacement of all hydro-pneumatic pumps with Flygt units

6 – Electrical equipment, gensets and pumps assumed to have 20 to 25-year useful service life

7 – Genset replacement at year 20 - 25 is predicated on assumption of parts availability and service labour increase with time, not due to unit run-time

8 – Major components, to be replaced as part of the 5-year capital plan, will **NOT** be required again as part of 20-year plan.

9 – Need to confirm forcemain velocities are not too high, if larger replacement pumps are selected at any given station

10 – Review of pump station SCADA metrics should be included in all future major station upgrading

6.3. Coordination with Other Infrastructure Upgrading Projects

Although the above upgrades have been assigned relative priorities based on their capacities and age, as applicable, the Town may wish to alter the order of these upgrades such that they can be included with other planned capital construction projects in the future, reducing overall construction costs and public inconvenience.

Further upgrades may be required if additional build-out occurs outside of the areas studied.

7. Capital Cost Estimates

7.1. Capacity Shortfall – Gravity Pipe Upgrades

A summary of capital costs associated with the recommended upgrades is presented in *Table 23*, including a **15% allowance for engineering and construction administration and a 25% contingency allowance**. Costs have been rounded up to the nearest $10,000. All construction costs are based on local, capital region 2017 construction data. Refer to *Appendix F* for detailed cost estimates and additional assumptions / clarifications. The total estimated cost for capacity related pipe projects to be included in the 5-Year Capital Plan is $1,570,000, while the total estimated cost for the 20-Year Capital Plan projects is $1,360,000. This equates to a combined total of $2,930,000.

Table 23: Construction Cost Summary (in 2017 dollars)

Map Location	Items / Description	Construction Cost	Year Capital Plan
1	130m of 300mm diameter 420m of 375mm diameter	$ 1,100,000	5
3	90m of 250mm diameter	$ 470,000	5
2	420m of 375mm diameter 10m of 450mm diameter	$ 870,000	20
4	140m of 250mm diameter	$ 490,000	20 (as needed)
	Total:	**$ 2,930,000**	

7.2. Lift Station Condition Upgrades

The corresponding cost estimates for the lift station upgrades described in *Section 6.2* are shown in *Table 24* and includes a **15% allowance for engineering and construction administration and a 25% contingency allowance**. Costs have been rounded up to the nearest $10,000. All costs are based on 2017 construction data.

Table 24: Recommended Lift Station Upgrades – Condition Assessment (in 2017 dollars)

5-Year Capital Plan	20-Year Capital Plan	Total
$ 2,210,000	$ 2,290,000	$ 4,500,000

Detailed cost estimates for each lift station can be found in *Appendix G*.

7.3. Total Estimated Capital Costs

Combining the gravity pipe and lift station upgrading costs, the total estimated capital costs for the 5 and 20-year build-out plans are as follows in *Table 25*:

Table 25: Total Estimated Capital Costs (in 2017 dollars)

Upgrade Type	5-Year Capital Plan	20-Year Capital Plan	Total ($millions)
Capacity-related upgrades	$ 1,570,000	$ 870,000 ($1,360,000 with Location 4)	$2.44 ($2.93)
Condition assessment upgrades	$ 2,210,000	$ 2,290,000	$4.50
Total Upgrades	**$ 3,780,000**	**$ 3,160,000 ($ 3,650,000)**	**$6.94 ($7.43)**

8. Conclusion and Recommendations

8.1. Conclusions

An upgraded sanitary sewer model was created for the Town, allowing up-to-date evaluation of the system function. A primary goal was identification of components requiring upgrading and inclusion in the Town's 5 and 20-year infrastructure capital plans. Pump station evaluations were based on both capacity concerns - via the model - and condition assessments at each station, while the conveyance system was evaluated solely on modeled capacities.

Existing conditions, based on 2016 Census population data, and future conditions, based on estimated future populations, were used to derive the base sanitary flows. I&I values for 5-year and extrapolated 100-year storms were incorporated in evaluating two separate Peak Wet Weather Flow scenarios for both existing and future service population models. The future conditions model included a factor of safety population of 20,500 for the purpose of assessing the system on a local or neighbourhood level. By contrast, a total population of 16,900 is appropriate for purposes of OCP application and related bylaws, and suitable for looking at the Town system as a whole.

8.1.1. Capacity

Steady state modeling and resulting capacity analysis revealed there are three gravity pipe locations which are expected to surcharge as a result of both the existing and future base sanitary loading scenarios, when a concurrent Q_5 storm event is modeled. A fourth gravity pipe section is expected to be rendered under capacity when subject to base sanitary flows (both existing and future) and a concurrent Q_{100} storm event.

There are pump stations which appear unable to meet the future theoretical Q_{100} loading, but this is subject to confirmation via recommendations which follow herein.

All recommended upgrades will meet the MMCD design guidelines for capacity – while accommodating a future growth and a concurrent Q_5, storm event, with one exception. The incoming 450mm main to the View Royal pump station, which is expected to be operating at 73% full, is not recommended to be enlarged, as it is the incoming main to the pump station and does not cause surcharge concerns at its upstream manhole. If the Town wishes to meet the MMCD criteria for this incoming main, upsizing to 525mm will meet the design criteria for capacity.

Extended period simulation and flow monitoring may indicate that some of these upgrades are not required, but the recommendations herein are based on the current scope of work. Future refinement (additions and deletions) of the capital projects list and resulting cost estimates are expected.

Note that impacts of additional development areas not yet contemplated here would need to be assessed, as a matter of due course.

8.1.2. Condition

Pump station condition assessments were completed, with service life upgrades recommended for a number of the pump stations over the same 5 and 20-year capital plan timelines.

Generally speaking, the Town's systems are in excellent operating condition, reflective of sound maintenance and past capital infrastructure planning/execution. The estimated costs for system upgrading over the 5 and 20-year capital plan horizons represent total costs typical of similarly sized communities on Vancouver Island where the systems are relatively new and/or have been well maintained.

8.1.3. Summary of Total System Upgrade Costs

The total estimated cost for both the capacity and condition-related upgrades are shown in *Table 26*.

Table 26: Total Estimated Capital Costs (in 2017 dollars)

Upgrade Type	5-Year Capital Plan	20-Year Capital Plan	Total ($millions)
Capacity-related upgrades	$ 1,570,000	$ 870,000 ($1,360,000 with Location 4)	$2.44 ($2.93)
Condition assessment upgrades	$ 2,210,000	$ 2,290,000	$4.50
Total Upgrades	**$ 3,780,000**	**$ 3,160,000 ($ 3,650,000)**	**$6.94 ($7.43)**

The above is appropriate for purposes of establishing the Town's DCC Bylaw list. Further refinement of required upgrades will likely stem from recommendations outlined below, resulting in the need for a bylaw update.

The specific calendar year for each of the 5-year Capital Plan expenditures has not yet been determined. The Town's 5-year Capital Plan is a living document; we expect the contents of which will be adjusted annually. The longer-term/20-year cost estimates are intended for purposes of long-term planning only, and the Town should expect significant variation in these costs over the longer-term.

8.2. Recommendations

1. A calibrated extended period, dynamic simulation model should be conducted for the Town's sanitary system. This will allow for daily loading patterns to be assessed and will confirm gravity pipe capacity shortfalls identified thus far as well as determining the extent (if any) of the upgrades required for the Atkins and Price Bay pump stations. This modeling outcome will also assist in evaluating the total flows from the Town in relation to the CRD allocation amounts. This engineering effort is anticipated and assumed included in the 15% engineering allowances per the above cost estimates. Note that this further model calibration and extended period simulations should be undertaken before any of the recommended sewer upgrades take place.

2. 15% of capital construction cost is expected adequate to cover additional in-stream monitoring, extended period modeling updates, periodic overall planning report update(s), detailed design and construction engineering for the above noted capital plan components cited. This overall 15% of recommended capital plan budgets as presented thus far can be roughly broken down, as follows:
    a. In-stream monitoring and model updating – 2.5%
    b. capital plan report updating – over the course of the plan horizon – every 3 to 5 years – 1%
    c. conceptual design of capital plan elements, in advance of inclusion in the following year's capital plan budget – 1.5%
    d. detailed design of each component – 5.5%
    e. construction tendering, contract administration and inspections – 4.5%
3. In-stream monitoring and extended period modeling should be undertaken in year one of the Town's updated 5-year capital plan. This should lead to an updated capital plan budget for planning year 2020. A number of locations should be considered, at major junctions in larger gravity networks and at inlets to pumping stations.
    a. This will aid in confirming the Q_{100} rates used in this study.
4. The population projection of 20,488 people and the respective PDWF loading should be confirmed following in-stream flow monitoring and be part of the model updates.
5. For purposes of conservatism, the recommended capital plan upgrades resulting in part from the application of I&I rates - due to the extrapolated Q_{100} storm event - should be included in the Capital Plan at the present time. This plan should be updated following the in-stream monitoring and continuous simulation modeling as recommended above. This process will allow:
    a. Confirming that projected / modeled depths of surcharge will materialize.
    b. Checking by means of in-stream monitoring, and via assessment of most recent pump-station data for 2018, probability of inflow component of I&I during Q_{100} design storm.
        i. Specifically, at the Atkins and Price Bay lift stations (wet well storage should be re-confirmed at both stations, concurrently).
        ii. Specifically, within sections of gravity sewer where surcharge depths are projected to be significant only in response to the Q_{100} induced I&I, both for existing and future development conditions.
6. Direct field survey is recommended as the means of establishing Minimum Building Elevation (MBE) for all service connections along lengths of pipe expected to be subject to modeled surcharged gravity pipe flows. If the maximum surcharge depths in the model are expected to not reach the MBEs, upgrades to gravity sewer locations which result from the base sewer flow plus Q_{100} storm event concurrent, may not need upgrading. This can be confirmed with additional survey and in-stream monitoring data in hand.
    a. Direct field surveys are also recommended to confirm invert elevations for the manholes that have been estimated thus far.

7. An I&I reduction study may be warranted, subject to monitoring and modeling updates recommended above. Presuming I&I is spatially quite varied from catchment to catchment, capital works projects can be deferred or eliminated, where it is reasonable that I&I levels could cost effectively be reduced.

    a. This effort is not included in the 15% capital plan engineering allowances as noted under recommendation 1, above.

    b. This effort is likely DCC project list applicable. The Town should confirm this with their DCC consultant.

8. Town operation staff should continue to monitor the system for surcharge during heavy rainfall events.

9. New pumping stations, or major existing station upgrades should include an investigation into frictional losses in higher velocity pressure sewers, and the cost/benefit of VFD unit installation as part of these future installations.

10. This report should be updated as new information is made available, likely on a 3 to 5-year cycle. Capital budgets should be refined annually, as additional modelling is undertaken, and/or other data is made available, as well as to account for inflation/price escalation. Per recommendation 2(c), above, conceptual designs should be undertaken in advance of finalizing capital plan budgets and scope, for any given calendar year. Cost estimates presented thus far are Class ‘D’ order of magnitude only.

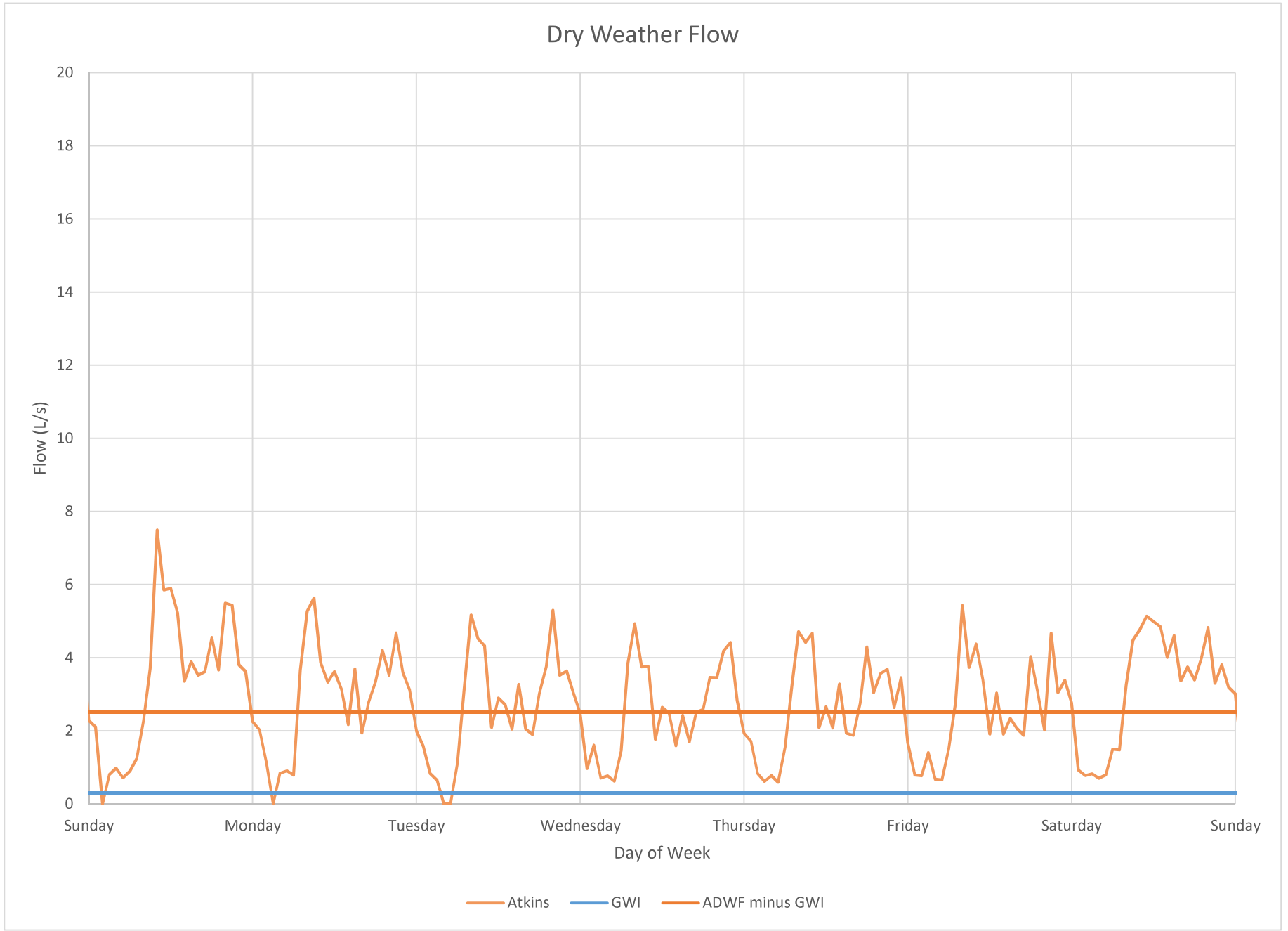
11. Subsequent to in-stream flow monitoring and continuous simulation modeling, the Town should review the recommended capital plan list presented here and make adjustments as necessary. This may also warrant minor amendments to the DCC bylaw projects list and accompanying cost estimates, this being a relatively common, routine process undertaken by municipal government.

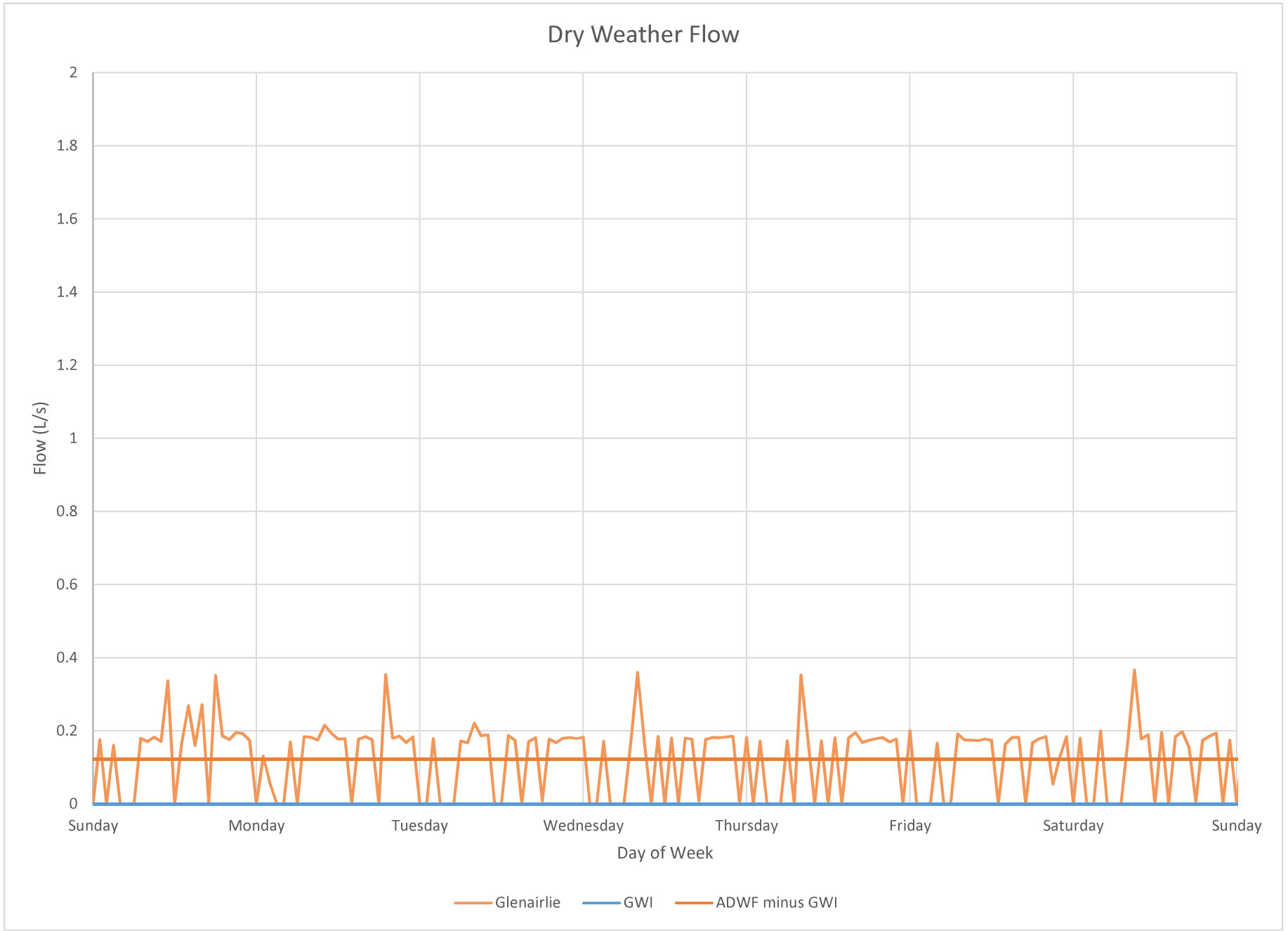
    a. Condition related capital plan projects, as recommended herein, are not expected to be affected by additional modeling.

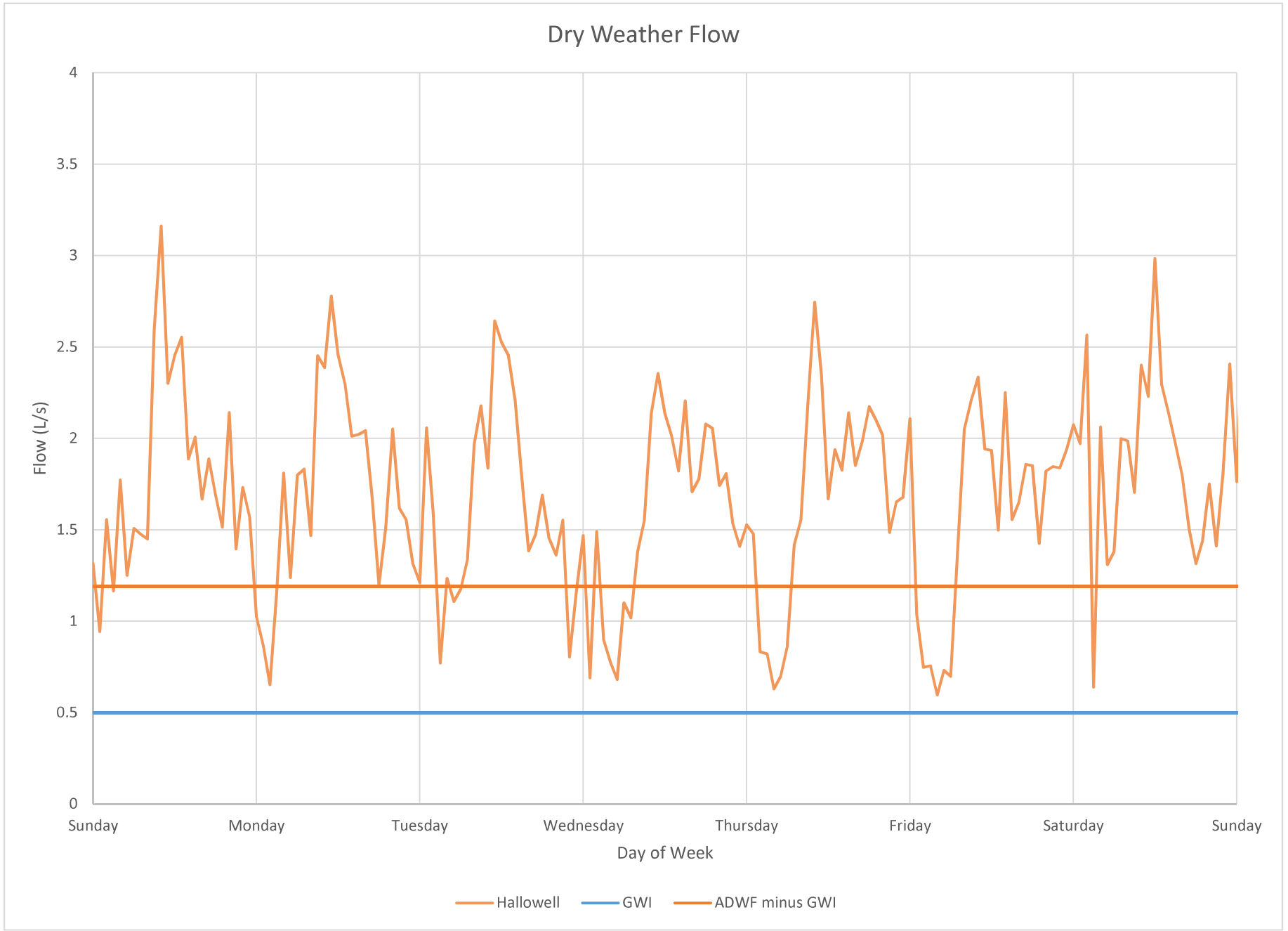
12. Future engineering effort should be considered as to the need for backup-power generators for the 4 remaining stations which are not fitted with permanent gensets.

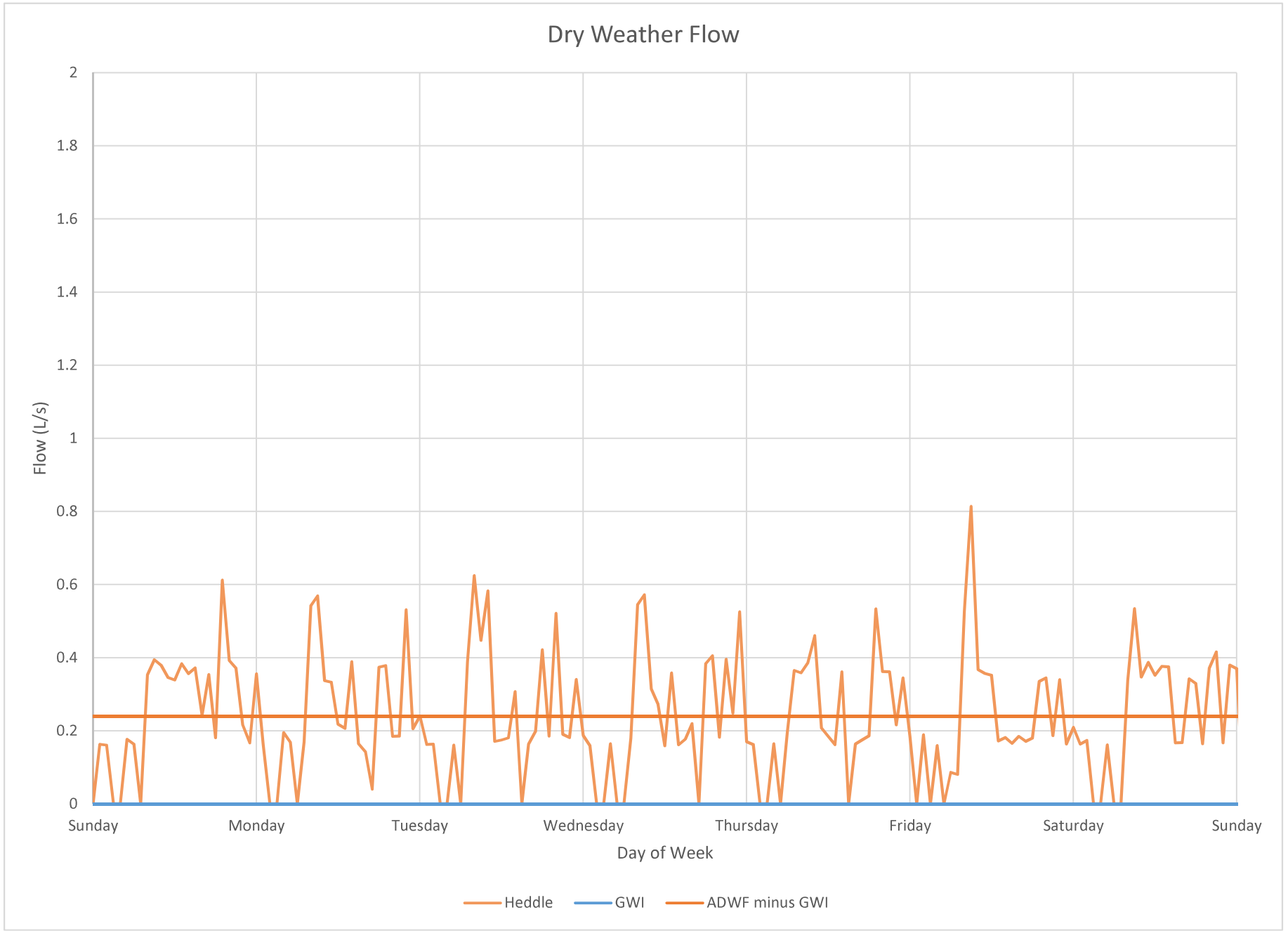
    a. SCADA requirements should also be outlined, as design criteria for all new major lift station upgrading projects.

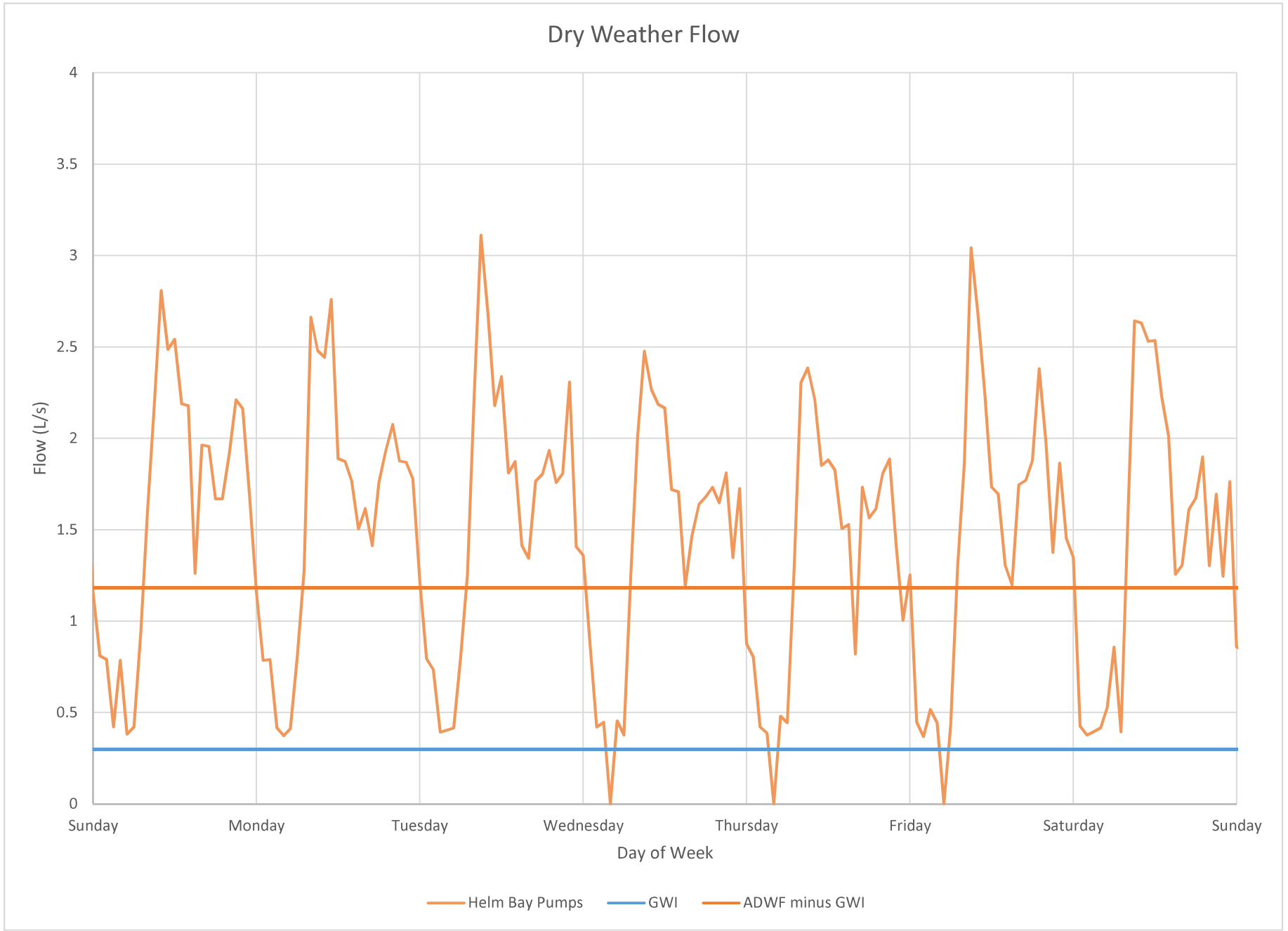
Appendix A: Pump Station Hydrographs

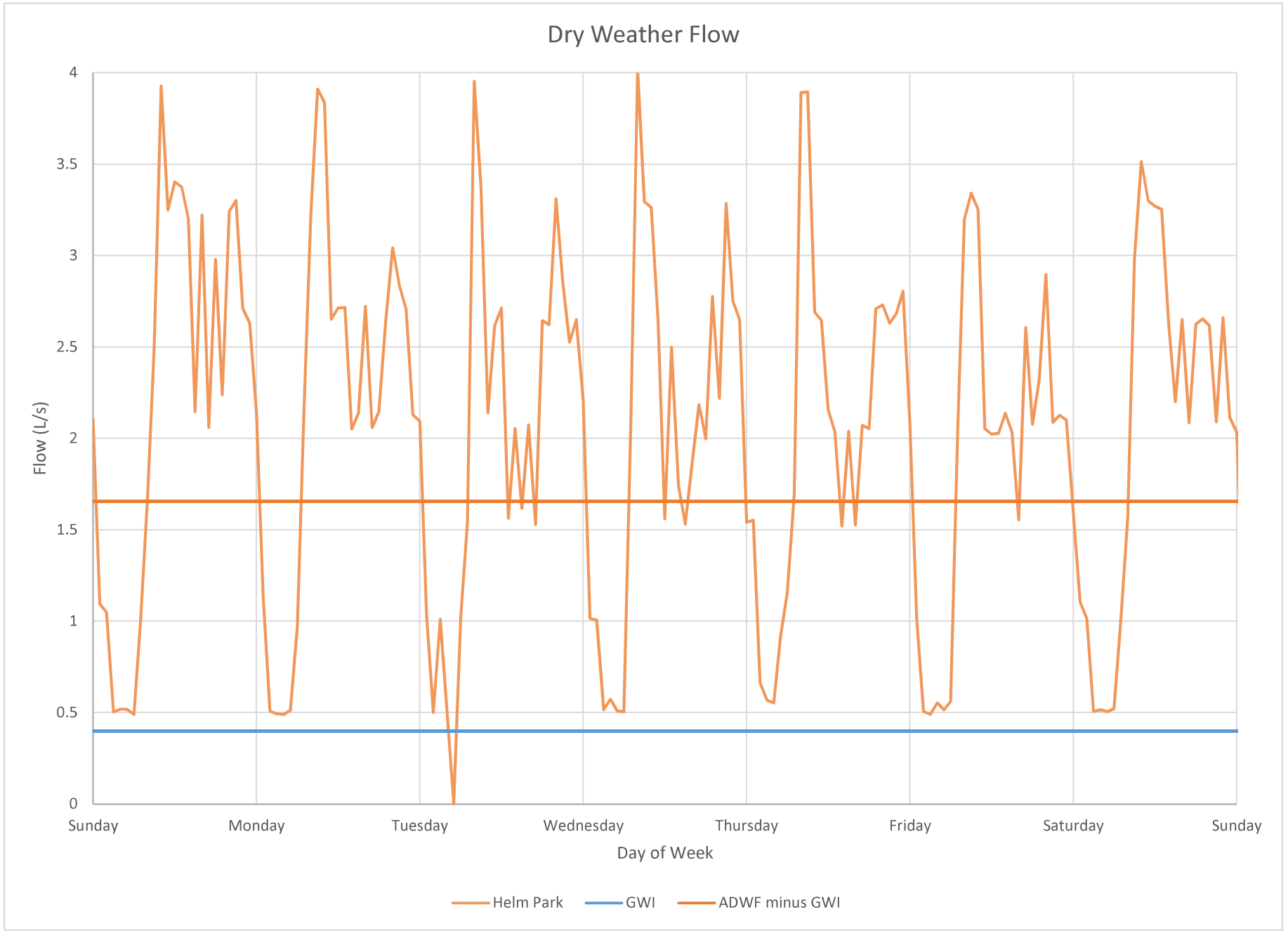

Dry Weather Flow
20
18
16
14
12
10
8
6
4
2
0
Flow (L/s)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Atkins
GWI
ADWF minus GWI

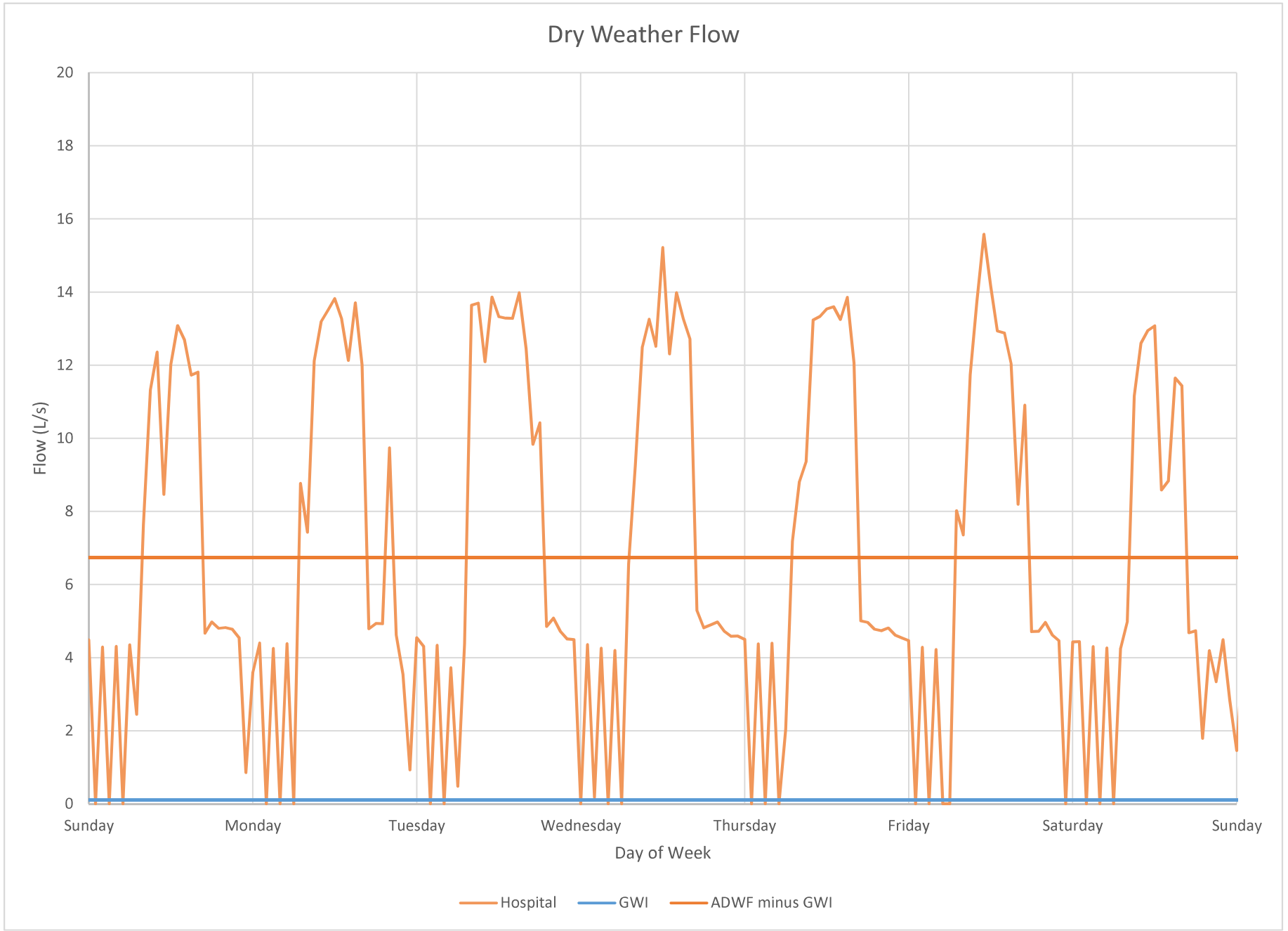

Dry Weather Flow
Flow (L/s)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Glenairlie
GWI
ADWF minus GWI

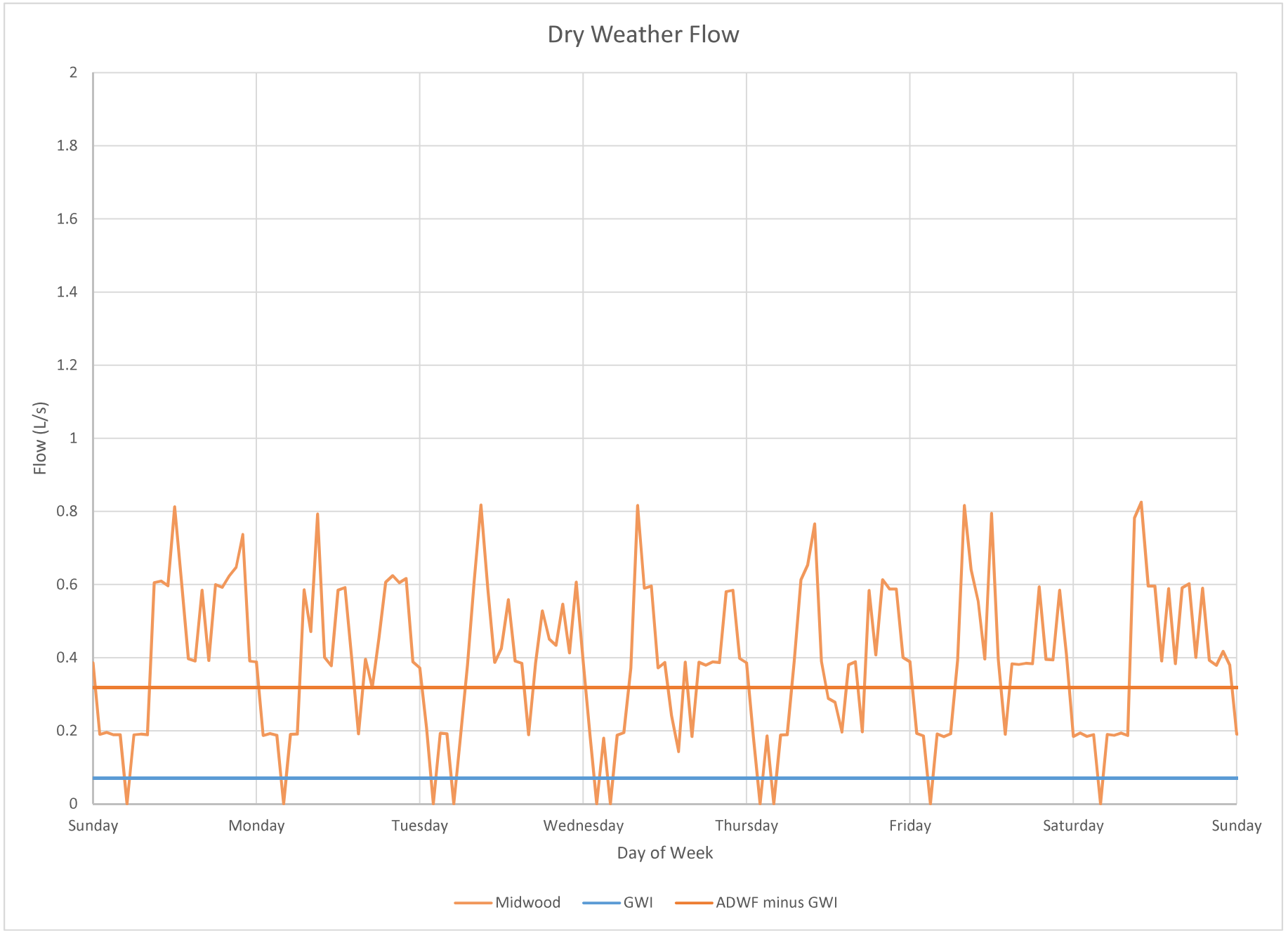

Dry Weather Flow
Flow (L/s)
4
3.5
3
2.5
2
1.5
1
0.5
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Hallowell
GWI
ADWF minus GWI

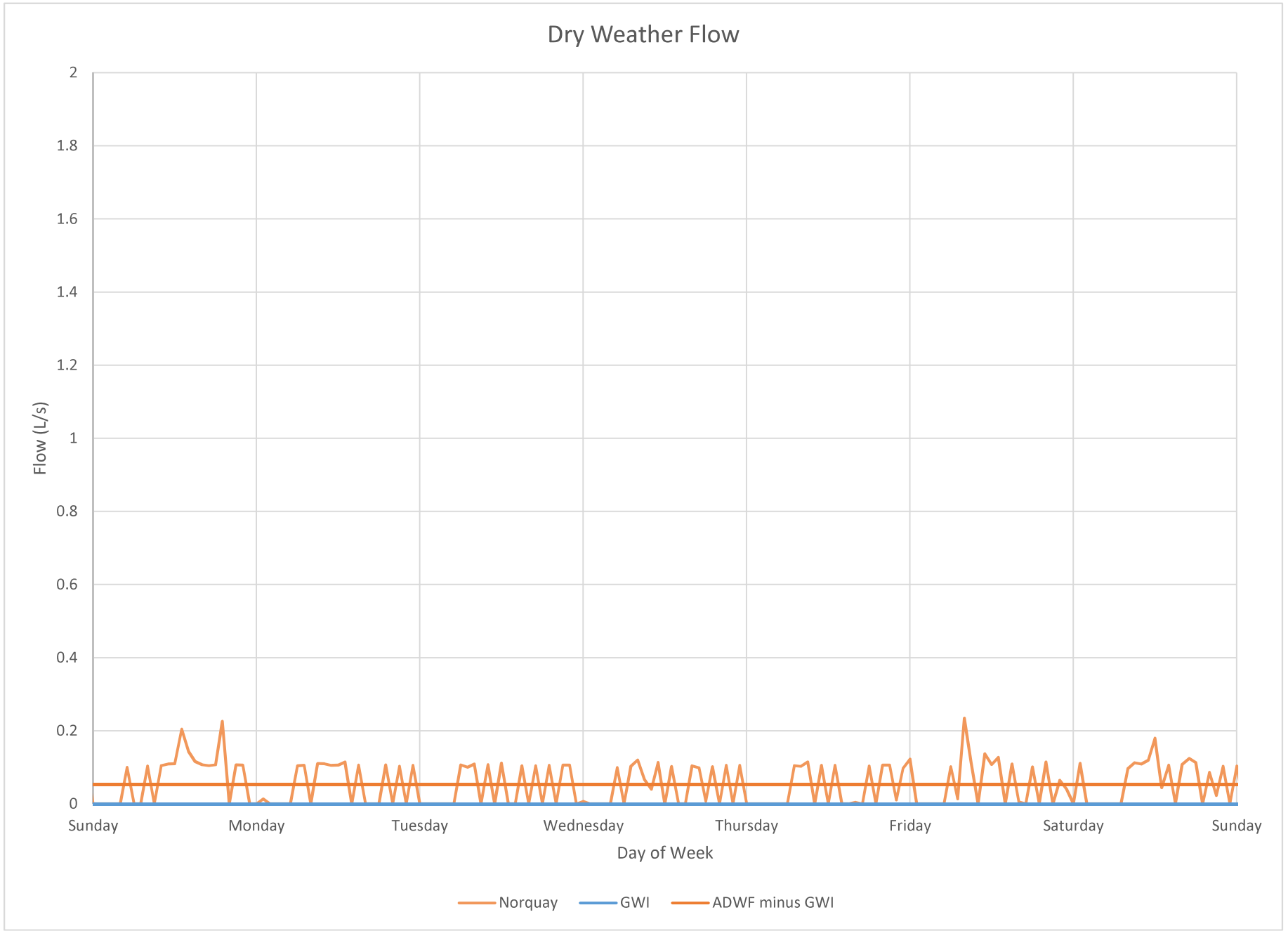

Dry Weather Flow
Flow (L/s)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Heddle
GWI
ADWF minus GWI

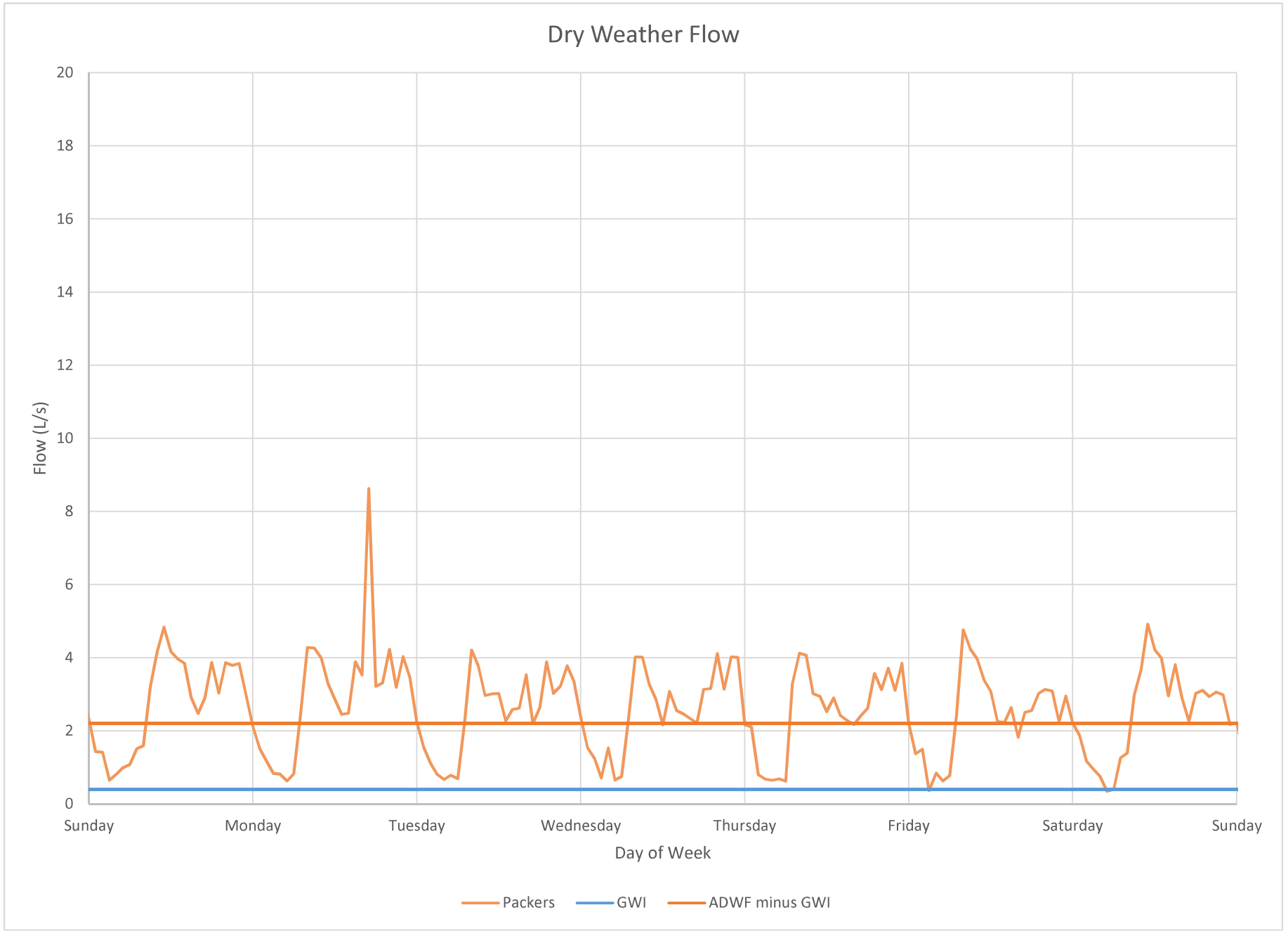

Dry Weather Flow
Flow (L/s)
4
3.5
3
2.5
2
1.5
1
0.5
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Helm Bay Pumps
GWI
ADWF minus GWI

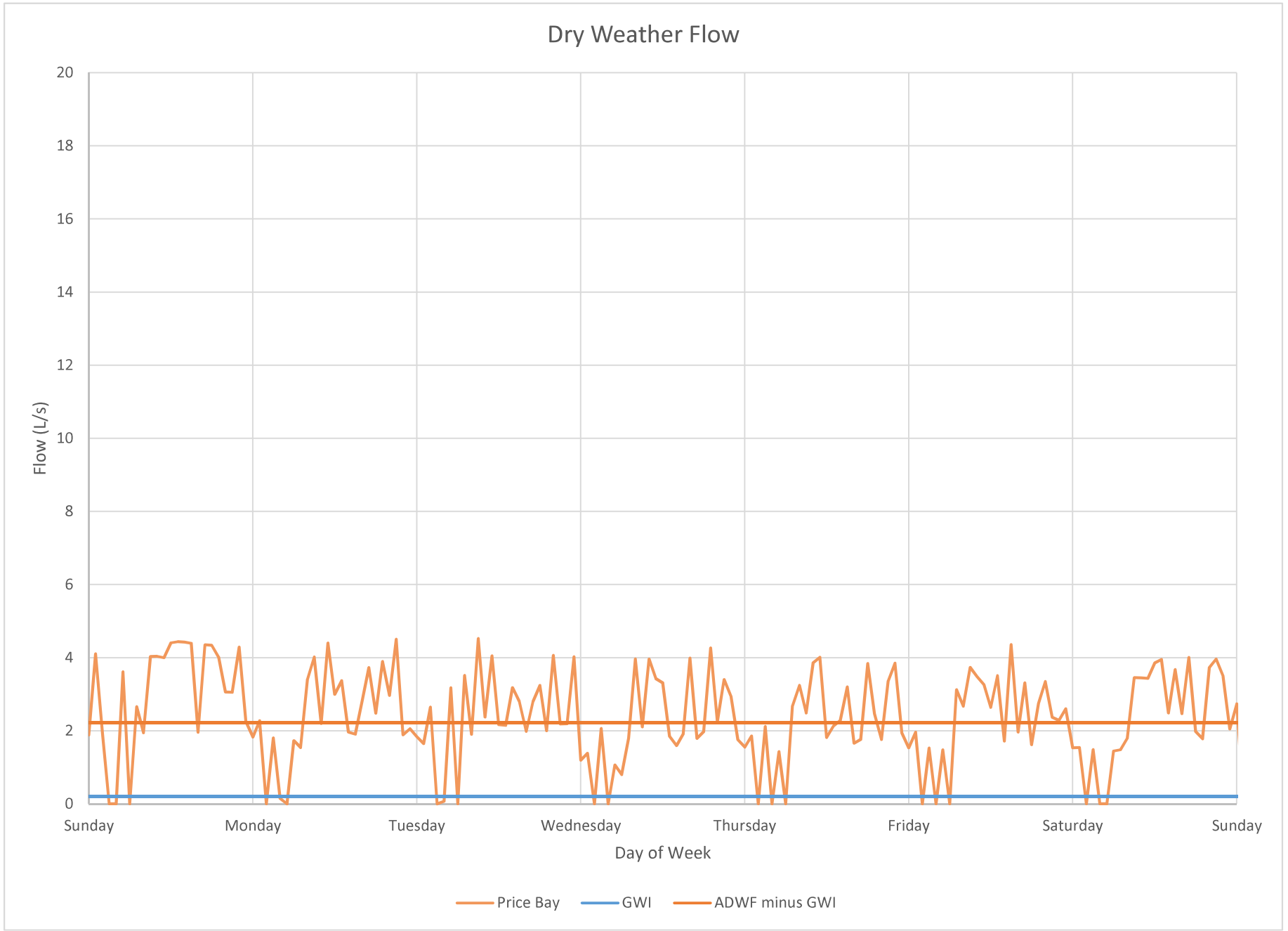

Dry Weather Flow
Flow (L/s)
4
3.5
3
2.5
2
1.5
1
0.5
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Helm Park
GWI
ADWF minus GWI

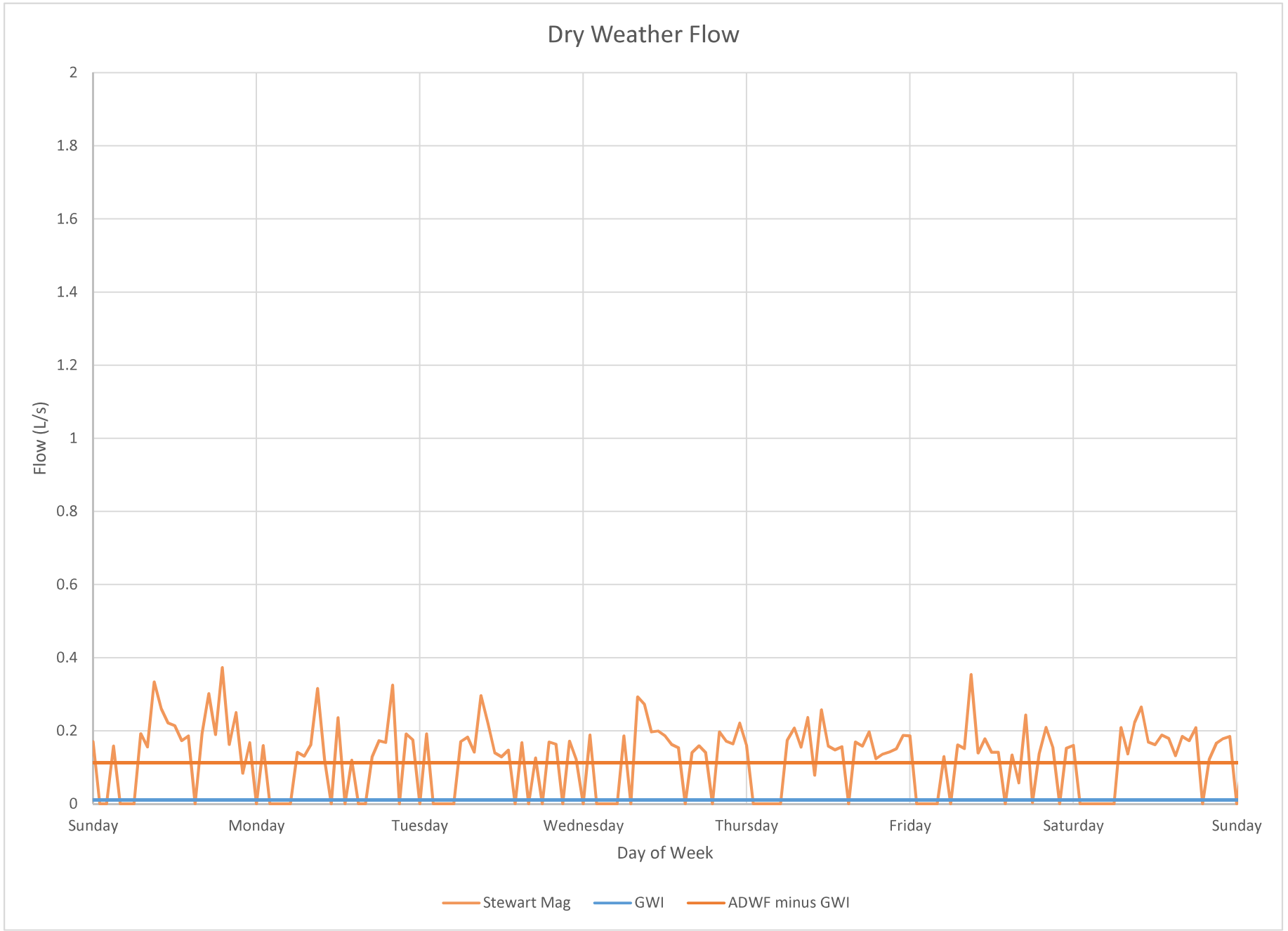

Dry Weather Flow
Flow (L/s)
20
18
16
14
12
10
8
6
4
2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Hospital
GWI
ADWF minus GWI

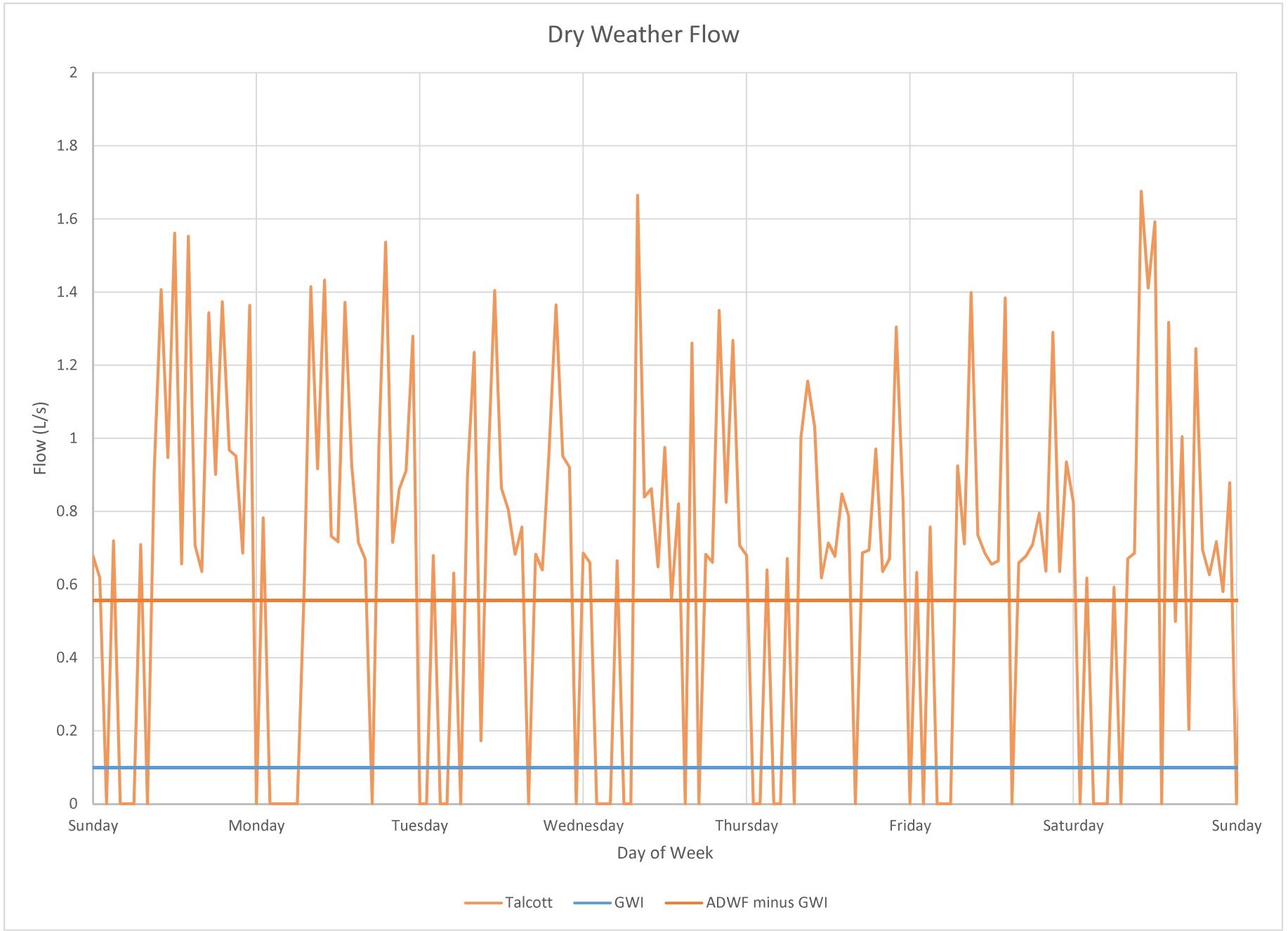

Dry Weather Flow
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Flow (L/s)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Midwood
GWI
ADWF minus GWI

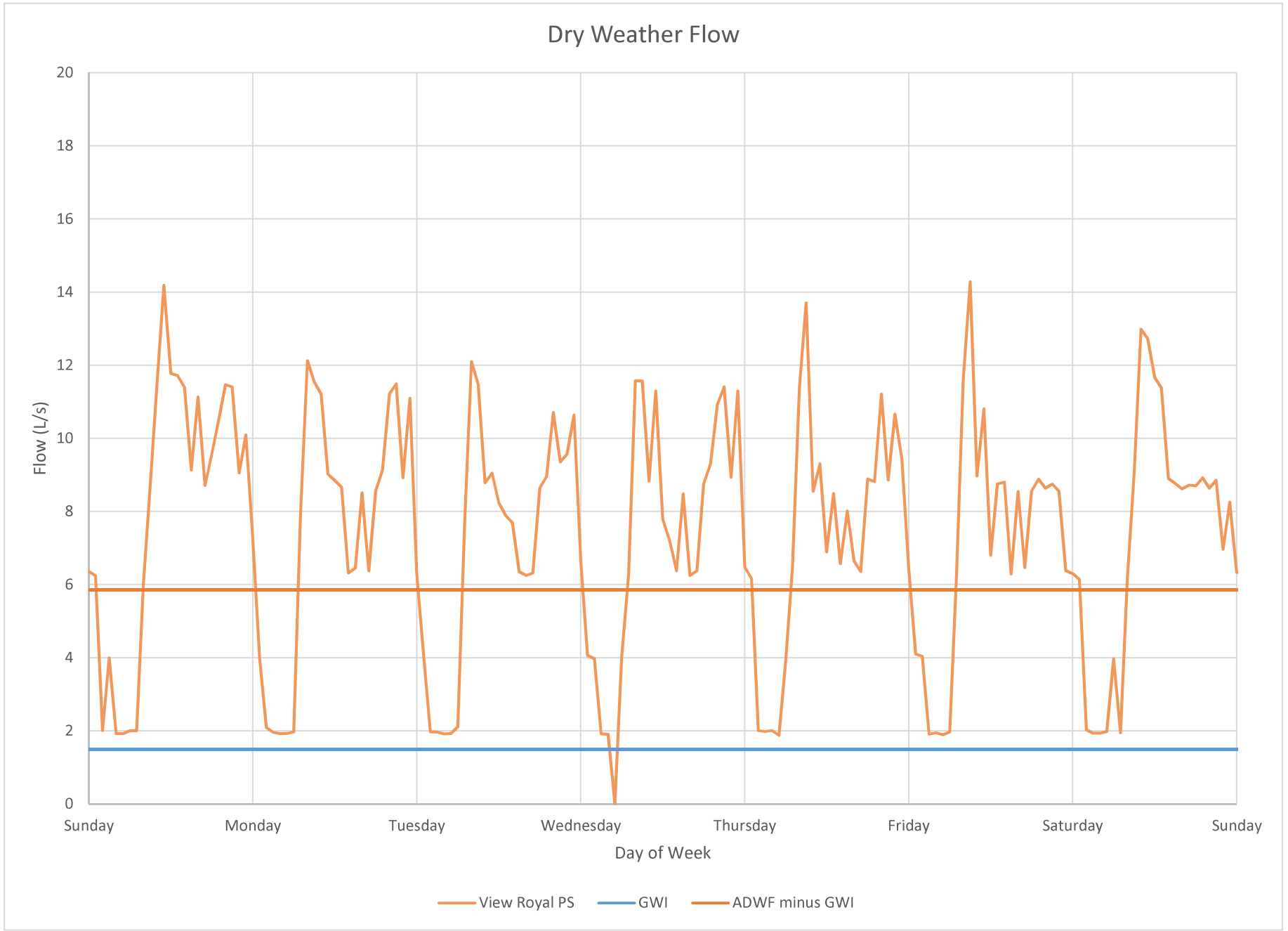

Dry Weather Flow
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Flow (L/s)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Norquay
GWI
ADWF minus GWI

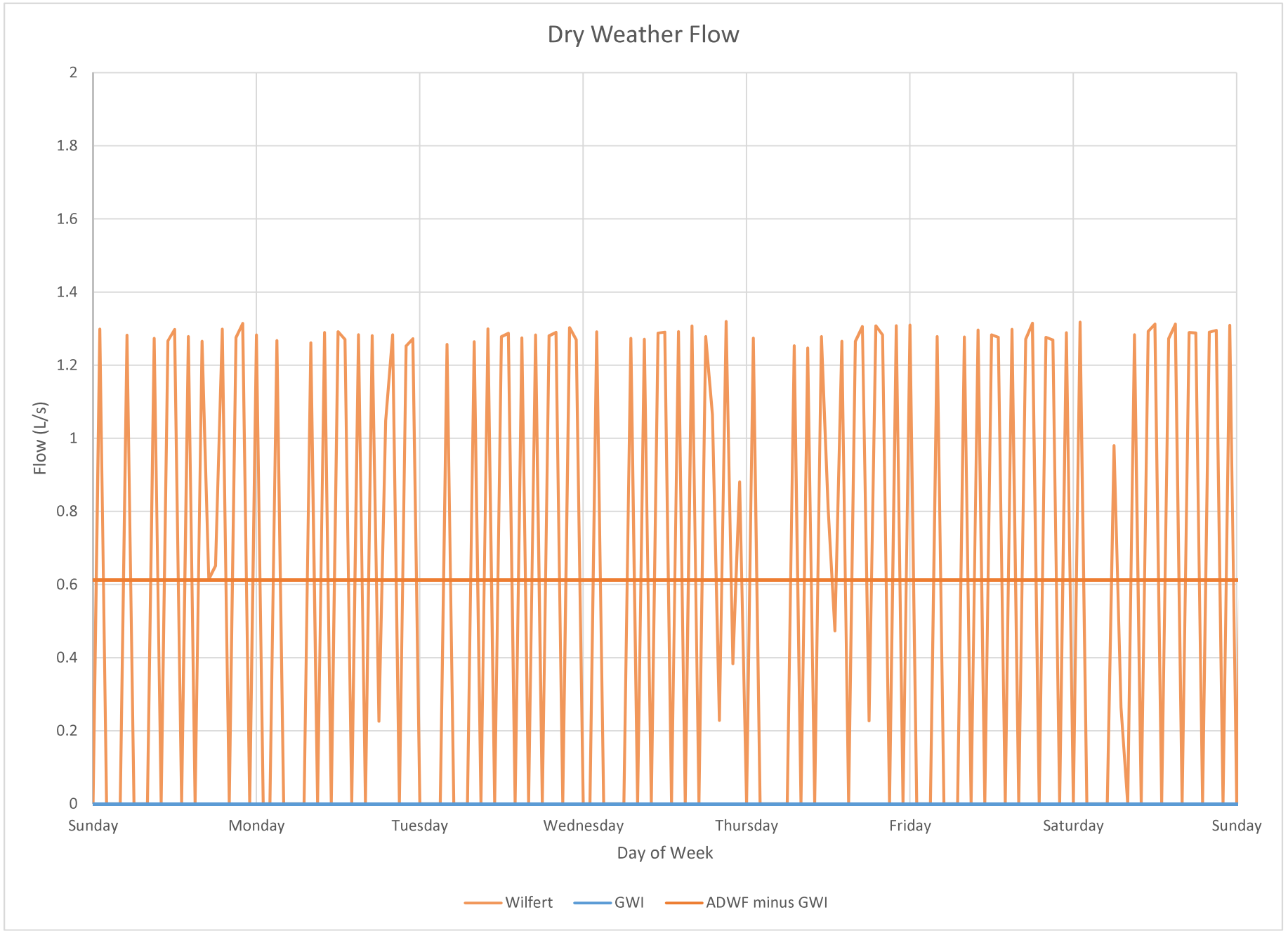

Dry Weather Flow
Flow (L/s)
20
18
16
14
12
10
8
6
4
2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Packers
GWI
ADWF minus GWI


Dry Weather Flow
Flow (L/s)
20
18
16
14
12
10
8
6
4
2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Price Bay
GWI
ADWF minus GWI


Dry Weather Flow
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Flow (L/s)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Stewart Mag
GWI
ADWF minus GWI


Dry Weather Flow
Flow (L/s)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Talcott
GWI
ADWF minus GWI


Dry Weather Flow
Flow (L/s)
20
18
16
14
12
10
8
6
4
2
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
View Royal PS
GWI
ADWF minus GWI


Dry Weather Flow
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Flow (L/s)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of Week
Wilfert
GWI
ADWF minus GWI

Appendix B: Pump Station Condition Assessment

Condition Assessment

Field assessments covering all the Town of View Royal's 17 sanitary sewer lift stations were conducted on August 28th, 29th and 30th, 2017.

Standardized reporting forms were prepared to assist with the collection of relevant condition data. The forms included high-level observations and comments. Reporting for each lift station was broken down into the following sections:

- General Information
- General Observation
- Specific Details (of components)
    - Civil / Structural
    - Pumps and Motors
    - Electrical System
    - Back-up Power
    - Mechanical
- Photos (of deficient components)

Noted for each component are:

- Make and model (where applicable);
- Description of component;
- Size of component; and,
- Installation/upgrade date.

Some station information was derived directly from City-supplied documents and lift station pump information plates.

1. Atkins Lift Station

General Information

Atkins Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
25hp | 575V | 27.2A | 3Ø | 60Hz	25hp | 575V | 27.2A | 3Ø | 60Hz	
Running Hours: 6,046 hrs	Running Hours: 6,431 hrs	Running Hours: N/A

Pumping Structures:
2,440 mm Ø fibreglass tank housing pumps | 1,800 mm Ø concrete tank housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Above-ground Kiosk	Built 2003

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Atkins sanitary sewer lift station is located on the east side at the end of Parsons Rd, off Atkins Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber with chemical dosing, a separate valve chamber manhole, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into CRD's Western Communities trunk main.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Atkins lift station is in overall good condition and operating satisfactorily. It has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition, as they are in a separate concrete manhole chamber away from the corrosive wet well environment. Some mechanical components are in bad condition and should be replaced/repaired.

The electrical system is in overall good condition. It is aging and nearing its life expectancy. The diesel generator for back-up power is in excellent overall condition.

An onsite eye wash station should be included with the lift station since there is chemical usage onsite for wet well dosing.

Access to the lift station is good. There is restricted parking along the road for Public Works vehicles and the adjacent Canada Post mail box.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System			●	

1. *Specific Details*

Civil / Structural

Wet Well:

The wet well is a 2,440Ø fibreglass chamber with a fibreglass access hatch and is in overall good condition. The access ladder is slightly corroded from the wet well environment.

The shocks for the access lid have surficial rust and rust should be removed for longevity of the shocks.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber — The 1,800 Ø concrete valve chamber is in overall good condition; however, the outlet drain was placed too high for accumulated water to drain.

Pumps and Motors

Pumps & Motors: There are 2-25 hp Hydromatic submersible pumps and motors housed in the wet well – these are in overall good condition as they are well-maintained. The impellers for both pumps were replaced over the past year.

A drawdown test was conducted on both pumps. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 240 V, 3Ø, 4W with a max rating power of 288 kW.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls: The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a high-level float and an ultrasonic level transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.10 m
- Lag Start: N/A
- Pump Stop: 0.50 m
- High Level: 1.30 m
- High High Level: 1.50 m

It was observed during the drawdown test that the vertical distance between pump start and pump stop was between 0.60 – 0.65m.

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:	There is a space heater in the electrical kiosk, but is not automatically integrated into the electrical system.
Lighting:	There is non-explosion proof incandescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch. No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Site lighting is available via street luminaire.
Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls, monitoring equipment, and dosing pump; and, (3) blower. The electrical kiosk is in overall good condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall excellent condition with no visible signs of corrosion.

Mechanical System

Piping:	The 150Ø steel piping inside the wet well and the 150Ø steel piping inside the valve chamber are in overall good condition. Other piping in the wet well appears to be in good condition.
Valves:	The valves for the 2 pumps are in overall good condition with minor surface corrosion. There is a check valve and a plug valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	The air release valve is in the valve chamber on the discharge line and is in overall good condition with minor surface corrosion.

Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The level transducer controls the pumps. The float and level transducer are both in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	The blower is in bad operable condition (not functioning) and requires repair or replacement. This may be also resolved with regular cleaning of the pump, as the chemicals solidify and clog the pumping tubes.
Odour Control:	The chemical dosing pump has been, or will soon be, removed. From a health and safety perspective, an eye wash station should be implemented at this lift station, as Public Works handle the chemicals.
Backflow Preventer:	An above-ground reduced pressure backflow preventer is housed in a kiosk and is in overall good condition. Public Works personnel noted that since the backflow preventer was installed that the water pressure to clean the wet well was drastically reduced making cleaning duration longer.

2. *Photos*

The following photos were taken during the onsite assessment dated August 28, 2017.

Photo 1
Outlet Drain inside Valve Chamber

Photo 2
Chemicals and Dosing Pump

2. Glenairlie Lift Station

General Information

Glenairlie Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2 – N/A**	**Pump 3 – N/A**
2.4hp | 460/230V | 5.1/10.0A | 3kW | 3Ø | 60Hz | 3415rpm		
Running Hours: 1,813 hrs	Running Hours: N/A	Running Hours: N/A

Pumping Structures:
1,230 mm Ø fibreglass tank housing pump and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground Valve Box	1980

Communications:	Back-up Power Supply:
Wireless Radio	Portable Generator

Description:

The Glenairlie sanitary sewer lift station is located on the north side Glenairlie Drive within a low traffic residential area.

The lift station consists of a single submersible pump in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, and backflow preventer. The lift station pumps the sewage into sanitary manhole MH 97B.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Glenairlie lift station is in overall good condition and operating satisfactorily. This is one of the older lift stations in the Town of View Royal and has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment and age of the lift station. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are located inside the wet well and are in overall good condition with minor signs of corrosion.

The electrical system is in overall fair condition. It is aging and nearing its life expectancy. There is a hook-up for back-up power/portable generator and is in overall good condition.

Access to the lift station is good. There is restricted parking along the north side of the road for Public Works vehicles and the lift station is blocked from the road with concrete no-post barriers.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System			●	
4	Back-up Power *		○		
5	Mechanical System		●		

** Portable generator hook-up*

Specific Details

Civil / Structural

Wet Well: The wet well is a 1,230Ø fibreglass chamber with a steel access hatch and is in overall good condition. The underside of the hatch shows signs of corrosion and should be re-surfaced/painted.

A portable ladder is used for wet well access.

There are no hangers for the lifting chain. The lifting chain is placed from cut-out tabs on the top of the fibreglass chamber.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There is a single 2.4 hp Flygt submersible pump and motor housed in the wet well – these are in good overall condition as they are well-maintained. The pumps were installed 5 years ago.

A drawdown test was conducted on the pump. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 230 V, 1Ø. The pump is a 3Ø pump.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls: The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall fair condition due to the aging equipment.

There is a float assembly and an ultrasonic level transducer with no HMI display panel. The following pump operating levels were provided at the station:

- Lead Start: 0.80 m
- Lag Start: N/A
- Pump Stop: 0.40 m
- High Level: 1.10 m
- High High Level: 1.70 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pump (Hand/Auto/Off) and is in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is a block heater in the electrical kiosk, but is not automatically integrated into the electrical system.

Lighting: There is non-explosion proof incandescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch.

	No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Site lighting is available via street luminaire.
Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with no insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical kiosk is in good overall condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes provisional hook-up for back-up power/portable generator and is in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø steel piping inside the wet well is in overall good condition, considering the age of the lift station. Other piping in the wet well appears to be in overall good condition.
Valves:	The valves for the single pump are in overall good condition with minor surface corrosion. There is a check valve and an eccentric plug valve housed in the wet well.
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a float assembly and an ultrasonic level transducer. The float assembly controls the pumps and is in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	There is no blower for ventilation into the wet well.
Odour Control:	There is no odour control.
Backflow Preventer:	An underground backflow preventer is housed in a concrete valve box and is in overall good condition.

Photos

The following photos were taken during the onsite assessment dated August 29, 2017.

	
Photo 1 Underside of the Steel Access Hatch	Photo 2 Tab to hang Lifting Chain

3. Hallowell Lift Station

General Information

Hallowell Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
5hp | 200V | 17.6A | 3Ø | 60Hz	5hp | 600V | 3.3A | 3Ø | 60Hz	
Running Hours: 11,109 hrs	Running Hours: 8,150 hrs	Running Hours: N/A

Pumping Structures:
2,400 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground Valve Box	N/A

Communications:	Back-up Power Supply:
Wireless Radio	Portable Generator

Description:

The Hallowell sanitary sewer lift station is located on the north side of Hallowell Rd, a dead-end road. The lift station is surrounded by industrial, businesses, and residential.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, and a backflow preventer. The lift station pumps the sewage into sanitary sewer manhole MH 572.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Hallowell lift station is in overall good condition and operating satisfactorily. It has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

Public Works personnel noted that since the Town of View Royal advised the local businesses of unacceptable items to put down the sink that there have been less problems with debris stuck in the pumps.

The valves and piping are in overall good condition.

The electrical system is in overall fair condition. It is aging and nearing its life expectancy. There is a hook-up for back-up power/portable generator and is in overall good condition.

Access to the lift station is good. There is restricted parking along the road for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System			●	
4	Back-up Power *		○		
5	Mechanical System		●		

** Portable generator hook-up*

Specific Details

Civil / Structural

Wet Well: The wet well is a 2,400Ø fibreglass chamber with a steel access hatch and is in overall good condition. The hinges of the access hatch shows signs of corrosion.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2 Hydromatic submersible pumps and motors housed in the wet well – these are in good overall condition as they are well-maintained. The impellers for both pumps were replaced over the past year.

Each pump has different ratings. Pump 1 has 5 hp with 200 V and 17.6 A power rating. Pump 1 has 3 hp with 600 V and 3.3 A power rating.

A drawdown test was conducted on both pumps. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 208 V, 3Ø.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls: The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition due to the aging equipment.

There is a high-level float and an ultrasonic level transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 0.80 m
- Lag Start: N/A
- Pump Stop: 0.60 m
- High Level: 1.40 m
- High High Level: 1.60 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is a space heater in the electrical kiosk and is in overall good condition.

Lighting: There is non-explosion proof incandescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch.

	No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Site lighting is available via street luminaire.
Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with no insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical kiosk is in overall good condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes provisional hook-up for back-up power/portable generator and is in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The steel piping inside the wet well is in overall good condition with minor signs of corrosion. Other piping in the wet well appears to be in good condition.
Valves:	The valves for the 2 pumps are in overall good condition with minor surface corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The level transducer controls the pumps. The float and level transducer are both in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	N/A
Odour Control:	N/A
Backflow Preventer:	An underground backflow preventer is housed in a concrete valve box and is in overall good condition.

Photos

The following photos were taken during the onsite assessment dated August 29, 2017.

Photo 1
Hinges for Access Hatch

Photo 2
Electrical Kiosk Structure

4. Heddle Lift Station

General Information

Heddle Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
4hp | 460/230V | 5.1/10A | 3kW | 3Ø | 60Hz | 3415rpm	4hp | 460/230V | 5.1/10A | 3kW | 3Ø | 60Hz | 3415rpm	
Running Hours: 723 hrs	Running Hours: 669 hrs	Running Hours: N/A

Pumping Structures:
1,220 mm Ø fibreglass tank housing pumps | 2,100 x 800 mm concrete chamber housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Above-ground Kiosk	Retrofit 2015

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Atkins sanitary sewer lift station is located at the end of Heddle Ave, at the corner of Tovey Cres and Governors Pt Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate valve chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 267.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Heddle lift station is in overall excellent condition and operating satisfactorily. This lift station is a new retrofit station (est. 2015). It has been well-maintained with no deficiencies. All pumping appurtenances appear to be in overall excellent condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall excellent condition, as they are in a separate concrete chamber away from the corrosive wet well environment.

The electrical system is in overall excellent condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is fair. There is parking along the road, but not dedicated for Public Works vehicles; however, traffic consists of local residents.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural	●			
2	Pumps and Motors	●			
3	Electrical System	●			
4	Back-up Power	●			
5	Mechanical System	●			

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a 1,220Ø fibreglass chamber with a fibreglass access hatch and is in overall excellent condition.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 2,100 x 800 mm concrete valve chamber is in overall excellent condition.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – these are in overall excellent condition as they were recently replaced over the past 2 years.

A drawdown test was conducted on one of the pumps.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 240 V, 1Ø.

The BC Hydro smart meter is located on hydro pole adjacent to the lift station and is in overall good condition.

Controls: The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and a pressure transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 0.70 m
- Lag Start: N/A
- Pump Stop: 0.30 m
- High Level: 1.50 m
- High High Level: 1.70 m

There is a magmeter flow meter at this lift station and is in good operable condition.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is a space heater in the electrical kiosk.

Lighting: No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is limited via street luminaire.

Fan: The fan is in overall good condition.

Electrical Control Kiosk: The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall good condition.

Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in excellent overall condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø PVC piping inside the wet well and the 75Ø PVC piping inside the valve chamber are in overall excellent condition. Other piping in the wet well appears to be in excellent condition.
Valves:	The valves for the 2 pumps are in overall excellent condition with no surface corrosion. There is a check valve and a gate valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	The air release valve is in the valve chamber on the discharge line and is in overall excellent condition.
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The level transducer controls the pumps. The float and level transducer are both in overall good condition.
Metering:	The magnetic flow meter is in overall excellent condition.
HVAC:	The blower is in overall excellent operable condition.
Odour Control:	N/A
Backflow Preventer:	An above-ground reduced pressure backflow preventer is housed in a kiosk and is in overall excellent condition.

Photos

No photos to provide.

5. Helmcken Bay Lift Station

General Information

Helmcken Bay Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2 – N/A**	**Pump 3 – N/A**
15hp | 460/230V | 19/39A | 11.2kW | 3Ø | 60Hz | 1755rpm	15hp | 460/230V | 19/39A | 11.2kW | 3Ø | 60Hz | 1755rpm	
Running Hours: 25,400 hrs	Running Hours: 25,965 hrs	Running Hours: N/A

Pumping Structures:
1,830 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Above-ground Kiosk	1980

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Helmcken Bay sanitary sewer lift station is located at the south end of Helmcken Rd, at the intersection of Helmcken Rd and View Royal Ave, at the Limekiln Shoreline access/entrance.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Helmcken Bay lift station is in overall fair condition and operating satisfactorily. This is one of the older lift stations in the Town of View Royal and has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment and age of the lift station. All pumping appurtenances appear to be in overall excellent condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are located inside the wet well and are in overall fair condition with signs of corrosion.

The electrical system is in overall fair condition. It is aging and nearing its life expectancy. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is good. There is ample street parking within the quiet and the lift station is blocked from the road with bollards and a retained landscape bed.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural			●	
2	Pumps and Motors	●			
3	Electrical System				●
4	Back-up Power	●			
5	Mechanical System			●	

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a 1,830Ø fibreglass chamber with a steel access hatch and is in overall fair condition. The aluminum hatch is in overall fair condition and is expected of the age.

A portable ladder is used for wet well access.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2- 15 hp Flygt submersible pump and motor housed in the wet well – these are in overall excellent condition as they were replaced within the past year.

A drawdown test was conducted on the pump. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 120-480 V, 3Ø, 3-wire and 192 kW max power.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall good condition.

Controls: The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall fair condition due to the aging equipment.

There is a high-level float and an ultrasonic level transducer with a HMI display panel. The following pump operating levels were provided at the station:

- Lead Start: 1.10 m
- Lag Start: N/A
- Pump Stop: 0.60 m
- High Level: 1.70 m
- High High Level: 1.90 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pump (Hand/Auto/Off) and is in overall poor condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is no heater in the electrical kiosk.

Lighting: There is no lighting inside the electrical kiosk.

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Lighting would be beneficial, as the wet well is not located in a well-lite area.

	Site lighting is available via street luminaire.
Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical panels inside the kiosk show signs of corrosion and the surface should be treated before the panels rust out. The electrical kiosk is in overall fair condition with signs of aging/corrosion on the base of the kiosk.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall excellent condition with no visible signs of corrosion. The location of the back panel is in a constricting area (against vegetation).

Mechanical System

Piping:	The 100Ø steel piping inside the wet well is in overall fair condition, considering the age of the lift station. Other piping in the wet well appears to be in overall good condition.
Valves:	The valves for the 2 pumps are in overall fair condition with surface corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	There are 2 flapper air valves located on the pumps' discharge line and are in overall fair condition due to the surface corrosion.
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer. The level transducer controls the pumps and is in overall fair condition.
Metering:	There is no flow meter at this lift station.
HVAC:	There is no blower for ventilation into the wet well.
Odour Control:	There is no odour control.

Backflow Preventer:	An above-ground reduced pressure backflow preventer is housed in a kiosk and was not assessed (no key for kiosk lock).

Photos

The following photo was taken during the onsite assessment dated August 28, 2017.

Photo 1
Corrosion on Electrical Kiosk and Panels

6. Helmcken Park Lift Station

General Information

Helmcken Park Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
15hp | 460-230V | 19/39A | 3Ø | 11.2kW | 60Hz	15hp | 460-230V | 19/39A | 3Ø | 11.2kW | 60Hz	
Running Hours: 6,374 hrs	Running Hours: 6,145 hrs	Running Hours: N/A

Pumping Structures:
2,000 mm Ø fibreglass tank housing pumps | 1,800 mm Ø concrete tank housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Above-ground Kiosk	Retrofit 2001

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Helmcken Park sanitary sewer lift station is located on the west side of Helmcken Centennial Park, at the entrance off Helmcken Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate valve chamber manhole, an electrical kiosk housing the motor control center, and a diesel generator. The lift station pumps the sewage into sanitary manhole MH 314.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Helmcken Park lift station is in overall good condition and operating satisfactorily. It has been well-maintained with minor deficiencies. There are minor parts in the valve chamber that show signs of corrosion, but due to a non-working drain. All pumping appurtenances appear to be in overall fair condition with little signs of wear and deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition and are in a separate concrete manhole chamber away from the corrosive wet well environment.

The electrical system is in overall good condition. It is aging and nearing its life expectancy. The diesel generator for back-up power is in excellent overall condition.

Access to the lift station is good. There is dedicated parking within the park for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural				
2	Pumps and Motors				
3	Electrical System				
4	Back-up Power				
5	Mechanical System				

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 2,000Ø fibreglass chamber with 2 steel access hatch and is in overall good condition. The access ladder is slightly corroded from the wet well environment.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 1,800 Ø concrete valve chamber is in overall good condition; however, the outlet drain is not working (suspect the pea trap is clogged).

Pumps and Motors

Pumps & Motors: There are 2-15 hp Flygt submersible pumps and motors (rotational) housed in the wet well – these are in overall good condition as they are well-maintained.

A drawdown test was conducted on both pumps. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 120-480 V, 3Ø, 4W with a max rating power of 288 kW.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls: The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a high-level float and an ultrasonic level transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.10 m
- Lag Start: N/A
- Pump Stop: 0.70 m
- High Level: 4.72 m
- High High Level: 4.92 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is a space heater in the electrical kiosk.

Lighting: There is non-explosion proof fluorescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch.

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is available via street luminaire.

Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical kiosk is in overall good condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall excellent condition with no visible signs of corrosion.

Mechanical System

Piping:	The 150Ø steel piping inside the wet well and the 150Ø steel piping inside the valve chamber are in overall good condition. Other piping in the wet well appears to be in good condition.
Valves:	The valves for the 2 pumps are in overall fair condition with surface corrosion. There is a check valve and a plug valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The level transducer controls the pumps. The float and level transducer are both in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	A backflow preventer was not observed. There is a hose bib enclosed in a concrete valve box.

Photos

The following photo was taken during the onsite assessment dated August 28, 2017.

Photo 1
Water in Valve Chamber

7. Hospital Lift Station

General Information

Heddle Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
20hp | 208V | 58A | 3Ø | 60Hz	20hp | 208V | 58A | 3Ø | 60Hz	20hp | 208V | 58A | 3Ø | 60Hz
Running Hours: 30, 030 hrs	Running Hours: 32,224 hrs	Running Hours: 30,458

Pumping Structures:
4,750 x 3,000 mm concrete chamber housing pumps, valves, and backflow preventer | concrete flume chamber

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	Retrofit 2004

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Hospital sanitary sewer lift station is located at the south end corner of the staff parking lot at Victoria General Hospital.

The lift station consists of triplex submersible pumps (all pumps are on rotation) and valves in a concrete wet well chamber, a flume chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 314.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Helmcken lift station is in overall good condition and operating satisfactorily. It has been well-maintained with minor deficiencies. All pumping appurtenances appear to be in overall good condition with little signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is good. There is dedicated parking and ample space for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System		●		

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a 4,750 x 3,000 mm chamber with aluminum hatch for the 3 pumps, additional access, and backflow preventer and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Flume Chamber The concrete flume chamber is in overall good condition. The flume inside the chamber get clogged by sewage from the hospital.

Pumps and Motors

Pumps & Motors: There are 3 Flygt submersible pumps and motors housed in the wet well – these are in overall good condition.

A drawdown test was conducted on one of the pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.2-20 A, 120-480 V, 3Ø, 3-wire with 19.2 kW max power.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall good condition.

Controls:

The system is controlled by a rudimentary Milltronic relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall fair condition.

There is a level transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.50 m
- Lag Start: N/A
- Pump Stop: 0.50 m
- High Level: 2.50 m
- High High Level: 4.00 m

There is no flow meter at this lift station.

Control and Monitoring:

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall fair condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a space heater in the electrical kiosk.

Lighting:

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is limited.

Fan:

The fan is in overall good condition.

Electrical Control Kiosk:

The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall fair condition.

Security:

There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in excellent overall condition with no visible signs of corrosion.

Mechanical System

Piping:	The 100Ø PVC piping inside the wet well is in overall good condition. Other piping in the wet well appears to be in good condition.
Valves:	The valves for the 3 pumps are in overall good condition with surface corrosion. There is a check valve and a plug valve for each pump (3 ea.).
Other Valves:	N/A
Pump Controls:	The pumps are controlled by an ultrasonic level transducer housed in PVC piping. The level transducer controls the pumps. The level transducer is in overall good condition.
Metering:	N/A
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	An underground backflow preventer is housed as part of the wet well, but in a separate chamber and is in overall good condition.

Photos

No photos to provide.

8. Midwood Lift Station

General Information

Midwood Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
2.4hp | 230V | 10A | 18kW | 1Ø | 60Hz | 1710rpm	2.4hp | 230V | 10A | 18kW | 1Ø | 60Hz | 1710rpm	
Running Hours: 1,474 hrs	Running Hours: 1,446 hrs	Running Hours: N/A

Pumping Structures:
1,220 mm Ø fibreglass tank housing pumps | 2,100 x 800 mm concrete chamber housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	Retrofit 2011

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Midwood sanitary sewer lift station is located at the end of Midwood Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate concrete valve chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 314.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Midwood lift station is in overall good condition and operating satisfactorily. It has been well-maintained with no deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition, as they are in a separate concrete chamber away from the corrosive wet well environment.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is good. There is no parking along the road, but parking is available for Public Works vehicles. Bollards should be installed to protect the kiosks and wet well from vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System		●		

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a 1,220Ø fibreglass chamber with an aluminum access hatch and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 2,100 x 800 mm concrete valve chamber is in overall excellent condition.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – these are in overall excellent condition.

A drawdown test was conducted on both pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 240 V, 1Ø, 3-wiring.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls:

The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and a pressure transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 0.90 m
- Lag Start: N/A
- Pump Stop: 0.30 m
- High Level: 1.50 m
- High High Level: 1.80 m

There is a magmeter flow meter at this lift station and is in good operable condition.

Control and Monitoring:

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a block heater in the electrical kiosk.

Lighting:

There is non-explosion proof fluorescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch.

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is limited via street luminaire.

Fan:

The fan is in overall good condition.

Electrical Control Kiosk:

The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall good condition.

Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in excellent overall condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø PVC piping inside the wet well and the 75Ø PVC piping inside the valve chamber are in overall excellent condition. Other piping in the wet well appears to be in excellent condition.
Valves:	The valves for the 2 pumps are in overall excellent condition with no surface corrosion. There is a check valve and a gate valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	The air release valve is in the valve chamber on the discharge line and is in overall excellent condition.
Pump Controls:	The pumps are controlled by a float assembly and a pressure transducer. The float and level transducer are both in overall good condition.
Metering:	The magnetic flow meter is in overall excellent condition.
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	The backflow preventer was not observed during the inspection.

Photos

No photos to provide.

9. Norquay Lift Station

General Information

Norquay Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2 – N/A**	**Pump 3 – N/A**
4hp | 230V | 5.1/10A | 3kW | 3Ø | 60Hz | 3415rpm	4hp | 230V | 5.1/10A | 3kW | 3Ø | 60Hz | 3415rpm	
Running Hours: 23,839 hrs	Running Hours: 15,526 hrs	Running Hours: N/A

Pumping Structures:
1,220 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	1980

Communications:	Back-up Power Supply:
Wireless Radio	Portable Generator

Description:

The Norquay sanitary sewer lift station is located at the end of Norquay Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) and valves in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and back-up power hook-up. The lift station pumps the sewage into sanitary sewer manhole MH 193.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Norquay lift station is in overall fair condition and operating satisfactorily. This is one of the older lift stations in the Town of View Royal and has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment and age of the lift station. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are located inside the wet well and are in overall good condition with minor signs of corrosion.

The electrical system is in overall fair condition. It is aging and nearing end of its life expectancy. There is back-up power hook-up located at the road edge and is in overall good condition.

Access to the lift station is limited, as the lift station is located on a narrow-sloped right-of-way. There is dedicated parking and guardrails at the lift station entrance.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural			●	
2	Pumps and Motors		●		
3	Electrical System			●	
4	Back-up Power *		○		
5	Mechanical System			●	

** Portable generator hook-up*

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 1,220Ø fibreglass chamber with a steel access hatch and is in overall fair condition. The hatch has some rusting on the underside, including the hinges.

A portable ladder is used for wet well access.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2- 4 hp Flygt submersible pump and motor housed in the wet well – these are in overall good condition.

A drawdown test was conducted on the pump. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 240 V, 1Ø, 3-wire.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall fair condition.

Controls: The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall fair condition due to the aging equipment.

There is a high-level float and an ultrasonic level transducer with a HMI display panel. The following pump operating levels were provided at the station:

- Lead Start: 0.70 m
- Lag Start: N/A
- Pump Stop: 0.40 m
- High Level: 0.90 m
- High High Level: 1.10 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pump (Hand/Auto/Off) and is in overall fair condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is no heater in the electrical kiosk.

Lighting: There is no lighting inside the electrical kiosk.

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Lighting would be beneficial, as the wet well is not located in a well-lite area.

	Site lighting is limited via street luminaire.
Fan:	There is no built-in fan in the electrical kiosk.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical panels and kiosk show signs of corrosion and the surface should be treated before the panels rust out. The electrical kiosk is in overall fair condition with signs of aging/corrosion on the base of the kiosk and panels.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes provisional hook-up for back-up power/portable generator and is in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø steel piping inside the wet well is in overall fair condition, considering the age of the lift station. Other piping in the wet well appears to be in overall fair condition.
Valves:	The valves for the 2 pumps are in overall fair condition with minor surface corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer. The level transducer controls the pumps and is in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	There is no blower for ventilation into the wet well.
Odour Control:	There is no odour control.
Backflow Preventer:	A below-ground backflow preventer is housed in a kiosk and is in overall fair condition.

Photos

The following photo was taken during the onsite assessment dated August 28, 2017.

	
Photo 1 Rusted Underside of Access Hatch	Photo 2 Rusted Kiosk

10. Packers Lift Station

General Information

Packers Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
5hp | 208V | 14A | 3Ø | 60Hz	5hp | 208V | 18A | 3Ø | 60Hz	
Running Hours: 647 hrs	Running Hours: 3,044 hrs	Running Hours: N/A

Pumping Structures:
2,440 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	Replaced 1999

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Packers sanitary sewer lift station is located at the end of Midwood Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) and valves in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 146.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Packers lift station is in overall good condition and operating satisfactorily. It has been well-maintained with no deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition and has little to no corrosion on the surface.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is good. There is dedicated parking for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System		●		

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 2,440Ø fibreglass chamber with a fibreglass access hatch and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2 Hydromatic submersible pumps and motors housed in the wet well – these are in overall good condition.

A drawdown test was conducted on both pumps.

Electrical System

Primary Power:	The lift station is metered/powered by an underground BC Hydro service.
Controls:	The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition. There is a float assembly and a pressure transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station: • Lead Start: 0.80 m • Lag Start: N/A • Pump Stop: 0.40 m • High Level: 4.70 m • High High Level: 4.90 m There is no flow meter at this lift station.
Control and Monitoring:	Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition. The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed. Communication to the Town of View Royal is via onsite antenna.
Heating:	There is a space heater in the electrical kiosk.
Lighting:	There is non-explosion proof fluorescent lighting in the power and control sections of the electrical kiosk. The lighting is controlled using a standard light switch. No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Site lighting is limited via street luminaire.
Fan:	The fan is in overall good condition.
Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower. The electrical kiosk is in overall good condition with minor signs of corrosion.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in excellent overall condition with no visible signs of corrosion.

Mechanical System

Piping:	The piping inside the wet well is in overall good condition.
Valves:	The valves for the 2 pumps are in overall good condition with very minor signs of corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a float assembly and a pressure transducer. The float and level transducer are both in overall good condition.
Metering:	N/A
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	The backflow preventer is in overall fair condition. The concrete valve box is cracked and should be replaced.

Photos

Photo 1
Cracked Concrete Box for Backflow Preventer

11. Price Bay Lift Station

General Information

Price Bay Lift Station

Pumps (running hours taken at time of visit):

Pump 1 – N/A	**Pump 2 – N/A**	**Pump 3 – N/A**
20 hp	20 hp	
Running Hours: N/A	Running Hours: N/A	Running Hours: N/A

Pumping Structures:

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit: Current

Communications:	Back-up Power Supply:

Description:

The Price Bay sanitary sewer lift station is located at the end of Price Rd.

New pumps were installed in the lift station in 2011, and in 2018.

The lift station was under retrofit construction during the condition assessment and is not to be included with this report.

12. Stewart Lift Station

General Information

Stewart Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
2.2hp | 460/230V | 3.3/6.6A | 1.6kW | 3Ø | 60Hz | 1670rpm	2.2hp | 460/230V | 3.3/6.6A | 1.6kW | 3Ø | 60Hz | 1670rpm	
Running Hours: 3,453 hrs	Running Hours: 3,320 hrs	Running Hours: N/A

Pumping Structures:
Circular fibreglass tank housing pumps | 2,100 x 800 mm concrete chamber housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Above-ground Kiosk	Retrofit 2013

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Stewart sanitary sewer lift station is located at the end of Stewart Ave within the entrance to Stewart shoreline.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate valve chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 231.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Stewart lift station is in overall good condition and not operating satisfactorily during high rains. This lift station is a new retrofit station (est. 2013). It has been well-maintained with some deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall excellent condition, as they are in a separate concrete chamber away from the corrosive wet well environment.

The electrical system is in overall excellent condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is fair. There is limited parking along the narrow road, but not dedicated for Public Works vehicles; however, traffic consists of local residents.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System	●			
4	Back-up Power	●			
5	Mechanical System	●			

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a circular fibreglass chamber with an aluminum access hatch and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 2,100 x 800 mm concrete valve chamber is in overall excellent condition.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – these are in overall excellent condition as they were replaced in the past 4 years;

however, during the high rains, the Operator received 'alarm calls'. This should be investigated.

A drawdown test was conducted on one of the pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 240 V, 1Ø.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls:

The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and a pressure transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 0.70 m
- Lag Start: N/A
- Pump Stop: 0.30 m
- High Level: 1.32 m
- High High Level: 1.52 m

There is a magmeter flow meter at this lift station and is in excellent operable condition.

Control and Monitoring:

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall excellent condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a space heater in the electrical kiosk.

Lighting:

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

There is no site lighting.

Fan:

The fan is in overall excellent condition.

Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower. The electrical kiosk is in overall excellent condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall excellent condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø PVC piping inside the wet well and the 75Ø PVC piping inside the valve chamber are in overall excellent condition. Other piping in the wet well appears to be in excellent condition.
Valves:	The valves for the 2 pumps are in overall excellent condition with no surface corrosion. There is a check valve and a gate valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	The air release valve is in the valve chamber on the discharge line and is in overall excellent condition.
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The float and level transducer are both in overall excellent condition.
Metering:	The magnetic flow meter is in overall excellent condition.
HVAC:	The blower is in overall excellent operable condition.
Odour Control:	N/A
Backflow Preventer:	An above-ground reduced pressure backflow preventer is housed in a kiosk and is in overall excellent condition.

Photos

No photos to provide.

13. Stoneridge Lift Station

General Information

Stoneridge Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
5hp | 460/230V | 6.8/14A | 3Ø | 3.7kW | 60Hz | 1745rpm	5hp | 230V | 21.4A | 3Ø | 60Hz	
Running Hours: 1,987 hrs	Running Hours: 1,246 hrs	Running Hours: N/A

Pumping Structures:
1,830 mm Ø fibreglass tank housing pumps | 1,500 mm Ø concrete chamber housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	Built 2001

Communications:	Back-up Power Supply:
Wireless Radio	Portable Generator

Description:

The Stoneridge sanitary sewer lift station is located at the end of Stoneridge Place, adjacent to Stoneridge Wetland Park.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate valve chamber, an electrical kiosk housing the motor control center, and backflow preventer. The lift station pumps the sewage into sanitary sewer manhole MH 868.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Stoneridge lift station is in overall good condition and operating satisfactorily. It has been well-maintained with minor deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition, as they are in a separate concrete chamber away from the corrosive wet well environment.

The electrical system is in overall good condition. The blower for the wet well is not working and should be repaired.

Access to the lift station is good. There is on-street parking along the road, but not dedicated for Public Works vehicles; however, traffic consists of local residents.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power *		○		
5	Mechanical System			●	

** Portable generator hook-up*

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 1,830Ø fibreglass chamber with a fibreglass access hatch and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 1,500Ø concrete valve chamber is in overall good condition.

Pumps and Motors

Pumps & Motors: There are 2 submersible pumps and motors housed in the wet well – Pump 1 is in overall good condition; Pump 2 was replaced in 2017 and is assumed to be in good condition.

A drawdown test was conducted on one of the pumps.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service providing service rating of 240 V, 1Ø.

The BC Hydro smart meter is located on hydro pole adjacent to the lift station and is in overall good condition.

Controls: The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and a pressure transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 0.90 m
- Lag Start: N/A
- Pump Stop: 0.30 m
- High Level: 3.38 m
- High High Level: 3.58 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is a space heater in the electrical kiosk.

Lighting: No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is limited via street luminaire.

Fan: The fan is in overall good condition.

Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower. The electrical kiosk is in overall good condition.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes provisional hook-up for back-up power/portable generator and is in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The 100Ø steel piping inside the wet well and the 100Ø steel piping inside the valve chamber are in overall good condition. Other piping in the wet well appears to be in fair condition.
Valves:	The valves for the 2 pumps are in overall good condition with minor surface corrosion. There is a check valve and a butterfly valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The float and level transducer are both in overall good condition.
Metering:	N/A
HVAC:	The blower is not working and should be repaired.
Odour Control:	Injector pump has been removed.
Backflow Preventer:	An under-ground backflow preventer is housed in a concrete valve box and is in overall good condition.

Photos

No photos to provide.

14. Talcott Lift Station

General Information

Talcott Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
3.9hp | 230V | 3.9A | 1Ø | 60Hz	3.9hp | 230V | 3.9A | 1Ø | 60Hz	
Running Hours: 3,211 hrs	Running Hours: 3,890 hrs	Running Hours: N/A

Pumping Structures:
1,830 mm Ø fibreglass tank housing pumps 1,520 mm Ø concrete chamber housing valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Under-ground	Built 1999

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Talcott sanitary sewer lift station is located along the side of Talcott Rd.

The lift station consists of duplex submersible pumps (all pumps are on rotation) in a fibreglass wet well chamber, a separate valve chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into sanitary sewer manhole MH 156.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Talcott lift station is in overall good condition and operating satisfactorily. It has been well-maintained with no deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition, as they are in a separate concrete chamber away from the corrosive wet well environment.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall excellent condition.

Access to the lift station is good. There is dedicated parking along the side of the road, but not dedicated for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System		●		

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 1,830Ø fibreglass chamber with a fibreglass access hatch and is in overall good condition.

The wet well is regularly cleaned from the onsite water supply.

Valve Chamber The 1,520Ø concrete valve chamber is in overall good condition.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – these are in overall good condition.

A drawdown test was conducted on one of the pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 240 V, 0.5-200 A, 1Ø, 60 Hz.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls:

The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and an ultrasonic level transducer with a Milltronics HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.25 m
- Lag Start: N/A
- Pump Stop: 0.50 m
- High Level: 3.26 m
- High High Level: 3.46 m

There is no flow meter at this lift station.

Control and Monitoring:

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a space heater in the electrical kiosk.

Lighting:

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is limited via street luminaire.

Fan:

The fan is in overall good condition.

Electrical Control Kiosk:

The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall good condition.

Security:

There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in excellent overall condition with no visible signs of corrosion.

Mechanical System

Piping:	The 100Ø PVC and steel piping inside the wet well and the 100Ø steel piping inside the valve chamber are in overall good condition. Other piping in the wet well appears to be in good condition.
Valves:	The valves for the 2 pumps are in overall excellent condition with no surface corrosion. There is a check valve and a plug valve for each pump (2 ea.). The valves are housed in a separate valve chamber.
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer housed in PVC piping. The float and level transducer are both in overall good condition.
Metering:	N/A
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	An underground backflow preventer is housed in a concrete valve box and is in overall good condition. The Operator noted that the water pressure was reduced after the installation of the backflow preventer.

Photos

No photos to provide.

15. Thetis Cove Lift Station

General Information

Thetis Cove Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2 – N/A**	**Pump 3 – N/A**
3hp | 230V | 17A | 3Ø | 60Hz	4hp | 460/230V | 5.1/10A | 3Ø | 60Hz	
Running Hours: 8,369 hrs	Running Hours: 5,736 hrs	Running Hours: N/A

Pumping Structures:
1,220 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	1980

Communications:	Back-up Power Supply:
Wireless Radio	Portable Generator

Description:

The Thetis Cove sanitary sewer lift station is located along View Royal Ave along the pathway to Thetis Cove shoreline acess.

The lift station consists of duplex submersible pumps (all pumps are on rotation) and valves in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and back-up power hook-up. The lift station pumps the sewage into sanitary sewer manhole MH 122.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Thetis Cove lift station is in overall fair condition and operating satisfactorily. This is one of the older lift stations in the Town of View Royal and has been well-maintained with minor deficiencies. There are minor parts in the wet well that show signs of corrosion, but only because of the nature of the environment and age of the lift station. All pumping appurtenances appear to be in overall fair condition with signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are located inside the wet well and are in overall fair condition with minor signs of corrosion.

The electrical system is in overall fair condition. It is aging and nearing its life expectancy. There is back-up power hook-up and is in overall fair condition.

Access to the lift station is limited, as the lift station is located on a narrow-sloped right-of-way. There is restricted parking at the road entrance with removable bollards for vehicular access.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural			●	
2	Pumps and Motors			●	
3	Electrical System			●	
4	Back-up Power *		○		
5	Mechanical System			●	

** Portable generator hook-up*

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 1,220Ø fibreglass chamber with a steel access hatch and is in overall fair condition. The hatch has some rusting on the underside, including the hinges.

A portable ladder is used for wet well access.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2 submersible pump and motor housed in the wet well (different makes of pumps) – these are in overall fair condition.

A drawdown test was conducted on Pump 2. Results are provided within this report.

Electrical System

Primary Power: The lift station is metered/powered by an underground BC Hydro service.

The BC Hydro smart meter is housed in a kiosk mounted to a hydro pole adjacent to the access and is in overall fair condition.

Controls: The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall fair condition due to the aging equipment.

There is a high-level float assembly controlling the pumps. The following pump operating levels were provided at the station:

- Lead Start: 0.18 m
- Lag Start: N/A
- Pump Stop: 0.07 m
- High Level: 1.60 m
- High High Level: 1.80 m

There is no flow meter at this lift station.

Control and Monitoring: Both manual and automatic control systems are available for controlling the pump (Hand/Auto/Off) and is in overall fair condition.

The SCADA system is integrated into the electrical system and is in overall fair condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating: There is no heater in the electrical kiosk.

Lighting: There is no lighting inside the electrical kiosk.

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks. Lighting would be beneficial, as the wet well is not located in a well-lite area.

Site lighting is very limited via street luminaire.

Fan: There is no built-in fan in the electrical kiosk.

Electrical Control Kiosk:	The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 2 enclosures to house the: (1) pump motor protection and starter; and, (2) controls and monitoring equipment. The electrical kiosk show signs of corrosion and the surface should be treated. The electrical kiosk is in overall poor condition with signs of aging/corrosion on the top of the kiosk and doors.
Security:	There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes provisional hook-up for back-up power/portable generator and is in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The 75Ø steel piping inside the wet well is in overall fair condition, considering the age of the lift station. Other piping in the wet well appears to be in overall fair condition.
Valves:	The valves for the 2 pumps are in overall fair condition with minor surface corrosion. There is a check valve and a plug valve for each pump (2 ea.). Both check valves were replaced over the past 3 years.
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level float assembly and is in overall good condition.
Metering:	There is no flow meter at this lift station.
HVAC:	The blower is in overall fair condition.
Odour Control:	There is no odour control.
Backflow Preventer:	A below-ground backflow preventer is at the lift station and is in overall fair condition.

Photos

The following photo was taken during the onsite assessment dated August 28, 2017.

Photo 1
Minor rust on Electrical Kiosk

16. View Royal Lift Station

General Information

View Royal Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
25hp | 230V | 61A | 3Ø | 60Hz	25hp | 208V | 67A | 3Ø | 60Hz	
Running Hours: 12,433 hrs	Running Hours: 12,153 hrs	Running Hours: N/A

Pumping Structures:
2,435 x 2,435 mm concrete tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	Retrofit 1998

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The View Royal sanitary sewer lift station is located on Pheasant Ln, near the Helmcken Rd / Pheasant Ln roundabout.

The lift station consists of duplex submersible pumps (all pumps are on rotation) and valves in a concrete wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into CRD's Western Communities Trunk main.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The View Royal lift station is in overall fair condition and operating satisfactorily. It has been well-maintained with very minor deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall fair condition and has corrosion on the surface.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall good condition.

Access to the lift station is good. There is dedicated parking for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural			●	
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power	●			
5	Mechanical System			●	

1. *Specific Details*

Civil / Structural

Wet Well: The wet well is a 2,435 x 2,435 mm concrete chamber with steel access hatches and is in overall good condition. The hatches have rust on the hinges and underside.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – these are in overall good condition. Pump 1 was installed in 2010 and Pump 2 in 2014.

A drawdown test was conducted on both pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 120-480 V, 3Ø, 4W with a max rating power of 288 kW.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls:

The system is controlled by a rudimentary Milltronics relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a high-level alarm float and an ultrasonic level transducer with a Milltronics HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.70 m
- Lag Start: N/A
- Pump Stop: 0.60 m
- High Level: 1.80 m
- High High Level: 2.00 m

There is no flow meter at this lift station.

Control and Monitoring:

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a space heater in the electrical kiosk.

Lighting:

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is via street luminaire.

Fan:

N/A

Electrical Control Kiosk:

The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall good condition with minor signs of corrosion.

Security:

There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall excellent condition with no visible signs of corrosion.

Mechanical System

Piping:	The piping inside the wet well is in overall fair condition.
Valves:	The valves for the 2 pumps are in overall good condition with very minor signs of corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	N/A
Pump Controls:	The pumps are controlled by a high-level alarm float and an ultrasonic level transducer. The float and level transducer are both in overall good condition.
Metering:	N/A
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	The water service is in overall fair condition.

Photos

Photo 1
Rusted Underside of Access Hatch

17. Wilfert Lift Station

General Information

Wilfert Lift Station

Pumps (running hours taken at time of visit):

Pump 1	**Pump 2**	**Pump 3 – N/A**
20hp | 200V | 62.5A | 3Ø | 60Hz	20hp | 200V | 62.5A | 3Ø | 60Hz	
Running Hours: 811 hrs	Running Hours: 2,445 hrs	Running Hours: N/A

Pumping Structures:
2,400 mm Ø fibreglass tank housing pumps and valves

Motor Control Center:	Backflow Preventer:	Built/Last Retrofit:
Above-ground Kiosk	Underground	N/A

Communications:	Back-up Power Supply:
Wireless Radio	Onsite Diesel Generator

Description:

The Wilfert sanitary sewer lift station is located on Hart Rd, near the Old Island Highway.

The lift station consists of duplex submersible pumps (all pumps are on rotation) and valves in a fibreglass wet well chamber, an electrical kiosk housing the motor control center, backflow preventer, and a diesel generator. The lift station pumps the sewage into CRD's Western Communities Trunk main.

The lift station is linked to the Town of View Royal's SCADA system via antenna.

General Observation/Recommendations

The Wilfert lift station is in overall good condition and operating satisfactorily. It has been well-maintained with no deficiencies. All pumping appurtenances appear to be in overall good condition with little to no signs of wear or deterioration. All pumps are inspected annually and repairs are made when necessary.

The valves and piping are in overall good condition and has minor corrosion on the surface.

The electrical system is in overall good condition. The diesel generator for back-up power is in overall good condition.

Access to the lift station is good. There is dedicated parking for Public Works vehicles.

The overall lift station condition assessment is summarized as follow:

Item	Category	Excellent	Good	Fair	Poor
1	Civil/Structural		●		
2	Pumps and Motors		●		
3	Electrical System		●		
4	Back-up Power		●		
5	Mechanical System		●		

1. Specific Details

Civil / Structural

Wet Well: The wet well is a 2,400Ø fibreglass chamber with a fibreglass access hatch and is in overall excellent condition.

The wet well is regularly cleaned from the onsite water supply.

Pumps and Motors

Pumps & Motors: There are 2 Flygt submersible pumps and motors housed in the wet well – the pumps were replaced in 2017 and 2018 and are in overall good condition.

A drawdown test was conducted on both pumps.

Electrical System

Primary Power:

The lift station is metered/powered by an underground BC Hydro service providing service rating of 0.5-200 A, 120-480 V, 3Ø, 4W with a max rating power of 288 kW.

The BC Hydro smart meter is located within the power distribution section of the electrical kiosk and is in overall excellent condition.

Controls:

The system is controlled by a rudimentary relay logic system and is linked to the Town of View Royal's SCADA system. The logic system is simple and reliable. The controls appear to be in overall good condition.

There is a float assembly and an ultrasonic level transducer with a HMI display panel for wet well levels. The following pump operating levels were provided at the station:

- Lead Start: 1.30 m
- Lag Start: N/A
- Pump Stop: 0.30 m
- High Level: 1.40 m
- High High Level: 1.60 m

There is no flow meter at this lift station.

Both manual and automatic control systems are available for controlling the pumps (Hand/Auto/Off) and are in overall good condition.

The SCADA system is integrated into the electrical system and is in overall good condition; however, the SCADA pack may be nearing its design life and a newer SCADA system should be reviewed.

Communication to the Town of View Royal is via onsite antenna.

Heating:

There is a space heater in the electrical kiosk.

Lighting:

No lighting is provided in the wet well. Although generally not required, explosion proof lighting within the wet well is recommended to provide sufficient lighting for Public Works personnel to perform maintenance tasks.

Site lighting is via street luminaire.

Fan:

N/A

Electrical Control Kiosk:

The motor control center is housed by an above-ground painted metal kiosk with insulation. The kiosk has 3 enclosures to house the: (1) pump motor protection and starter, (2) controls and monitoring equipment; and, (3) blower.

The electrical kiosk is in overall good condition with no signs of corrosion.

Security:

There are no intrusion detectors at this lift station.

Back-up Power

Back-up Power:	The lift station includes an onsite diesel generator housed in a Genset kiosk. The generator is exercised annually. The generator and kiosk are in overall good condition with no visible signs of corrosion.

Mechanical System

Piping:	The piping inside the wet well is in overall good condition.
Valves:	The valves for the 2 pumps are in overall good condition with very minor signs of corrosion. There is a check valve and a plug valve for each pump (2 ea.).
Other Valves:	The air valve and slid valve are in overall good condition.
Pump Controls:	The pumps are controlled by a high-level float and an ultrasonic level transducer. The float and level transducer are both in overall good condition.
Metering:	N/A
HVAC:	The blower is in overall good operable condition.
Odour Control:	N/A
Backflow Preventer:	The backflow preventer is in overall good condition.

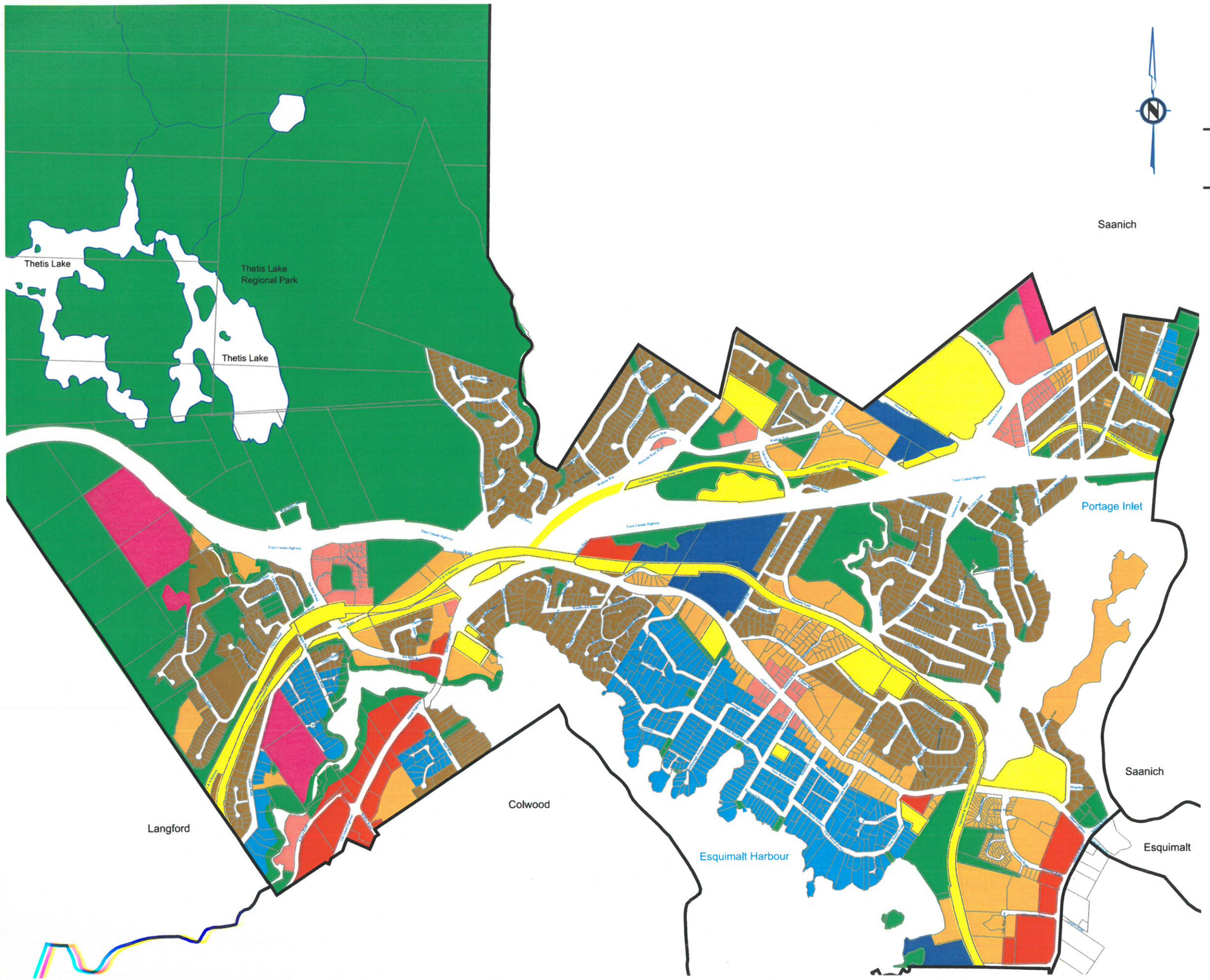
Photos

No photos to provide.

Appendix C: Future Land Use Map

TOWN OF VIEW ROYAL
MASTER DRAINAGE PLAN
UPDATE 2017

FUTURE LAND USE MAP



LEGEND

- COMMERCIAL
- COMMUNITY FACILITY
- MIXED RESIDENTIAL
- NEIGHBORHOOD MIXED-USE
- PARK, OPEN SPACE
- RESIDENTIAL
- LARGE LOT RESIDENTIAL
- RURAL
- INTENSIVE MIXED-USE
- MUNICIPAL BOUNDARY

0 150 1:15,000 750m

APLIN MARTIN

Project 16-282
14/07/2017

Figure 3

Appendix D: Model Input Assumptions and Model Output Validation

D. Model Geometry

D.1.1 GIS Integration, SANSYS Data and Survey Information

The following GIS shape files were received from the Town and imported into the PC-SWMM model:

- Conduits which included gravity mains, force mains
- Cadastral files which included survey parcels
- Junctions with included cleanouts, fittings, manholes
- Network structures which included sewer network structures (pump stations), discharge points
- Sanitary catchment areas

The shape files provided the names of each attribute; the X-Y coordinate locations for junctions; and the corresponding length, assumed roughness, type of main (force or gravity), and diameter for conduits. LiDAR data was also received, providing rim elevations for the junctions in the model.

It was noted by the Town that the GIS information would be missing integral data such as pipe inverts and slopes, and that these would be retrieved from the Town's existing SANSYS sanitary sewer model. The SANSYS data contained directly applicable information for 532 out of 754 junctions - imported to PC-SWMM.

Where geometric data was missing, industry standard assumptions were adopted – for pipe lengths and slopes, pending future additional survey. The Town advised that infrastructure on strata properties be eliminated from the model, as no information was available for these locations, and a number of as-builts were received to provide information for some of the other missing manholes. Following these updates, it was decided that any pipe segments less than 5m long at the terminal ends of the system that were still missing data were to be removed from the model with the goal of reducing surveying costs, as these minor upstream segments are expected to have adequate capacity due to the minimal loadings these segments receive. Data for remaining manholes were measured in the field if accessible and added to the model, while the others that could not be accessed were estimated based on a constant slope between the nearest known upstream and downstream manholes. Since cleanouts and fittings could not be accessed to measure invert elevations, these were also similarly estimated based on upstream and downstream invert elevations.

Agreement on maximum allowable flows from the Hospital were not known, and if these exist, should be confirmed an included in the models.

For the purpose of this study, the sanitary system was evaluated assuming the 413 sites at the RV Park were all occupied.

D.1.2 Naming Convention

Two names were provided for each piece of infrastructure in GIS. The first was a string of numbers and letters (136 for manhole; 136X for main for example) believed to be specific to the Town and matching the SANSYS data, while the other provided information on the infrastructure owner and type of infrastructure, followed by a string of zeros and the same number as described above (VRMH0000000000000136 for example), believed to be the naming convention used by the CRD.

The CRD node-name was imported into PCSWMM since it provided additional information useful for identifying the specific infrastructure (manhole, cleanout, fitting, etc.). Mains contained the same identifier as their upstream junction, followed by the letter X or Y to signify it as a main.

D.2 Sewer Network

The sewer network within the model comprises conduits, junctions, sub catchments, storage nodes, pumps, and outlets.

D.2.1 Conduits

The model contains three distinct types of conduits:

1. Gravity mains
2. Force mains
3. CRD trunk main

The gravity mains comprise the majority of the model's conduits, ranging in size from 150mm to 450mm, with all mains discharging either to one of the Town's 17 pump stations or the CRD's Craigflower pump station. Inlet (upstream) and outlet (downstream) main elevations were included to properly model drops at the manholes. Initial depths were added for each conduit based on the average expected depths to reduce filling of the mains at the beginning of the simulation, which reduced calculation errors.

Force mains are located downstream of each pump station and range in size from 75mm to 250mm. Force mains downstream of the Atkins, Helmcken Bay, Wilfert, and View Royal pump stations discharge directly into the CRD trunk main, while the majority of the remaining force mains discharge to gravity mains further down the system on route to the CRD trunk main through the aforementioned pump stations. The exception to this is the Hospital, Helmcken Park, and Midwood pump stations, which connect to the CRD trunk main by gravity on Shoreline Drive.

The CRD main receives flow from other municipalities before entering View Royal and as a result could not be modeled effectively, but this reality is not material or of consequence to the View Royal operating models.

Although it was not the focus of the study, Hydraulic Grade Line (HGL) information from the CRD was required for the force main tie-in points described above, in order that the model would calculate the approximate required pump head and corresponding flow rates correctly in modelling the outflow from the wet wells. In reality, these pump stations connect to the trunk main through siphons, which allows for a constant-required HGL. To simulate this, the CRD main size was modelled as very large, with the invert elevations at each tie-in point matching the CRD's recorded HGLs. This allows the system to be modeled without fluctuations in the HGL. *Table D1* indicates the HGL values received from the CRD for each of the connecting pump stations.

Table D1: Pump Station HGLs at CRD Trunk Main Tie-in Points

Pump Station	HGL (m)
Atkins	25.82
Helmcken Bay	10.00
View Royal	10.00
Wilfert	27.18

D.2.2 Junctions

The model contains three distinct types of junctions:

1. Manholes
2. Cleanouts
3. Fittings

All of these junctions are treated in the same manner. A number of junctions did not have invert elevation information and could not be accessed in the field. In these cases, it was assumed that junctions upstream and downstream of mains are constant - so that an estimated invert elevation could be calculated. A total of 36 out of 797 junctions were estimated with this method. Future refinement/survey data acquisition will allow this to be corrected. Furthermore, five invert elevations were changed as they either appeared to be wrong (10m lower than surrounding junctions) or had negative slopes, which obstructed flow through the system. These sections were all less than 20m in length. These junctions were labelled either “InvertEstimated” or “InvertChanged” in the Tag attribute in PC-SWMM, supplemented with a description of the issues to be reviewed in future and the interim correction in the model.

The junctions receive flow demand information from the sub catchment layer described below, with I&I demands being stored in the junction’s “Baseline” attribute and the BSF demands being stored in the junction’s “Average Value” attribute. Initial depths were added for each junction based on the average expected depths to reduce filling of the mains at the beginning of the simulation, which reduced calculation errors.

D.2.3 Sub Catchments

The sub catchments layer in the model represents all of the parcels in View Royal that are believed to connect to the Town’s sanitary sewer network. Each sub catchment has been tagged with the pump station name it discharges to, which automatically colour-codes so that each pump station catchment area can easily be distinguished in the model. Note that if any properties are added to these models, the pump station tag name must be written to match the others.

This layer is used to calculate all of the model’s flow demands. A new group under the sub catchments attribute tab named “Sanitary Inputs/Calculations” contains all of the attributes necessary to calculate BSF and I&I demands for each parcel in View Royal, with these two values being transferred to the junction layer as described above.

D.2.4 Storage Nodes

Storage nodes have been used in the model to represent each pump station wet well. Many wet well invert elevations that were imported were deemed to be incorrect. Wet well diameters, invert elevations and depths were extracted from the Town’s pump station as-builts to properly model their capacities in PC-SWMM. Storage nodes also received a text tag, supplemented with a description of the change if applicable, showing which wet wells had their invert elevations changed based on the Town’s as-built drawings.

D.2.5 Pumps

Pumps were added manually to the model, directly following the storage node. All pump stations have two pumps, with the exception of the Glenairlie and Hospital pump stations, which have one and three pumps respectively.

Pump curve information was received from the Town for all pumps except for the Hallowell and Wilfert pump stations. Pump data for these two locations was received internally from McElhanney following the pump station condition assessments and manufacturer pump curves were located.

D.2.6 Outfalls

The CRD trunk main and Craigflower pump station were both imported into PC-SWMM in the initial stages as they were included in shape files - with other View Royal owned infrastructure. The CRD main was kept in the model for spatial purposes, so that future modellers can discern how the Town's infrastructure interacts with the CRD's main, but the Craigflower pump station was converted to an outfall, such that the model could discharge all of the Town's flows without further modelling the CRD system. Ie: allowing for one 'aggregate' system model, rather than a series of separate models.

		Model Outputs vs. Expected Calculated Values											
		PDWF (L/s)			I&I (L/s)						PWWF (with 5 Yr I&I) (L/s)		
Pump Station	Contributing Areas/Notes	Modelled	Expected	% Difference	Modelled 5 Yr	Expected 5 Yr	% Difference	Modelled 100 Yr	Expected 100 Yr	% Difference	Modelled	Expected	% Difference
Atkins		13.35	13.62	-2%	12.10	12.10	0%	17.85	17.85	0%	25.46	25.72	-1%
Glenairlie		0.26	0.27	-3%	0.37	0.37	0%	0.54	0.54	1%	0.64	0.64	0%
Hallowell		2.03	2.09	-3%	2.15	2.15	0%	3.18	3.18	0%	4.18	4.24	-2%
Heddle		0.72	0.74	-3%	0.67	0.67	0%	0.99	0.99	0%	1.39	1.41	-1%
HelmBay	Heddle, Stewart, HelmBay	7.17	5.85	20%	14.10	10.48	29%	14.03	19.08	-31%	19.91	16.33	20%
HelmPark		6.96	6.90	1%	9.52	9.52	0%	13.50	13.5	0%	16.48	16.41	0%
Hospital		15.90	15.39	3%	2.07	2.07	0%	3.07	3.06	0%	17.99	17.46	3%
Midwood		1.36	1.38	-2%	1.69	1.69	0%	2.50	2.5	0%	3.05	3.07	-1%
Norquay		0.23	0.21	10%	0.18	0.16	13%	0.23	0.27	-15%	0.41	0.37	11%
Packers		7.06	7.06	0%	9.09	9.08	0%	12.49	12.49	0%	16.14	16.14	0%
PriceBay		6.52	6.39	2%	10.21	10.19	0%	16.49	16.52	0%	16.72	16.58	1%
Stewart		0.56	0.54	3%	1.43	1.43	0%	2.30	2.3	0%	1.99	1.97	1%
Stoneridge		1.04	1.07	-3%	0.52	0.52	-1%	0.77	0.77	0%	1.57	1.59	-1%
Talcott	Stoneridge	6.36	2.82	77%	6.48	2.47	90%	3.70	7.83	-72%	9.51	5.29	57%
ThetisCove		0.35	0.33	6%	1.21	1.21	0%	1.78	1.78	0%	1.56	1.54	1%
ViewRoyal	Price Bay, Norquay, HelmBay, Glenairlie	41.26	33.31	21%	38.49	13.55	96%	20.02	67.16	-108%	83.11	46.86	56%
Wilfert		3.27	3.28	0%	2.24	2.25	0%	3.32	3.33	0%	5.52	5.53	0%

Appendix E: Detailed Model Output

LOCATION 1 - Fort Victoria RV Park, North of E&N Rail Trai

									Existing - 5 year I&I					Existing - 100 year I&I					Future - 5 year I&I					Future - 100 year I&I					UPGRADES										UPGRADES											
									Manhole				Main	Manhole				Main	Manhole				Main	Manhole				Main											Future - 5 year I&I											
Name	Inlet Node	Outlet Node	Length (m)	Diameter (m)	Slope (m/m)	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Diameter (m)	Diameter Change?	Slope (m/m)	Slope Change?	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max Velocity (m/s)	Max Velocity (m/s)
VRMH000000000000190X	VRMH000000000000190	VRMH000000000000146	46.531	0.200	0.00107	13	14.492	1.492	0.11	No	0	1.382	0.77	0.14	No	0	1.352	0.86	0.11	No	0	1.382	0.49	4.18	Yes	3.98	0	0.49	0.300	Yes	0.00107	No	13	14.492	1.492	0.10	No	0	1.392	0.40	0.11	No	0	1.382	0.51	0.9	0.91
VRMH000000000000146X	VRMH000000000000146	VRMH000000000000145	62.328	0.200	0.05060	9.85	12.985	3.135	0.63	Yes	0.43	2.505	0.77	2	Yes	1.8	1.135	0.86	0.24	Yes	0.04	2.895	0.57	6.05	Yes	5.85	0	0.57	0.300	Yes	0.03998	Yes	10.51	12.985	2.475	0.21	No	0	2.925	0.51	0.21	No	0	2.925	0.54	1.9	1.19
VRMH000000000000139X	VRMH000000000000139	VRMH000000000000139A	11.492	0.300	0.01392	8.67	10.366	1.696	0.09	No	0	1.606	0.47	0.1	No	0	1.596	0.52	0.12	No	0	1.576	0.63	0.13	No	0	1.566	0.63	0.375	Yes	0.00261	Yes	8.67	10.366	1.696	0.10	No	0	1.596	0.53	0.13	No	0	1.566	0.67	0.83	1.11
VRMH000000000000140X	VRMH000000000000140	VRMH000000000000139	27.906	0.300	0.00502	8.92	11.298	2.378	0.14	No	0	2.238	0.54	0.16	No	0	2.218	0.6	0.25	No	0	2.128	0.66	0.22	No	0	2.158	0.66	0.375	Yes	0.00251	Yes	8.79	11.298	2.508	0.21	No	0	2.168	0.55	0.27	No	0	2.108	0.71	0.78	1.05
VRMH000000000000141X	VRMH000000000000141	VRMH000000000000140	42.947	0.300	0.00210	9.06	12.6	3.54	0.18	No	0	3.36	0.71	0.21	No	0	3.33	0.82	0.28	No	0	3.26	0.77	0.39	Yes	0.09	3.15	0.77	0.375	Yes	0.00256	Yes	8.89	12.6	3.71	0.23	No	0	3.31	0.62	0.3	No	0	3.24	0.64	0.7	0.92
VRMH000000000000143X	VRMH000000000000143	VRMH000000000000142	45.491	0.300	0.00264	9.32	14.012	4.692	0.23	No	0	4.462	0.77	0.34	Yes	0.04	4.352	1	0.3	No	0	4.392	0.75	1.12	Yes	0.82	3.572	0.75	0.375	Yes	0.00264	No	9.17	14.012	4.842	0.24	No	0	4.452	0.59	0.27	No	0	4.422	0.56	0.76	0.95
VRMH000000000000191X	VRMH000000000000191	VRMH000000000000190	99.769	0.200	0.04525	13.05	17.248	4.198	2.78	Yes	2.58	1.418	0.71	0.47	Yes	0.27	3.728	0.71	0.19	No	0	4.008	0.68	4.18	Yes	3.98	0.018	0.68	0.200	No	0.04525	No	13.05	17.248	4.198	0.15	No	0	4.048	0.54	0.2	No	0	3.998	0.71	1.17	1.17
VRMH000000000000142X	VRMH000000000000142	VRMH000000000000141	53.25	0.300	0.00300	9.16	13.27	4.11	0.25	No	0	3.86	0.81	0.3	No	0	3.81	1	0.3	No	0	3.81	0.76	0.75	Yes	0.45	3.36	0.76	0.375	Yes	0.00263	Yes	-	-	-	-	-	-	-	0.59	-	-	-	-	0.58	0.77	0.97
VRMH000000000000143X	VRMH000000000000143	VRMH000000000000142	101.568	0.300	0.00000	9.44	13.061	3.621	0.23	No	0	3.391	0.88	1.15	Yes	0.85	2.471	1	0.29	No	0	3.331	0.75	1.57	Yes	1.27	2.051	0.75	0.375	Yes	0.00256	Yes	9.32	13.061	3.741	0.23	No	0	3.391	0.60	0.26	No	0	3.361	0.56	0.74	0.96
VRMH000000000000144X	VRMH000000000000144	VRMH000000000000143	53.511	0.300	0.00654	9.44	11.512	2.072	0.46	Yes	0.16	1.612	0.81	1.7	Yes	1.4	0.372	1	0.31	Yes	0.01	1.762	0.76	3.09	Yes	2.79	0	0.76	0.375	Yes	0.00280	Yes	9.61	11.512	1.902	0.25	No	0	1.822	0.60	0.28	No	0	1.792	0.56	0.79	1
VRMH000000000000145X	VRMH000000000000145	VRMH000000000000144A	17.769	0.250	0.00056	9.84	11.478	1.638	0.56	Yes	0.31	1.078	1	1.86	Yes	1.61	0	1	0.2	No	0	1.438	0.74	5.65	Yes	5.4	0	0.74	0.300	Yes	0.00732	Yes	10.38	11.478	1.098	0.18	No	0	1.458	0.65	0.19	No	0	1.448	0.54	1.38	1.53
VRMH000000000000144AX	VRMH000000000000144A	VRMH000000000000144	82.56	0.250	0.00061	9.79	11.268	1.478	0.18	No	0	1.298	0.87	2	Yes	1.75	0	1	0.29	Yes	0.04	1.188	0.66	3.48	Yes	3.23	0	0.66	0.375	Yes	0.00715	Yes	9.79	11.268	1.478	0.24	No	0	1.238	0.55	0.26	No	0	1.218	0.5	1.11	1.37

LOCATION 2 - Border of View Royal Park and Helmcken Meadows/Pheasant Meadows Townhomes

									Existing - 5 year I&I					Existing - 100 year I&I					Future - 5 year I&I					Future - 100 year I&I					UPGRADES										UPGRADES											
									Manhole				Main	Manhole				Main	Manhole				Main	Manhole				Main											Future - 5 year I&I											
Name	Inlet Node	Outlet Node	Length (m)	Diameter (m)	Slope (m/m)	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Diameter (m)	Diameter Change?	Slope (m/m)	Slope Change?	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max Velocity (m/s)	Max Velocity (m/s)
VRMH000000000000604X	VRMH000000000000604	VRMH000000000000600	24.061	0.150	0.01288	4.673	7.464	2.791	0.05	No	0	2.741	0.09	0.07	No	0	2.721	0.09	0.08	No	0	2.711	0.09	3.86	Yes	3.71	0	0.09	0.150	No	0.01288	No	4.673	7.464	2.791	0.07	No	0	2.721	0.09	0.08	No	0	2.711	0.09	0.3	0.36
VRMH000000000000603X	VRMH000000000000603	VRMH000000000000600	97.493	0.150	0.00744	4.673	7.464	2.791	0.05	No	0	2.741	0.12	0.07	No	0	2.721	0.13	0.08	No	0	2.711	0.12	3.86	Yes	3.71	0	0.12	0.150	No	0.00744	No	4.673	7.464	2.791	0.07	No	0	2.721	0.12	0.08	No	0	2.711	0.13	0.3	0.34
VRMH000000000000608X	VRMH000000000000608	VRMH000000000000607	43.284	0.150	0.05370	2.02	5.072	3.052	0.21	Yes	0.06	2.842	0.07	0.77	Yes	0.62	2.282	0.08	0.09	No	0	2.962	0.07	4.7	Yes	4.55	0	0.07	0.150	No	0.05370	No	2.02	5.072	3.052	0.07	No	0	2.982	0.06	0.09	No	0	2.962	0.08	0.57	0.6
VRMH000000000000135X	VRMH000000000000135	VRMH000000000000134	138.968	0.300	0.00029	0.7	3.075	2.375	0.14	No	0	2.235	0.73	0.15	No	0	2.225	0.75	0.21	No	0	2.165	0.64	0.24	No	0	2.135	0.64	0.375	Yes	0.00691	Yes	-0.55	3.075	3.625	0.18	No	0	2.195	0.51	0.23	No	0	2.145	0.69	1.07	1.33
VRMH000000000000136X	VRMH000000000000136	VRMH000000000000135	37.132	0.300	0.01374	0.74	4.56	3.82	0.85	Yes	0.55	2.97	1	1.13	Yes	0.83	2.69	1	0.24	No	0	3.58	0.64	3.04	Yes	2.74	0.78	0.64	0.375	Yes	0.00700	Yes	0.44	4.56	4.12	0.19	No	0	3.63	0.51	0.26	No	0	3.56	0.51	1.07	1.34
VRMH000000000000133X	VRMH000000000000133	VRMH000000000000075	22.406	0.300	0.00045	-1.35	3.88	5.23	0.2	No	0	5.03	0.75	0.24	No	0	4.99	0.89	0.46	Yes	0.16	4.77	0.86	0.69	Yes	0.39	4.54	0.86	0.375	Yes	0.00669	Yes	-1.35	3.88	5.23	0.21	No	0	5.02	0.39	0.27	No	0	4.96	0.55	1.38	1.72
VRMH000000000000134X	VRMH000000000000134	VRMH000000000000133	90.17	0.300	0.02263	-1.34	3.071	4.411	0.28	No	0	4.131	0.7	0.99	Yes	0.69	3.421	0.75	0.32	Yes	0.02	4.091	0.56	1.01	Yes	0.71	3.401	0.56	0.375	Yes	0.00688	Yes	-1.2	3.071	4.271	0.18	No	0	4.231	0.39	0.23	No	0	4.181	0.5	1.07	1.32
VRMH000000000000075Y	VRMH000000000000075	VRNS000000000000VRPS	6.164	0.250	0.04873	-	-	-	-	-	-	-	0.89	-	-	-	-	0.97	-	-	-	-	1	-	-	-	-	1	0.450	Yes	0.04873	No	-	-	-	-	-	-	-	0.73	-	-	-	-	0.81	2.25	2.77
VRMH000000000000137X	VRMH000000000000137	VRMH000000000000136	81.764	0.300	0.00355	1.25	4.089	2.839	0.48	Yes	0.18	2.359	1	0.82	Yes	0.52	2.019	1	0.24	No	0	2.599	0.64	3.19	Yes	2.89	0	0.64	0.375	Yes	0.00685	Yes	0.73	4.089	3.359	0.19	No	0	2.649	0.51	0.23	No	0	2.609	0.69	1.07	1.33
VRMH000000000000138X	VRMH000000000000138	VRMH000000000000137A	29.393	0.300	0.00374	1.61	4.868	3.258	0.5	Yes	0.2	2.758	1	1.02	Yes	0.72	2.238	1	0.24	No	0	3.018	0.62	4.49	Yes	4.19	0	0.62	0.375	Yes	0.00748	Yes	1.47	4.868	3.398	0.19	No	0	3.068	0.50	0.26	No	0	2.998	0.67	1.11	1.38
VRMH000000000000137AX	VRMH000000000000137A	VRMH000000000000137	20.087	0.300	0.00348	1.54	4.737	3.197	0.5	Yes	0.2	2.697	1	0.98	Yes	0.68	2.217	1	0.24	No	0	2.957	0.63	4.3	Yes	4	0	0.63	0.375	Yes	0.00715	Yes	1.32	4.737	3.417	0.19	No	0	3.007	0.51	0.26	No	0	2.937	0.68	1.02	1.36

LOCATION 3 - Talcott Road, Downstream of Talcott Pump Station

									Existing - 5 year I&I					Existing - 100 year I&I					Future - 5 year I&I					Future - 100 year I&I					UPGRADES										UPGRADES											
									Manhole				Main	Manhole				Main	Manhole				Main	Manhole				Main											Future - 5 year I&I											
Name	Inlet Node	Outlet Node	Length (m)	Diameter (m)	Slope (m/m)	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Diameter (m)	Diameter Change?	Slope (m/m)	Slope Change?	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max Velocity (m/s)	Max Velocity (m/s)
VRMH000000000000157X	VRMH000000000000157	VRMH000000000000156	23.366	0.150	0.00976	9.755	11.138	1.383	0.37	Yes	0.22	1.013	0.55	3.38	Yes	3.23	0	1	0.1	No	0	1.283	0.36	3.47	Yes	3.32	0	0.36	0.150	No	0.00976	No	9.755	11.138	1.383	0.09	No	0	1.293	0.35	0.09	No	0	1.293	0.36	0.31	0.44
VRMH000000000000156X	VRMH000000000000156	VRMH000000000000155	45.532	0.150	0.00253	9.64	12.342	2.702	0.06	No	0	2.642	0.69	0.08	No	0	2.622	0.77	#N/A	#N/A	#N/A	#N/A	#N/A	0.09	No	0	2.612	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.04	#N/A	#N/A	2.662	0.44	0.81	0.81
VRMH000000000000155X	VRMH000000000000155	VRMH000000000000154	43.244	0.200	0.02869	8.39	12.336	3.946	0.07	No	0	3.876	0.3	0.1	No	0	3.846	0.41	0.13	No	0	3.816	#N/A	0.12	No	0	3.826	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.13	#N/A	#N/A	3.836	0.4	0.87	0.89
VRMH000000000000157AX	VRMH000000000000157A	VRMH000000000000157	40.342	0.150	0.07225	9.983	13.275	3.292	0.01	No	0	3.282	0.07	4.65	Yes	4.5	0	0.52	0.01	No	0	3.282	0.07	4.94	Yes	4.79	0	0.07	0.150	No	0.07225	No	9.983	13.275	3.292	0.01	No	0	3.282	0.05	0.02	No	0	3.272	0.08	0.2	0.45
NEW PARALLEL SECTION BELOW																																				**NEW TWINNED SECTION**											
C2	VRMH000000000000156	J14	2.57	0.200	0.00778	9.67	12.416	2.746	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.1	No	0	2.646	0.38	#N/A	#N/A	#N/A	#N/A	0.38	0.250	Yes	0.00778	Yes	9.67	12.416	2.746	0.10	No	0	2.646	0.38	0.1	No	0	2.646	0.47	1.48	1.48
C3	J15	VRMH000000000000154	3.7	0.250	0.00541	8.39	12.336	3.946	0.07	No	0	3.876	#N/A	0.1	No	0	3.846	#N/A	0.13	No	0	3.816	0.51	0.12	No	0	3.826	0.51	0.250	Yes	0.00541	Yes	8.39	12.336	3.946	0.11	No	0	3.836	0.49	0.13	No	0	3.816	0.45	1.17	0.87
C4	J14	J15	83.99	0.200	0.01429	8.44	12.715	4.275	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.250	Yes	0.01429	Yes	8.44	12.715	4.275	0.12	No	0	4.155	0.39	0.11	No	0	4.165	0.5	0.84	1.21

LOCATION 4 - Along Trans-Canada Hwy - Northwest of Adam's Storage View Royal

									Existing - 5 year I&I					Existing - 100 year I&I					Future - 5 year I&I					Future - 100 year I&I					UPGRADES										UPGRADES											
									Manhole				Main	Manhole				Main	Manhole				Main	Manhole				Main											Future - 5 year I&I											
Name	Inlet Node	Outlet Node	Length (m)	Diameter (m)	Slope (m/m)	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Diameter (m)	Diameter Change?	Slope (m/m)	Slope Change?	Outlet manhole invert elevation (m)	Outlet manhole rim elevation (m)	Depth - Rim to Invert (m)	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max. Water Depth in Manhole (m)	Surcharge ?	Max. Surcharge Depth (m)	Distance from Rim (m)	Max d/D	Max Velocity (m/s)	Max Velocity (m/s)
VRMH000000000000173X	VRMH000000000000173	VRMH000000000000172	53.052	0.200	0.00226	6.48	10.485	4.005	0.16	No	0	3.845	0.71	0.42	Yes	0.22	3.585	1	0.18	No	0	3.825	0.71	0.42	Yes	0.22	3.585	0.71	0.200	No	0.00226	No	6.48	10.485	4.005	0.10	No	0	3.905	0.43	0.33	Yes	0.13	3.675	0.84	0.54	0.54
VRMH000000000000169X	VRMH000000000000169	VRMH000000000000168	87.577	0.200	0.00320	5.27	7.567	2.297	0.15	No	0	2.147	0.67	0.18	No	0	2.117	0.8	0.15	No	0	2.147	0.67	0.18	No	0	2.117	0.67	0.250	Yes	0.00308	Yes	5.27	7.567	2.297	0.08	No	0	2.217	0.30	0.15	No	0	2.147	0.53	0.58	0.58
VRMH000000000000172X	VRMH000000000000172	VRMH000000000000171	151.844	0.200	0.00250	6.04	7.659	1.619	0.25	Yes	0.05	1.369	0.87	1.49	Yes	1.29	0.129	1	0.18	No	0	1.439	0.77	1.41	Yes	1.21	0.209	0.77	0.200	No	0.00250	No	6.05	7.659	1.609	0.08	No	0	1.539	0.43	0.14	No	0	1.479	0.8	0.54	0.54
VRMH000000000000171X	VRMH000000000000171	VRMH000000000000170	65.734	0.200	0.00091	5.88	9.573	3.693	0.13	No	0	3.563	0.77	0.16	No	0	3.533	0.81	0.11	No	0	3.583	0.57	0.16	No	0	3.533	0.57	0.250	Yes	0.00304	Yes	5.82	9.573	3.753	0.08	No	0	3.613	0.30	0.14	No	0	3.553	0.52	0.58	0.58
VRMH000000000000174X	VRMH000000000000174	VRMH000000000000173	51.759	0.200	0.00522	6.79	10.343	3.553	0.17	No	0	3.383	0.58	0.3	Yes	0.1	3.253	0.72	0.17	No	0	3.383	0.58	0.3	Yes	0.1	3.253	0.58	0.200	No	0.00522	No	6.79	10.343	3.553	0.10	No	0	3.453	0.33	0.22	Yes	0.02	3.333	0.71	0.36	0.54
VRMH000000000000167X	VRMH000000000000167	VRNS000000000000PAPS	11.715	0.200	0.00341	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.6	#N/A	#N/A	#N/A	#N/A	0.67	#N/A	#N/A	#N/A	#N/A	0.6	#N/A	#N/A	#N/A	#N/A	0.6	0.250	Yes	0.00341	No	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.28	#N/A	#N/A	#N/A	#N/A	0.48	0.62	0.62
VRMH000000000000168X	VRMH000000000000168	VRMH000000000000167	104.483	0.200	0.00335	4.92	10.056	5.136	0.13	No	0	5.006	0.69	0.15	No	0	4.986	0.82	0.13	No	0	5.006	0.69	0.15	No	0	4.986	0.69	0.250	Yes	0.00306	Yes	4.92	10.056	5.136	0.08	No	0	5.056	0.30	0.13	No	0	5.006	0.52	0.57	0.57
VRMH000000000000170Y	VRMH000000000000170	VRMH000000000000169	70.913	0.200	0.00395	5.6	9.59	3.99	0.16	No	0	3.83	0.73	0.19	No	0	3.8	0.86	0.19	No	0	3.8	0.53	0.19	No	0	3.8	0.53	0.250	Yes	0.00310	Yes	5.57	9.59	4.02	0.08	No	0	3.91	0.30	0.15	No	0	3.84	0.52	0.58	0.58

Appendix F: Cost Estimates: Gravity

View Royal Sanitary Master Plan Upgrades - View Royal, BC
CLASS D CONSTRUCTION COST ESTIMATE
Location 1 - Fort Victoria RV Park, North of E&N Rail Trail

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1.0	**SANITARY SEWERS**				
1.1	`300 mm dia. Sewer Pipe, Imported Backfill (2-3 m depth)	m	80	$500	$ 40,000
1.2	`300 mm dia. Sewer Pipe, Trenchless Installation, Casing and Carrier P Under Railway	m	47	$3,500	$ 164,500
1.3	`375 mm dia. Sewer Pipe, Imported Backfill (2-3 m depth)	m	277	$600	$ 166,200
1.4	`375 mm dia. Sewer Pipe, Imported Backfill (3-5 m depth)	m	142	$1,000	$ 142,000
	TOTAL SANITARY SEWERS				**$ 512,700**
2.0	**ADDITIONAL CONSTRUCTION COSTS**				
2.1	Traffic Control	LS	1	$5,000	$ 5,000
2.2	Surface Restoration	m	232	$100	$ 23,200
2.3	1200mm Diameter Manholes, on 100m spacing, typ.	m	546	$100	$ 54,600
2.4	Removal of Existing Pipe	m	546	$100	$ 54,600
2.5	Reconnections of Service Connections - Assumed at 25m intervals, $1,000 each, double serviced frontage	m	546	$100	$ 54,600
2.6	Bypass Pumping	m	546	$100	$ 54,600
	TOTAL ADDITIONAL CONSTRUCTION COSTS				**$ 246,600**
	SUBTOTAL				**$ 759,300**
	CONTINGENCY ALLOWANCE @ 25%				$ 189,825
	SUBTOTAL CONSTRUCTION COST				$ 949,125
	ENGINEERING @ 15%				$ 142,369
	TOTAL CONSTRUCTION COST				**$ 1,091,494**

SITE-SPECIFIC ASSUMPTIONS:

1. Trenchless installation required under railway
2. No obstructions within RV park that require demolition or reinstatement
3. Potential need to re-align sewer around existing electrical substation
4. Existing ROW in place and no additional land acquisition required

GENERAL ASSUMPTIONS/CLARIFICATIONS:

1. for 300mm diameter - 2-3 metres deep - cost of supply and install new pipe $500 per leneal metre, typical 2017 prices tendered locally
2. assumes no bedrock removal
3. assumes no substantive groundwater issues to be contended with
4. assumes removal and replacement on existing line and grade.
5. all above prices are net of taxes

View Royal Sanitary Master Plan Upgrades - View Royal, BC
CLASS D CONSTRUCTION COST ESTIMATE
Location 2 - Border of View Royal Park and Helmcken Meadows/Pheasant Meadows Townhomes

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1.0	**SANITARY SEWERS**				
1.1	`375 mm dia. Sewer Pipe, Imported Backfill (3-5 m depth)	m	420	$1,000	$ 420,000
1.2	`450 mm dia. Sewer Pipe, Imported Backfill (3-5 m depth)	m	6	$1,100	$ 6,600
	TOTAL SANITARY SEWERS				**$ 420,000**
2.0	**ADDITIONAL CONSTRUCTION COSTS**				
2.1	Traffic Control	LS	1	$5,000	$ 5,000
2.2	Surface Restoration	m	22	$100	$ 2,200
2.3	1200mm Diameter Manholes, on 100m spacing, typ.	m	426	$100	$ 42,600
2.4	Removal of Existing Pipe	m	426	$100	$ 42,600
2.5	Reconnections of Service Connections - Assumed at 25m intervals, $1,000 each, double serviced frontage	m	426	$100	$ 42,600
2.6	Clearing and Grubbing of Trees	ha	0.3	$20,000	$ 6,000
2.7	Bypass Pumping	m	426	$100	$ 42,600
	TOTAL ADDITIONAL CONSTRUCTION COSTS				**$ 183,600**
	SUBTOTAL				**$ 603,600**
	CONTINGENCY ALLOWANCE @ 25%				$ 150,900
	SUBTOTAL CONSTRUCTION COST				$ 754,500
	ENGINEERING @ 15%				$ 113,175
	TOTAL CONSTRUCTION COST				**$ 867,675**

SITE-SPECIFIC ASSUMPTIONS:

1 Clearing and grubbing for trees required along sewer line in park
2 Existing ROW in place and no additional land acquisition required

GENERAL ASSUMPTIONS/CLARIFICATIONS:

1 for 300mm diameter - 2-3 metres deep - cost of supply and install new pipe $500 per leneal metre, typical 2017 prices tendered locally
2 assumes no bedrock removal
3 assumes no substantive groundwater issues to be contended with
4 assumes removal and replacement on existing line and grade.
5 all above prices are net of taxes

View Royal Sanitary Master Plan Upgrades - View Royal, BC
CLASS D CONSTRUCTION COST ESTIMATE
Location 3 - Talcott Road, Downstream of Talcott Pump Station

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1.0	**SANITARY SEWERS**				
1.1	`250 mm dia. Sewer Pipe, Imported Backfill (3-5 m depth)	m	7	$800	$ 5,600
1.2	`250 mm dia. Sewer Pipe, Trenchless Installation, Casing and Carrier P Under Highway	m	84	$3,500	$ 294,000
	TOTAL SANITARY SEWERS				**$ 299,600**
2.0	**ADDITIONAL CONSTRUCTION COSTS**				
2.1	Surface Restoration	m	-	$100	$ -
2.2	1200mm Diameter Manholes, on 100m spacing, typ.	m	91	$100	$ 9,100
2.3	Removal of Existing Pipe	m	-	$100	$ -
2.4	Reconnections of Service Connections - Assumed at 25m intervals, $1,000 each, double serviced frontage	m	91	$100	$ 9,100
2.5	Bypass Pumping	m	91	$100	$ 9,100
	TOTAL ADDITIONAL CONSTRUCTION COSTS				**$ 27,300**
	SUBTOTAL				**$ 326,900**
	CONTINGENCY ALLOWANCE @ 25%				$ 81,725
	SUBTOTAL CONSTRUCTION COST				$ 408,625
	ENGINEERING @ 15%				$ 61,294
	TOTAL CONSTRUCTION COST				**$ 469,919**

SITE-SPECIFIC ASSUMPTIONS:

1 Trenchless installation required under highway
2 Existing 150mm under Highway to be abandoned if poor condition - if condition OK, may reduce new pipe to 200mm and operate in parallel with ex

GENERAL ASSUMPTIONS/CLARIFICATIONS:

1 for 300mm diameter - 2-3 metres deep - cost of supply and install new pipe $500 per leneal metre, typical 2017 prices tendered locally
2 assumes no bedrock removal
3 assumes no substantive groundwater issues to be contended with
4 assumes removal and replacement on existing line and grade.
5 all above prices are net of taxes

View Royal Sanitary Master Plan Upgrades - View Royal, BC
CLASS D CONSTRUCTION COST ESTIMATE
Location 4 - Along Trans-Canada Hwy - Northwest of Adam's Storage View Royal

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT
1.0	**SANITARY SEWERS**					
1.1	`250 mm dia. Sewer Pipe, Imported Backfill (3-5 m depth)	m	71	$800	$	56,800
1.2	`250 mm dia. Sewer Pipe, Trenchless Installation, Casing and Carrier P Under Highway	m	66	$3,500	$	231,000
	TOTAL SANITARY SEWERS				**$**	**287,800**
2.0	**ADDITIONAL CONSTRUCTION COSTS**					
2.1	Surface Restoration	m	-	$100	$	-
2.2	1200mm Diameter Manholes, on 100m spacing, typ.	m	137	$100	$	13,700
2.3	Removal of Existing Pipe	m	71	$100	$	7,100
2.4	Reconnections of Service Connections - Assumed at 25m intervals, $1,000 each, double serviced frontage	m	137	$100	$	13,700
2.5	Bypass Pumping	m	137	$100	$	13,700
	TOTAL ADDITIONAL CONSTRUCTION COSTS				**$**	**48,200**
	SUBTOTAL				**$**	**336,000**
	CONTINGENCY ALLOWANCE @ 25%				$	84,000
	SUBTOTAL CONSTRUCTION COST				$	420,000
	ENGINEERING @ 15%				$	63,000
	TOTAL CONSTRUCTION COST				**$**	**483,000**

SITE-SPECIFIC ASSUMPTIONS:

1. Trenchless installation required under highway
2. Upsized under-capacity pipes from 200mm to 250mm. Downstream pipes to Packers PS showing no surcharging kept as 200mm to reduce constru
3. Existing ROW in place and no additional land acquisition required

GENERAL ASSUMPTIONS/CLARIFICATIONS:

1. for 300mm diameter - 2-3 metres deep - cost of supply and install new pipe $500 per leneal metre, typical 2017 prices tendered locally
2. assumes no bedrock removal
3. assumes no substantive groundwater issues to be contended with
4. assumes removal and replacement on existing line and grade.
5. all above prices are net of taxes

Appendix G: Cost Estimates: Pump Stations

Town of View Royal
Sanitary Sewer Master Plan Update
Lift Station Condition Assessment - Related Recommended Approximate Budget Allocations
for 5 Year Capital Plan and 20 year Full Build out Scenario
October, 2017

EXISTING CONDITIONS						short term - 5 year capital plan applicable		Priority	longer term - 20 year build out [year 2037] expectation		Priority	
station #	Station Name	Pump HP	external valve chamber	back-up Power	Year of construction/latest retrofit	major component	approx. aggregate cost		major component	approx. aggregate cost		Notes
1	Atkins	25	Y	Y	2003	modest upgrade of mech/hvac, elect[scada]	$15,000	**2**	all except wet well/valve chamber	$310,000	**3**	likely that major components will require replacement early on in the longer term plan, other than wet well and valve chamber. Eye wash station to be added.
2	Glenairlie	2	N	N	1980	complete replacement except wet well. Add valve chamber	$170,000	**1**	n/a	$0	-	simplex pump station existing. Requires second pump in the short term. Assume 1,200mm diameter wet well will be adequate for second pump - eg Heddle.
3	Hallowell	5	N	N	1996?	complete replacement except wet well. Add valve chamber	$170,000	**10**	n/a	$0	-	Consider that the station will be eliminated in the longer term, if development downstream materializes. Timing of this is unknown, therefore proceed toward end of five year plan. Judgement call at that time.
4	Heddle	4	Y	Y	2015	n/a	$0	-	pumps/motors, Elec	$55,000	**12**	This is a relatively new station. Assume pumps and elec will require replacement as part of 20 year programme, but genset will not.
5	Helmcken Bay	15	N	Y	1980	Elec, mech, valve chamber	$155,000	**6**	pumps/motors	$40,000	**10**	new pumps in 2012 and 2016. Genset is thought to be newer than the remainder of the station. Assume new genset is not required for 20 year plan. Valve chamber required
6	Helmcken Park	15	Y	Y	2001	mech - minor misc.	$10,000	-	pumps/motors, Elec, mech, genset	$225,000	**4**	new pumps in 2015, 2016
7	Hospital	20	N	Y	2004	Elec	$50,000	**13**	pumps/motors, mech, genset	$250,000	**5**	electrical issue to be attended to short term, pumps not alternating automatically. Needs valve chamber, longer term
8	Midwood	2.4	Y	Y	2011	n/a	$0	-	pumps/motors, Elec, mech	$105,000	**9**	This is a relatively new station. Assume pumps, etc, will require replacement as part of 20 year programme, but genset will not. Is sea level rise an issue for this station? Likely greater than 20 year horizon?
9	Norquay	4	N	N	1980	complete replacement except wet well. Add valve chamber	$170,000	**7**	n/a	$0	-	n/a
10	Packers	5	N	Y	1999	pumps/motors	$20,000	**4**	Elec, mech, valve chamber, genset	$150,000	**1**	assume new valve chamber is expected, long term
11	Price Bay	20	Y	Y	2018	n/a	$0	-	pumps/motors	$75,000	**13**	This is a relatively new station. Assume pumps will require replacement as part of 20 year programme
12	Stewart	2.2	Y	Y	2013	n/a	$0	-	pumps/motors	$20,000	**11**	This is a relatively new station. Assume pumps will require replacement as part of 20 year programme. Elec and mech may be discretionary at 20 year term - not included here.
13	Stoneridge	5	Y	Y	2001	mech/odor issue, single pump required	$35,000	**3**	pumps/motors, Elec, genset	$95,000	**2**	needs odor control issue attended to in the short term and one pump replaced - budget cost is best guess.
14	Talcott	3.9	Y	Y	1999	pumps/motors, elec, mech	$105,000	**12**	genset	$40,000	**8**	genset replacement expected - longer term. Assume valve chamber ok long term.
15	Thetis Cove	3	N	N	1980	complete replacement except wet well. Add valve chamber	$170,000	**8**	n/a	$0	-	assume pumps will not require replacement again, prior to expiration of 20 year design planning horizon
16	View Royal	25	N	Y	1998	Elec, mech, valve chamber	$195,000	**11**	pumps/motors, genset	$150,000	**6**	assume existing wet-well can be serviceable over the design horizon. Rehab of concrete wet-well to be assumed as O&M cost, not capital budget. Needs external valve chamber in the short term. New pumps in 2012, 2014. Assume pumps will be required again late in the 20 year, longer term horizon.
17	Wilfert	20	N	Y	1996	pumps/motors, elec, mech, valve chamber	$270,000	**9**	genset	$75,000	**7**	assumes short term need for upgrade. Older station, add valve chamber in short term. Assume genset can wait till longer term.
						Subtotal:	**$1,535,000**		Subtotal:	**$1,590,000**		
						Contingency Allowance @ 25%:	**$383,750**		Contingency Allowance @ 25%:	**$397,500**		
						Subtotal Construction Costs:	**$1,918,750**		Subtotal Construction Costs:	**$1,987,500**		
						Engineering @ 15%:	**$287,813**		Engineering @ 15%:	**$298,125**		
						TOTAL CONSTRUCTION COST:	**$2,206,563**		TOTAL CONSTRUCTION COST:	**$2,285,625**		

Notes/Assumptions:

1. Cost estimates should be considered as preliminary, class 'd' only. Given large degree of variability in expected lifespan of existing assets, due to maintenance schedules, et
2. Costs cited are due to condition of the station components, **not** due to capacity issues. Thus, the proportion of costs recoverable though DCCs should reflect this.
3. Backup gensets, if in place now, are assumed to require replacement at year 20. the 4 stations without backup power are smaller HP and assumed to not require same, through year 20
4. Assumption is that on-going wet wells, hatches and/or valve chamber rehab costs - to remedy leakage and minor structural issues - will be attended to as O&M budget issues
5. New valve chambers are assumed desired/expected, as part of the 20 year plan, where separate chambers do not yet exist.
6. Expectation that all stations will be re-built in component parts, not reconstructed in full, i.e.: wet-wells will be rehabilitated and reused - 20 year models suggest capacity requirements do not warrant larger wet wells
7. Short term - 5 year plan to include replacement of all hydro-pneumatic pumps with Flygt units
8. Electrical equipment, gensets and pumps assumed to have 20 to 25 year useful service life
9. Genset replacement at year 20 - 25 is predicated on assumption of parts availability and service labour increase with time, not due to unit run-time
10. Major components, to be replaced as part of the 5 year capital plan, will **NOT** be required again as part of 20 year plan. ***This warrants further discussion with the Town, prior to finalizing the repor***
11. need to confirm forcemain velocities are not too high, if larger replacement pumps are selected at any given statior
12. costs cited do not include taxes, 20% contingency or 10% engineering allowance. All costs cited in 2017 dollars

Justification for these priorities are as follows:

0-5 years

1. the Glenairlie PS is top as it a simplex which does not meet current standards will be out of commission if the single existing pump fails;

Next priorities were to deal with some of the minor issues.

2. Ventilation and eye wash at Atkins is a safety item.
3. Stoneridge minor issues next to deal with odour issue, and address pump while there.
4. Packers.
5. Helmcken Park.

The remaining 3 1980 pump stations have been prioritized based on flow rate/HP considering that the larger the PS the more difficult it is to deal with inflows in the event of failure.

6. Helmcken Bay, mainly concerned about electrical failure.
7. Norquay
8. Thetis Cove

Major upgrades for remaining PS generally in order of age.

9. Wilfert PS.
10. Hallowell PS
11. View Royal PS
12. Talcott PS
13. Hospital PS electrical upgrades. This is more of an annoyance for the operator so I pushed to end of 5 years.

6-20 years

Generally in order based on age.

1. Packers
2. Stoneridge
3. Atkins (moved ahead of Helmcken Park due to potential capacity issues in the future)
4. Helmcken Park
5. Hospital
6. View Royal, genset is likely next oldest of remaining, but not sure.
7. Wilfert genset
8. Talcott

Now getting into replacement for pumps/elec done recently, based on age.

9. Midwood
10. Helmcken Bay
11. Stewart
12. Heddle
13. Price Bay