Core Area Inflow & Infiltration Program 2021 Report

Capital Regional District | October 2021

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CORE AREA INFLOW & INFILTRATION PROGRAM
2021 REPORT

EXECUTIVE SUMMARY

The Core Area Liquid Waste Management Plan (CALWMP) sets out goals and commitments for the municipalities, First Nations and Capital Regional District (CRD) to manage Inflow & Infiltration (I&I) through the Core Area I&I Management Plan. The Core Area I&I 2021 Report documents progress towards meeting these commitments for the period of 2020 to mid-2021.

In general, municipalities with aging sewer infrastructure are addressing areas with elevated I&I through sewer catchment analysis, investigations, rehabilitation and targeted sewer renewal. The municipalities with newer sewer infrastructure are focusing on I&I prevention. Overviews of municipal I&I actions, along with specific actions from this reporting period, are as follows:

Colwood diligently inspects its new underground infrastructure to manage and prevent I&I. In 2020, Colwood started to update its Sewer Master Plan and its sanitary sewer model (in progress). As part of the work, sewer flow data loggers were installed at several pump stations including three of Colwood's municipal pump stations and the Department of National Defence's Belmont pump station. Colwood camera inspected approximately 7,500 metres of sewer mains in 2020.

Esquimalt completed an extensive infrastructure investigation between 2004 and 2016, including the relining of approximately half of its sanitary sewer system. In 2020 to mid-2021, Esquimalt completed a detailed I&I report that includes a 10-year plan for addressing I&I concerns within the Township to get below 4xADWF (average dry weather flow). The action items will be combined with other sewer related projects such as those derived from sewer modeling and camera inspections. Esquimalt also carried out a number of sewer repairs and worked with CRD Source Control to determine possible cross connections into the Gorge Waterway (ongoing).

Langford has a rapidly expanding new sewer system. Langford diligently inspects new connections and is incentivized to monitor and repair the sewer system to preserve sewer capacity for future growth. Since mid-2020, Langford has camera inspected 2305 metres of sewer mains and inspected 45 manholes for I&I. It also rehabilitated 27 sewer inspection chambers.

Oak Bay is working on the Uplands combined sewer separation project. In 2020 to mid-2021, Oak Bay completed a 5-year program to camera inspect its sanitary sewers, contracted a consultant to build a sanitary sewer model for the municipality (in progress), rehabilitated or replaced 3.66 km of sewer mains, fixed 14 cross-connections, and initiated a number of specific infrastructure projects and studies.

Saanich continues its sewer maintenance and repair program, including camera inspections, sewer relining, smoke testing and flow monitoring. In 2020/2021, Saanich relined or replaced 3,914 metres of sanitary sewer main and 125 laterals and two manholes. It also completed 5 spot repairs. Saanich camera-inspected 5,656 metres of sewer main. It smoke tested 2,935 metres of the Brett pump station catchment and repaired 7 found cross-connections. During this reporting period, Saanich developed programs and procedures related to smoke testing and the inspection and replacement of "no-corrode" sewer pipe and updated its sanitary sewer model. Saanich is currently updating its sewer master plan.

Victoria continues to manage its sewer repair and replacement work in its Sewer Master Plan. In 2020/2021, Victoria contracted a consultant to complete a comprehensive I&I reduction plan for the municipality. Victoria installed, repaired or replaced 2,852 metres of sewer mains, 167 laterals, 4 manholes and 17 inspection chambers. It also camera Inspected 24,900 metres of sanitary sewer mains, 887 laterals, 650 manholes and added two high accuracy flow metres to its monitoring network. A highlight was securing a federal grant to upgrade some of its sewer, storm drain and water main infrastructure over the next 9 years to address challenges related to natural hazards (i.e., earthquakes, climate change).

View Royal continued its programs related to sewer maintenance and repairs, camera inspections, sewer flushing and flow monitoring. In 2020/2021, View Royal camera-inspected 1,429 metres of sewer pipe and upgraded the Thetis Cove pump station, which included the addition of a flow meter. View Royal also found and fixed an abandoned sewer main that was contributing I&I to the View Royal sewer system.

The Esquimalt Nation hired a consultant to inspect their sewer system and provide recommendations in 2018. Since then, the Nation followed up by removing / capping unused laterals, grouting a leaky manhole, and completing a mainline repair. They also renewed/upgraded their pump station.

The Songhees Nation does routine sewer maintenance and repairs as needed. In 2015, the Nation hired a consultant to investigate their sewer system for I&I sources and to provide detailed designs for remediation. The work is ready for tender and awaiting funding from Indigenous Services Canada.

Through the Core Area I&I Program, the CRD continues to work with its municipal and First Nations partners on I&I related management and reduction efforts. This includes regional flow monitoring, standardizing I&I approaches, preparing management plans and annual reports, education programs and private property I&I initiatives. This also involves coordination with municipalities and national organizations that are dealing with similar issues. Key actions completed in 2020/2021 include:

- Working with the CRD Integrated Water Services Department; vetted sewer flow data and produced monthly municipal sewer reports for each of the core area participant areas; each area gets its own custom report. The key audience for the reports are municipal engineering staff and First Nation’s administration. The reports quantify monthly sewer flows and compare it to previous years. They also quantify I&I rates, overflows, and periodically compare the flows to the CRD sewer allocations. The reports are distributed quarterly and started in January 2020.
- Working on the 5-year update to the I&I Management Plan. (The last version was submitted to the Province in April 2017).
- Finalizing a project documenting the flow data accuracy from core area municipal pump stations.
- Completing a study looking at downspout disconnection programs and best practices from around Canada.

The work described above will continue to support the regional effort to control and reduce municipal I&I flow rates; however, continued and focused work is still needed to meet the Core Area Liquid Waste Management Plan (CALWMP) commitment of reducing wet weather flows below 4 times average dry weather flow at Clover Point and the McLoughlin Point wastewater treatment plant by 2030. Municipalities with older sewers, and inherently higher I&I, will need to allocate additional resources and accelerate efforts to meet their respective I&I reduction targets.

1. BACKGROUND

1.1 Overview

The CRD completed a CALWMP in July 2000 to serve the municipalities of Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria, View Royal, Esquimalt Nation and Songhees Nation. The plan provides a strategy for managing liquid waste and was approved by the Ministry of Environment. Section 5 of the CALWMP addresses the *Management of Infiltration and Inflow and Control of Wastewater Overflows* (see Appendix A).

Each year, the CRD’s Core Area Liquid Waste Management Committee, comprised of core area representatives, submits a CALWMP status report to the Province. In order to prepare this report, the committee requires annual reports from the CRD departments that are involved in the implementation of the CALWMP. This report provides the update for the Core Area I&I Program and includes data from 2020 to mid-2021. The report is divided as follows:

- Section 1 - Background
- Section 2 - Key Initiatives
- Section 3 - Overflows
- Section 4 – Private Property Inflow & Infiltration
- Section 5 – Education
- Section 6 – Inflow & Infiltration Rates for the Core Area
- Section 7 – Sewer Allocations
- Section 8 – Municipal and First Nation’s I&I Initiatives
- Section 9 – Summary

1.2 Study Area

The CRD’s core area is a partnership of seven local governments and two First Nation areas. These include Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria, View Royal, the Esquimalt Nation and the Songhees Nation. The core area has a total land area of about 215 km^2 and a population of approximately 320,000 people.

In the core area, municipal sewer flows are discharged into CRD trunk sewers. Prior to December 2020, these trunk sewers conveyed sewage to either the Clover or Macaulay pump stations, where the flows were screened and pumped out through deep sea outfalls. As of December 2020, the flows are conveyed to a treatment plant located at McLoughlin Point.

A map of the core area sewers is located in Figure 1.1. The Clover Long outfall is shown on the map because sewer modeling predicts that it’ll be the only location that overflows for sub 5-year rainfall events. A summary of sewer infrastructure in the core area is located in Table 1.1.

Figure 1.1: Map of the Capital Regional District Core Area

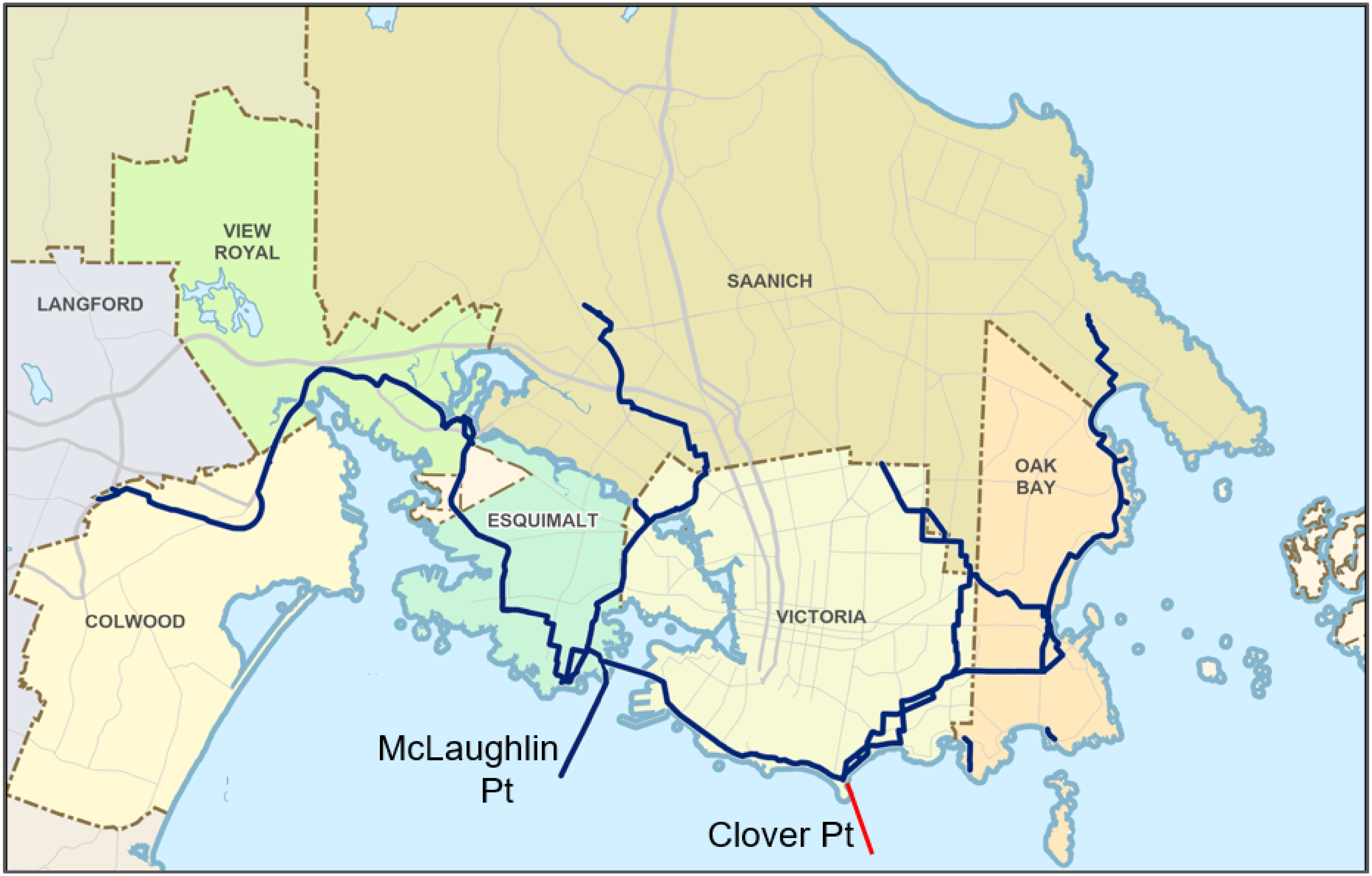


Table 1.1: Sewer Infrastructure in the CRD Core Area

** Excludes Hartland Landfill site, but includes Hartland Leachate Line*

Jurisdiction		Gravity Sewers (km)	Force Mains (km)	Man holes	Pump Stations	Laterals **	Average Pipe Age *** (years)	% Developed Properties Connected to Sewer
Colwood	Municipal	37.1	7.3	568	10	2159	19	45%
	Private	5.2	3.7	120	12		20	
	Gov't of Canada	6.7	2.7	125	6		31	
Esquimalt	Municipal	56.8	4.0	874	12	3404	55	100%
	Private	0.2	0.0	3	0		86	
	Gov't of Canada	15.6	4.5	368	23		50	
Langford	Municipal	117.5	22.1	1769	14	8522	16	83%
	Private	11.4	2.1	167	10		15	
Oak Bay	Municipal	100.2	2.0	1312	7	3813	75	100%
	Private	2.4	1.4	32	3		27	
Saanich	Municipal	548.8	19.6	6390	39	28950	47	94%
	Private	11.6	0.0	181	0		20	
Victoria	Municipal	233.3	3.2	2855	12	13676	94	100%
	Private	0.0	0.0	3	2		N/A	
View Royal	Municipal	44.7	5.8	864	17	2119	34	96%
	Private	2.4	0.6	33	5		17	
First Nations	Esquimalt	1.4	0.3	22	1	N/A	27	100%
	Songhees	N/A	0.3	N/A	1	N/A	N/A	99%
CRD Owned *		51.9	48.2	293	16	3	22	N/A
Total		1,247	128	15,979	200	62,646		

*** Some estimated*

**** Includes both gravity and force mains*

1.3 Core Area Inflow & Infiltration Program

The Core Area I&I Program (I&I program) is guided by the Core Area I&I Subcommittee, which was established in the mid-1990s to work regionally to identify various methods of reducing and controlling I&I. The subcommittee comprises representatives from the CRD, Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria and View Royal, and typically meets several times per year.

I&I program staff provide educational services to the public and technical support to municipalities to help promote reduction of the amount of rainwater and groundwater entering the sanitary sewer system to achieve the CALWMP commitment of reducing wet weather flows below four times average dry weather flow at Clover Point and the McLoughlin Point wastewater treatment plant by 2030.

The 2020 program budget was $474,714. This included $49,000 carried over from the 2019 budget which was earmarked for Esquimalt's special I&I study. Due to the pandemic, only $416,668 was spent.

The goals of the program are to:

- assist members with regulatory compliance,
- coordinate and analyze regional flow monitoring and analysis,
- promote the inspection and repair of private property laterals through education,
- assist with prioritization of I&I reduction work required to reduce sewage overflows,
- support sewer asset management programs, and
- support efforts to maintain sewer capacity needed for future growth, densification, and climate change.

I&I program staff carry out a variety of routine tasks, including:

- preparing annual I&I reports, I&I Management Plans and Overflow Management Plan updates,
- developing and analyzing flow meter data for I&I analyses,
- assisting municipalities with tasks related to I&I reduction,
- developing and executing private property I&I initiatives, and
- national leadership in I&I initiatives, such as private property initiatives and benchmarking.

1.4 Past Reports

Since 2001, a regional effort of flow monitoring and analysis has been undertaken resulting in many regional initiatives. The results of this work are documented in reports summarized in Table 1.2. Of key interest are the I&I Management Plan and the Overflow Management Plan (executive summaries are located in Appendix B and C, respectively).

Table 1.2: Key Program Reports by Year

Year	Reports Completed
2005	• I&I Analyses Results Report: October 2001 to March 2004 • Biennial Report for the Ministry
2006	• I&I Analyses Results Report: October 2004 to April 2005
2007	• I&I Analyses Results Report: October 2005 to April 2006 • Biennial Report for the Ministry
2008	• Overflow Management Plan • I&I Analyses Results Report: October 2008 to March 2010
2009	• Biennial Report for the Ministry
2010	• I&I Analyses Results Report: October 2010 to March 2012
2011	• n/a
2012	• I&I Management Plan
2013	• Annual Reports for 2012
2014	• Overflow Management Plan: 5-Year Update • Annual Reports for 2013
2015	• Annual Reports for 2014
2016	• n/a
2017	• Annual Reports for 2016 • I&I Management Plan: 5 Year Update (included annual report for 2015)
2018	• Annual Reports for 2017
2019	• 2019 Annual Report (includes info for 2018 to mid-2019)
2020	• 2020 Annual Report (includes info for 2018 to mid-2019)

2. KEY INITIATIVES

2.1 Inflow & Infiltration Management Plan Five Year Update

The Core Area I&I Management Plan is updated every 5 years. The last update was submitted to the Province in April 2017. The 5-year update is on schedule to be submitted in early 2022. Key additions include:

- Using the core area sewer model (built in 2018) to predict overflow locations and volumes for different return period storms and climate change scenarios,
- Comparing measured sewer flows to allocated sewer flows in the CRD sewer bylaw,
- More specific municipal I&I reduction plans, and
- The updated I&I education approach.

2.2 Municipal Monthly Sewer Reports

The CRD's Integrated Water Services (IWS) Department and the I&I program worked together to develop monthly wastewater flow reports for all participant areas connected to the core area sewer system where wastewater will be treated at the new McLoughlin Wastewater Treatment Plant.

There is a separate report for each of the core area participant areas. The key audience for the reports are municipal engineering staff and First Nation's administration. The reports provide a summary of wastewater flow, include I&I statistics and comparisons to previously collected data. The flow data used to populate the reports comes from the core area cost sharing sewer flow metres, and is collected using the core area SCADA system.

The reports are important to the I&I program because they effectively summarize the status of I&I in each municipality and First Nation on a monthly basis.

Key actions carried out by the I&I program include:

- worked with Integrated Water Services to develop the layout for the reports. Of key importance to the I&I program were:

  - the inclusion of a graph containing hourly sewer flows and rainfall for the report month, which is the most intuitive way to see how sewer flows respond to rainfall (i.e., I&I).

  - comparison tables showing measured sewer flows to allocated flows for each municipal catchment discharging to the CRD system. The allocations come from CRD's Bylaw No. 4304 (2020) which aligns with the core area CALWMP's commitments. Each catchment discharging to the CRD sewer system has allocations for both "average dry weather flow" and "peak 24 hour flow." The tables can be used to identify which of these catchments exceed their allocations and by how much, making them valuable for the I&I program. Currently these tables are only included in the monthly reports once per year.

  - summaries of overflows for the month. Overflow volumes are not quantified as part of monthly sewer volumes or I&I rates so they need to be listed to tell the whole story.

- built the reporting template in Excel. The template auto-populates when batches of new data are added. This simplifies the ongoing use of the template, eliminates most sources of error, and greatly increases the long-term viability of the overall project.

- Updates and refinements to the reporting template.

- Vetting of flow data for use in the reports.

Appendix D contains examples of the monthly reports. Note that these reports are sent with cover letters that provide additional context to the reports.

2.3 FlowWorks.com for Vetting Sewer Flow Data

Sewer flow data collected using core area SCADA system is considered “raw” and should be vetted prior to use. Traditionally, this requires substantial effort and is only formally carried out once a year (i.e., to support core area sewer cost sharing calculations). To provide reliable flow data for the monthly reports, a more efficient vetting approach was needed.

In early 2020, Integrated Water Services and the Core Area I&I program decided to upload the core area sewer flow data to FlowWorks.com, which contains tools for viewing, vetting and analyzing municipal wastewater flow data. Once the raw data was on FlowWorks, substantial site setup work was needed to make the data useful. The CRD’s I&I program led this effort, which included:

- developing efficient data review tools and processes for vetting the data,
- setting up processes and formulas for auto-correcting and manually correcting data,
- building batch data export functions including batch exports that seamlessly insert into the Monthly Sewer Reports template,
- building virtual sewer flow sites to reliably address data gaps,
- building correlations for sites with known issues that can be in place until sites with issues can be corrected, and
- updates to accommodate changes in the core area conveyance system related to the treatment plant project.

The I&I program continues to do the vetting of the core area flow data on FlowWorks with final engineer signoff by IWS.

2.4 Assessing the Accuracy of Municipal Pump Station Flow Data

In 2021, the CRD worked with a consultant to finalize a process for assessing the accuracy of municipal pump station flow data. Flow data from each core area municipal pump station was then assessed.

As a background, I&I program staff routinely generate sewer flow data for municipal pump stations using electronic data from wetwell levels, pump starts/stops, wetwell dimensions and flow monitor devices. The flow data is used for I&I analyses. The accuracy of the data can be substantially lower for some pump stations due to site-specific factors.

It is important to understand the accuracy of the data is for each pump station, as the data may be used for sewer modeling, sewer master plans, development decisions, etc. For some pump stations, additional work would be needed to achieve acceptable accuracy.

A copy of the report is located in Appendix E.

2.5 Review of the Master Municipal Construction Document

The Master Municipal Construction Documents (MMCD) is the foundation for municipal infrastructure contracts in British Columbia. It contains standard specifications and standard detail drawings. The purpose of this project was to review the sections of the MMDC that relate to I&I and to propose improvements based on best practices and Canadian standards.

The review was completed in 2020. However, in mid-2021, a national committee was formed to create a CSA standard for I&I in new development. (The CRD’s I&I program accepted an invitation to be on this committee.) It was decided that it would be best to wait for this new standard to be complete before trying to get changes made in the MMCD.

2.6 Esquimalt Project

Prior to 2020, Esquimalt collected substantial I&I investigation data for the municipality including a calibrated sewer model, dense I&I data, municipal wide CCTV, smoke testing and manhole inspection data. In 2020, the Core Area I&I Program provided funding to Esquimalt to have this data reviewed by a consultant and turned into a prioritized list of I&I reduction actions. The report will be finalized in 2021. The preliminary results are already a valuable component Esquimalt's section in the I&I Management Plan update.

2.7 Downspout Disconnection

A consultant was hired to summarize downspout disconnection programs and best practices from around Canada. The final report is located in Appendix F.

In summary, many parts of Canada allow downspouts to be disconnected so that their flows discharge to the ground away from buildings. Even the insurance industry has documents showing when this can be appropriate. The purpose of this project was to summarize how and when this is currently done in Canada. Included are a number of municipal examples. The results will be used to see if downspout disconnections could be a tool for addressing roof drains found to be cross-connected to the sanitary sewer.

2.8 Future Initiatives

Table 2.1: Anticipated Next Steps for Supporting Inflow & Infiltration Reduction

Action	Description / Timeline
Data collection, investigation and planning to address catchments that exceed their sewer allocations	• Focused on catchments that exceed their allocations in Oak Bay and Victoria. (Similar work was already funded by the CRD for Esquimalt (Section 2.6) • Includes finalizing the pilot project that involved sewer investigation work in three Oak Bay catchments with high I&I. The work included camera inspections, smoke testing and manhole inspections. The final step is to follow-up on the smoke testing results to find the specific defects resulting in the "errant smoke".
Developing an Approach for Finding and Addressing Cross-Connections	• Finding and fixing cross-connections can be complex. However, once found, the I&I reduction benefits of fixing cross-connections are easy to quantify and in some cases can be dramatic. • The project will involve interviews and meetings with various stakeholders including consultants, operations staff, CCTV/smoke testing contractors, plumbers, etc. • A review of best practices from around North America will be considered. • Efforts will be made to create a path forward for disconnecting cross-connected roof drains, when appropriate, which is commonly done around Canada (Section 2.7)
Assessing the Accuracy of Municipal Pump Station Flow Data – Phase 2	• In 2021, a project was carried out to check the accuracy of municipal pump station flow data generated by the I&I program (Section 2.4). It was found that the methods used to create the flow data were not suitable for a small number of the pump stations. The purpose of Phase 2 to assess options for getting reliable flow data for these pump stations.

Action	Description / Timeline
Pump Station Flow Data for Colwood and Saanich	• Colwood and Saanich currently cannot derive sewer flow data from their pump stations. The CRD and its consultants will assess options for addressing this and may provide resources for implementation. • The Department of National Defence's Belmont pump station may be added to this list to support the needs of Colwood.
Mainline sewer camera inspections during rainfall events.	• This will involve hiring sewer camera inspection companies during large rainfall events and using the I&I program's portable mainline sewer camera • The goal is to better understand the sources of I&I in high I&I catchments. • This should lead to a better understanding of how much water is actually coming from sewer laterals and from point source cross-connections.
Update: Private Property I&I Options from North America	• In 2011, the CRD commissioned a report summarizing the private property I&I programs used across North America. • In 2014, the CRD updated this report to answer additional questions and to increase the focus on what's happening in Canada. • The purpose of this project is to provide an update on this work.
Interactive Display	• Finalize the interactive display for outreach events, etc.
Assisting with Municipal Programs *(Ongoing)*	Assist the municipalities, upon request, with the following: • incorporating the powers of the sample private property I&I model bylaw into their municipal bylaws, as appropriate • providing options for municipal-specific private property I&I programs to help address their unique needs and circumstances • assisting with municipal-specific private property I&I related educational materials (i.e., brochures to support municipal smoke testing or municipal installation of inspection chambers) • addressing public property laterals, smoke testing results (smoking guns), methods for collecting basement flooding statistics when home owners inform city.
Collaborations / Leadership *(Ongoing)*	• Continue working in collaboration with Metro Vancouver and the National Water and Wastewater Benchmarking Initiative's I&I Task Force to further private property I&I programs / options in Canada.

3. OVERFLOWS

3.1 Overview

Sanitary sewer overflows are releases of raw sewage into storm drains and/or local waterways. The majority of sewer overflows occur during heavy rainfall events as a result of I&I overwhelming the capacity of the sewer system. Overflows may also occur as a result of sewer blockage, pipe failure and pump station failures.

Sewer overflows can expose people, pets and the environment to sewage, harmful chemicals, infectious bacteria, viruses, parasites, etc. The risks associated with sewage releases are influenced by the following characteristics of the receiving environments:

- public use (e.g., shoreline access, kayaking, swimming, shellfish harvesting),
- habitat sensitivity (e.g., productive or endangered habitats such as shellfish areas, kelp beds and herring spawning sites), and
- flushing characteristics (e.g., exposed coast line or in-land waters)

Reducing I&I will decrease the frequency, volume and duration of sewer overflows.

In 2014, the CRD submitted an update to the Province on the status of its commitments documented in the Core Area Overflow Management Plan (2008). A copy of the executive summary of the 2014 update is located in Appendix C.

3.2 Reported Overflows

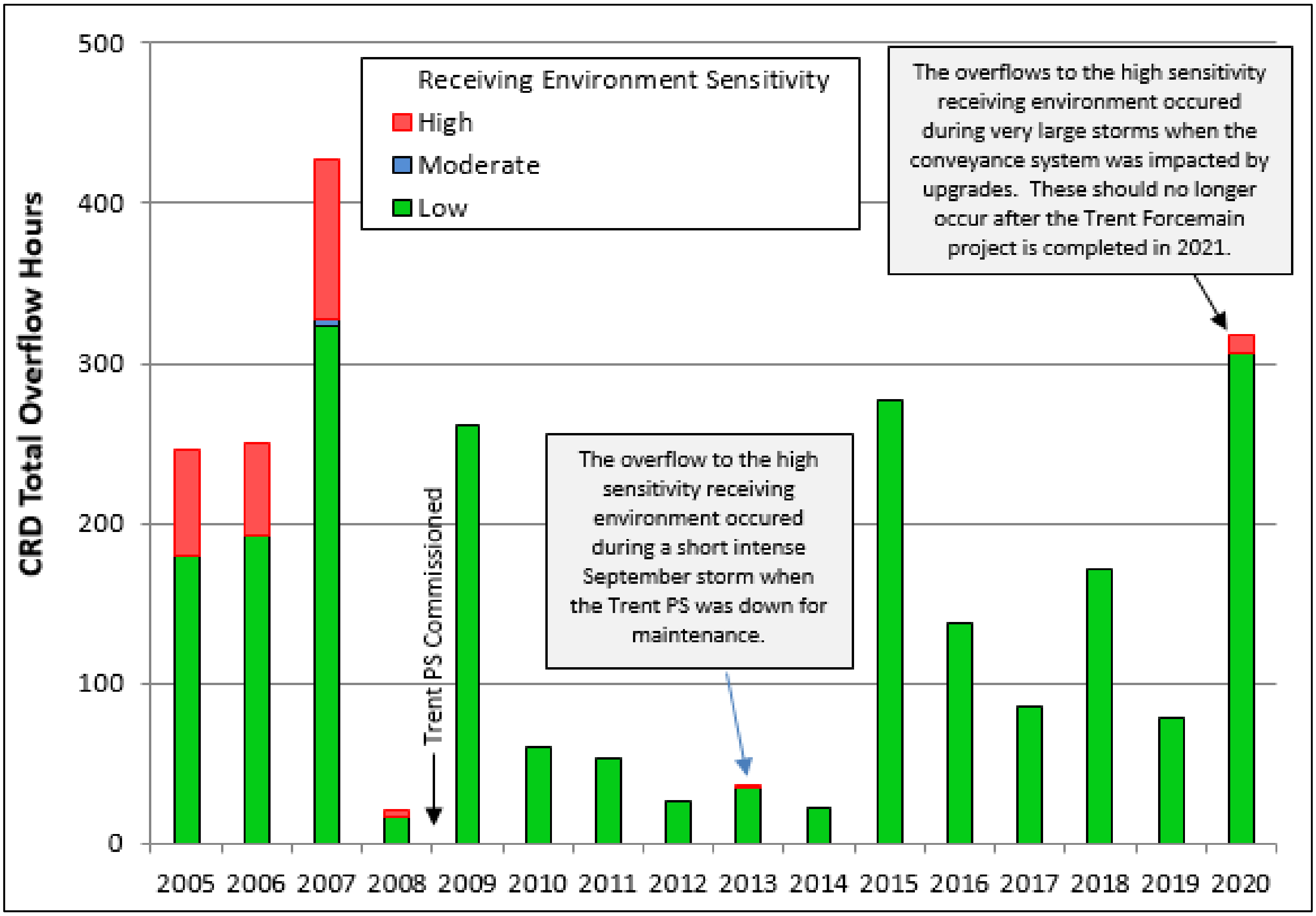
CRD staff monitor regional overflow points with overflow sensors. The core area municipalities monitor their pump stations for overflows. When overflows occur, they are investigated, documented and reported to Emergency Management BC.

Figure 3.1 summarizes the overflows by year between 2005 and mid-2021. Note that discharges to high sensitivity receiving environments have been dramatically reduced since the Trent pump station was commissioned in late 2008.

Figures 3.2 to 3.4 summarize the specific overflow events by year for 2018 to mid-2021. Note that the vast majority of overflow hours occur during very large storm events when conditions are saturated.

It is expected that there will be a reduction in locations with overflows and overflow hours as a result of conveyance system upgrades related to the core area treatment plant project, projected to be online by the mid-2021.

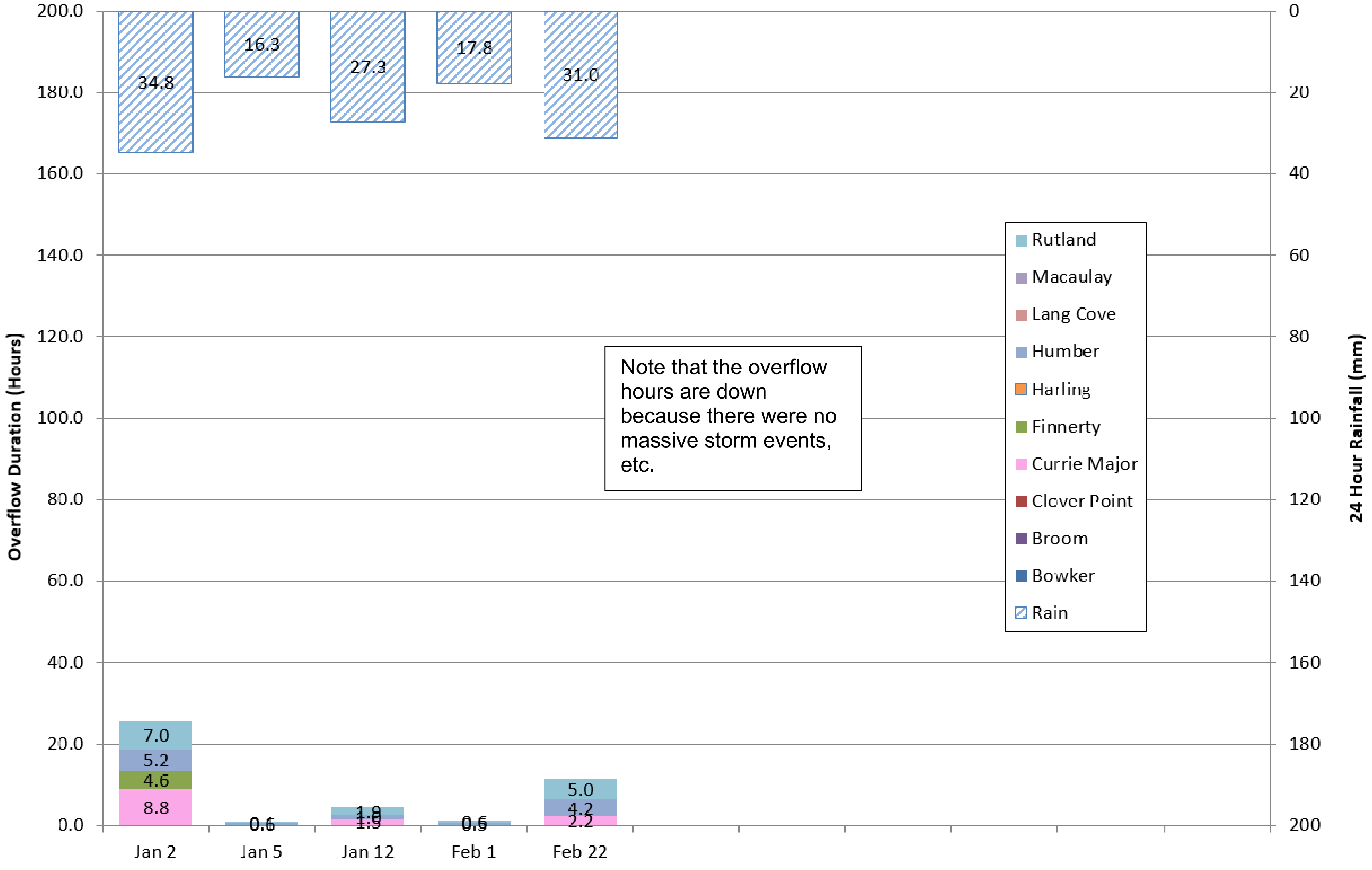
Figure 3.1: Graphical Comparison of Rainfall vs. Overflows



The overflows to the high sensitivity receiving environment occured during very large storms when the conveyance system was impacted by upgrades. These should no longer occur after the Trent Forcemain project is completed in 2021.

The overflow to the high sensitivity receiving environment occured during a short intense September storm when the Trent PS was down for maintenance.

Figure 3.2: Capital Regional District Overflows from January to June 2021



Note that the overflow hours are down because there were no massive storm events, etc.

Figure 3.2: Capital Regional District Overflows from 2020

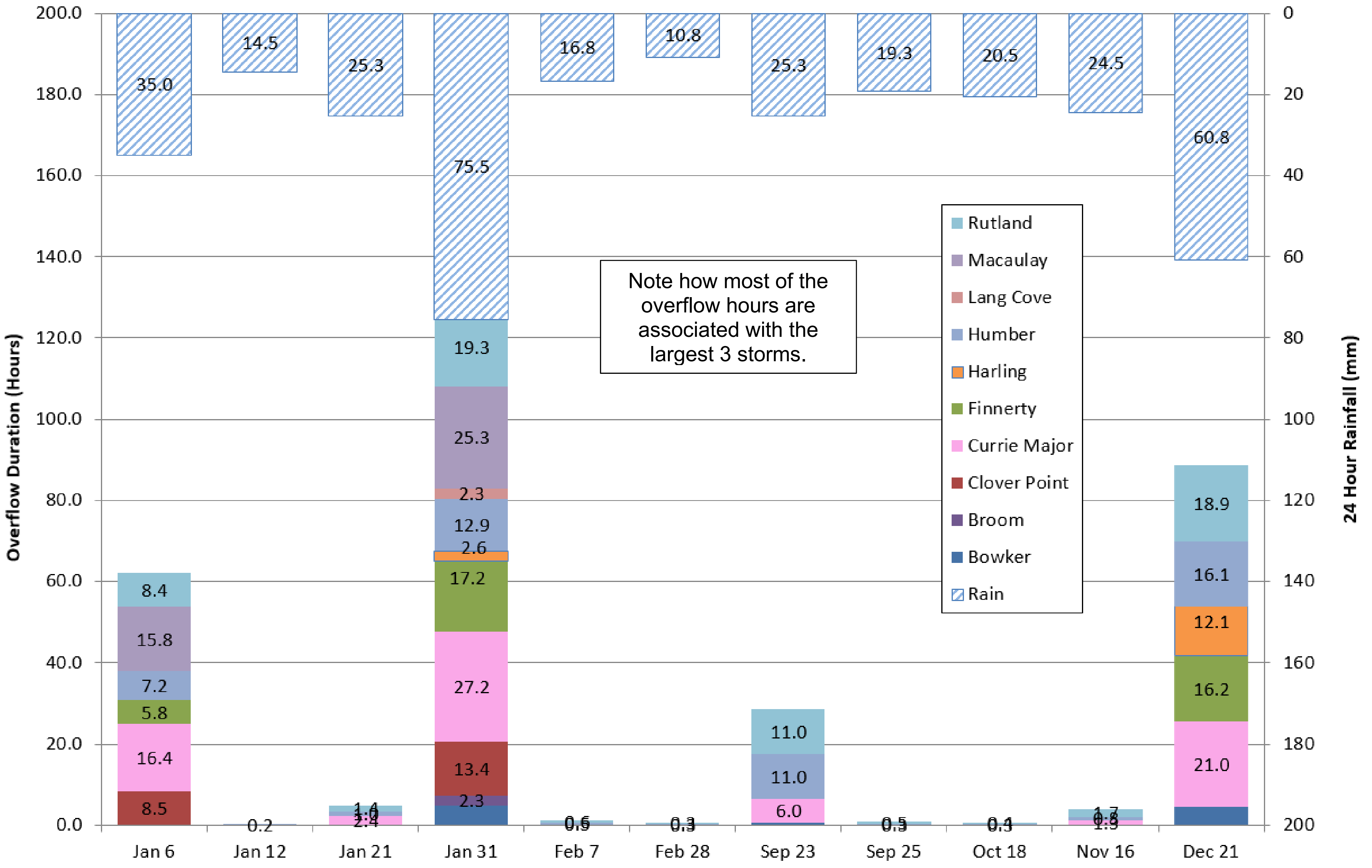
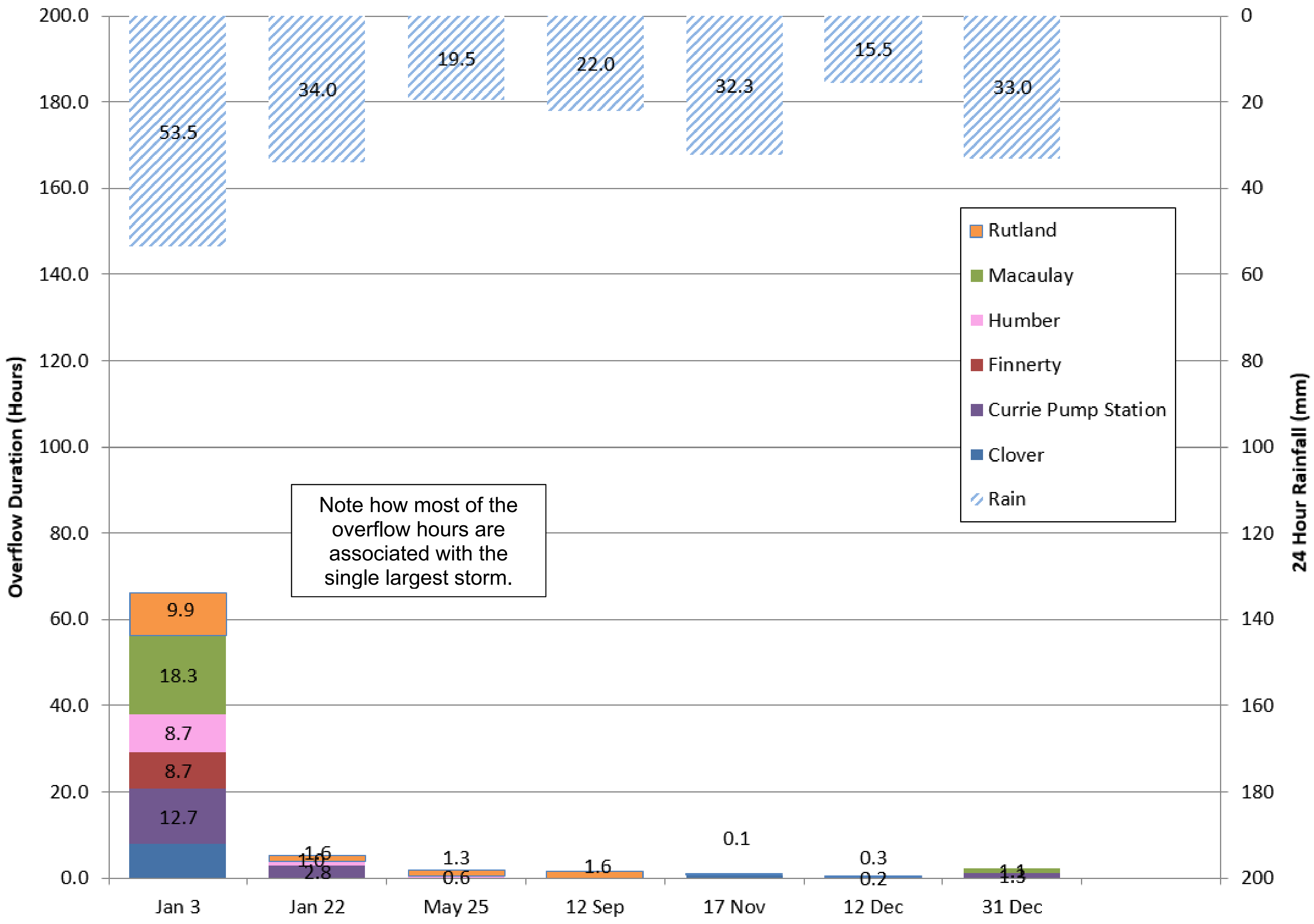
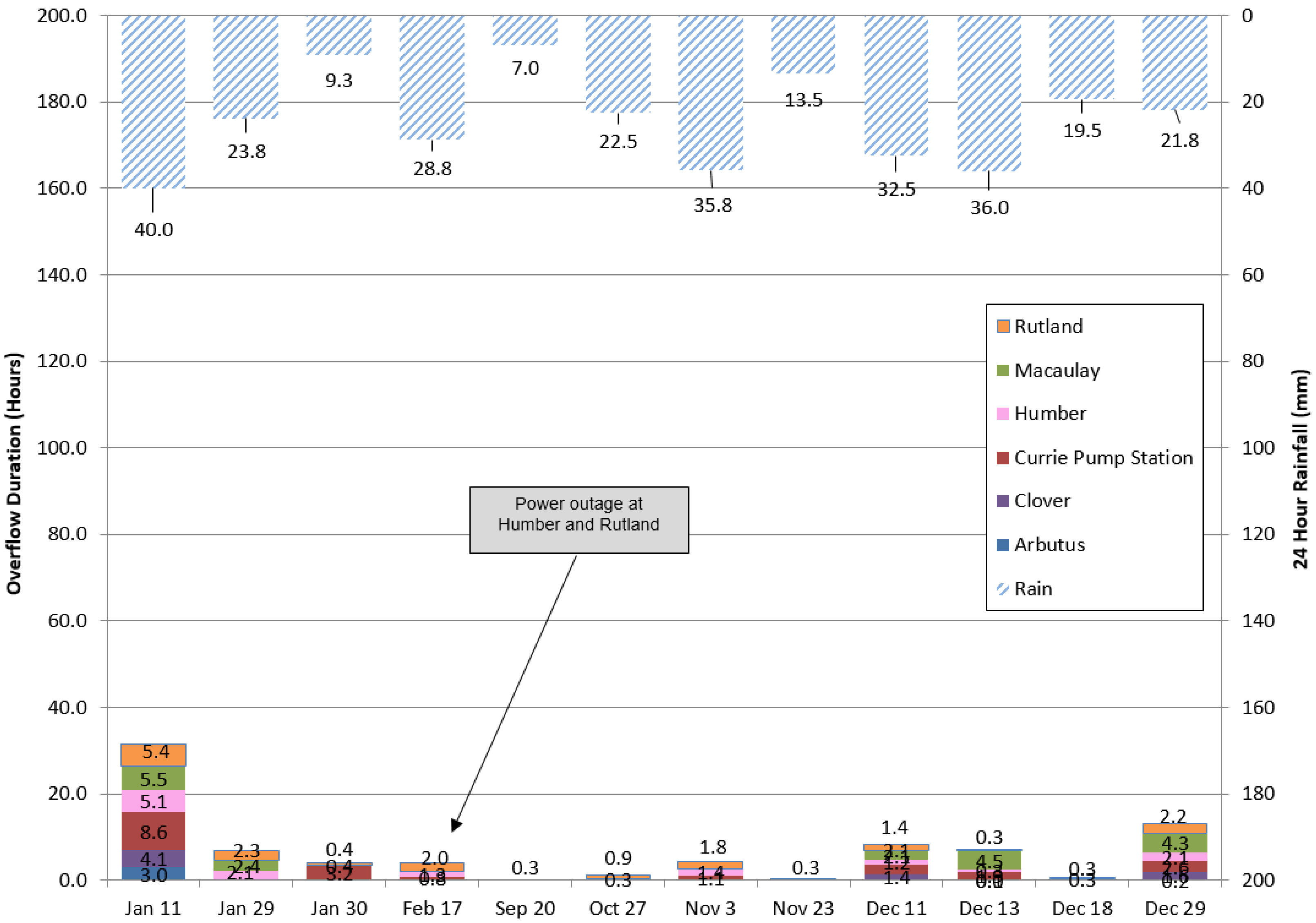


Figure 3.3: Capital Regional District Overflows from January to June 2019



Note how most of the overflow hours are associated with the single largest storm.

Figure 3.4: Capital Regional District Overflows in 2018



4. PRIVATE PROPERTY INFLOW & INFILTRATION

In North America, it is often estimated that half of all I&I comes from private properties. As such, it is important that municipalities adopt strategies for addressing it; however, addressing private property I&I has proven difficult for the following reasons.

1. It's uncommon
   - The only municipalities with significant approaches for dealing with private property I&I are a small number of American municipalities that were required to address to it to avoid substantial fines from regulators (i.e., the Environmental Protection Agency).

2. It is expensive
   - Finding problems is expensive (e.g., $250 for a camera inspection per property).
   - Addressing the problems can cost thousands of dollars.
   - Who pays, etc.?

3. Liability
   - Requiring or carrying out work on property brings potential liabilities to the municipality.

4. It's complicated
   - Private property I&I is only a significant problem if the overall catchment has as I&I problem.
   - Cross-connections (inflow) may be the main source of "fast" I&I in these catchments but finding cross-connections is complex.
   - Lateral replacement programs are theoretically easier to setup. However, they generally apply to all properties, not just properties in catchments with high I&I. (For a private property lateral to be a source of infiltration, the groundwater table needs to be higher than the level of the lateral, which may not be the case.)

Core Area I&I Program staff continue to work towards workable private property I&I options for the core area. The goal is to provide the municipalities with tools/options that they can implement, as appropriate, to meet their CALWMP commitments for I&I and overflows. Table 4.1 summarizes actions carried out to date.

Table 4.1: Private Property Inflow & Infiltration Actions to Date

Timeline	Action
Ongoing	• CRD: - review case studies of jurisdictions taking steps to deal with private property I&I - meet with various experts and share information - work with and share information with Metro Vancouver, which is also working to establish programs to address private property I&I - are members of the National Water and Wastewater Benchmarking Initiatives I&I Task Force - provide I&I education to the public • Two municipalities within the core area (Oak Bay and Esquimalt) require that laterals be inspected and fixed if required, when applications are made for major building permits. • Each of the core area municipalities have sewer bylaws or council policies that relate to private property I&I.

Timeline	Action
2020 to mid-2021	• Completed a study looking at disconnecting cross-connected downspouts (Section 2.7).
2019 to 2020	The CRD has developed the following items to support the updated I&I education approach: • a brochure and banner that fully aligns with the Generally Accepted Principles document, • updated website content to align with the new approach, • attendance at a list of key regional events to interface with the public, including annual home show events, municipal events and key stakeholder events, and • a slideshow for presenting to realtors.
2018 to 2019	The educational approach for addressing private property I&I was updated. The approach has the same desired outcomes as the existing approach: to promote the inspection and maintenance of sewer laterals. However, the approach focuses on preventing basement flooding which is more relevant to homeowners. The central document for the approach is the "Generally Accepted Principles" document, which: • has full acceptance from the key stakeholder groups, • aligns the various stakeholder groups on the topic, • is designed to answer questions that the public may have on the issue in a clearly communicated fashion, • establishes relationships with the various I&I related stakeholders, • was developed in partnership with over 20 key stakeholder groups (local, provincial and national). Through consensus, the focus was extended to all private property underground pipes, including foundation drains and stormwater laterals, and • can be used by stakeholder to educate the public. In late 2018, the CRD completed a report documenting how each of the key stakeholder groups preferred to be engaged on the I&I topic. The report also documented the level of outreach effort deemed appropriate for each of these groups.
2017	The following is a list of private property I&I work carried out in 2017 and the first half of 2018, details of which are located in Section 2: • completed a background report to better understand I&I-related stakeholders, • a report showing how to identify semi-combined sewers using GIS, • collected additional private property I&I models bylaws from across Canada, and • Enforcement Approach for Addressing Cross Connections, as presented by the City of Burnaby to the Core Area I&I Subcommittee.

Timeline	Action
2016	• In general, the I&I Subcommittee agreed that the powers from the sample model bylaw should be incorporated into existing municipal sewer bylaws. To support this, the CRD retained consultants, Pinna Sustainability Inc., to compare the powers in the sample model bylaw to the powers in each municipality's existing sewer bylaws, and a gap analysis was completed. Based on the results, recommendations were made for updating each of the municipal sewer bylaws using language from the sample model bylaw. One municipality noted that they may include parts of the sample model bylaw as part of a new municipal bylaw. • On February 11, 2016 the CRD presented to the National Water and Wastewater Benchmarking Initiatives I&I Task Force on the topic of "Implementation of a Private Property I&I Management Program". The CRD is considered a frontrunner in Canadian municipalities regarding private property I&I efforts, and staff shared the CRD's experiences and plans for moving forward.
2015	• In late 2014, the Core Area Liquid Waste Management Committee (CALWMC) asked the CRD to prepare a sample model bylaw related to private property I&I. The sample bylaw was built using past I&I Subcommittee feedback and the best parts of existing bylaws from across Canada and the US, as documented in the report by Pinna Sustainability Inc. in 2014. The draft bylaw was reviewed by a lawyer and by the I&I Subcommittee for general acceptability. The sample model bylaw was prepared and presented to the CALWMC on May 13, 2015. The committee recommended the sample bylaw be discussed with the I&I Subcommittee to determine how best to move it forward. The I&I Subcommittee decided it would be best to incorporate the powers from the sample model bylaw into the existing municipal sewer use bylaws. One municipality (Esquimalt) may customize the sample model bylaw into a stand-alone bylaw suitable for Esquimalt.
2014	• On May 22, 2014, the I&I Subcommittee unanimously recommended that each municipality be able to customize their approach for meeting agreed-upon targets. This could involve a model bylaw that could be altered, as required, to meet the needs of individual municipalities. Overall, it was understood that municipalities with elevated I&I need a different approach than municipalities with low I&I. • In 2014, the CRD commissioned a study by Pinna Sustainability Inc. to prepare a memo entitled Update on Private Property I&I Programs. It contains supplementary research for the Stantec Report (2010). Notably it: - summarizes effective "drivers" for private property I&I programs, - details private property I&I programs from across Canada by province, - contains updates on private property I&I programs from the US, - documents potential problems related to implementing private property I&I programs and includes North American examples, and - summarizes "good practices" that should apply to all private property I&I programs. For each "good practice" there is example bylaw language taken from existing Canadian sewer bylaws. • In late 2014, the CALWMC asked the I&I program staff to make a presentation to it in early 2015 and to include a working "draft" model bylaw in the presentation.

Timeline	Action
2013	• Staff shortlisted private property I&I options and refined the options. • The I&I Subcommittee reviewed the shortlist and provided feedback on multiple occasions. • Options were discussed with representatives from stakeholder groups (i.e., real estate, building association, building inspection and insurance industry, etc.)
2012	• Staff prepared private property I&I specific education materials related to the program options noted in the Stantec report, including: - handouts summarizing each of the program option categories, - a detailed comparison table of the options, and - a reference guide covering frequently asked questions. • In June 2012, CRD staff hosted a workshop focused on private property I&I for elected representatives. The purpose of the meeting was to present background information, options for moving forward, and to open dialogue on the topic. New ideas were discussed and those who were present endorsed the implementation of the consultation portion of the private property I&I plan. • On November 30, 2012, CRD staff put on a workshop for members of the Victoria Real Estate Board. The workshop was a collaborative effort between the Core Area I&I Program, Onsite Program (i.e., septic systems) and Cross Connection Program. The purpose of the workshop was to provide education and to promote the use of infrastructure inspection in the real estate industry.
2011	• CRD staff provided an overview of the 2010 Stantec report to elected representatives and recommended a full workshop in 2012. • CRD staff initiated an I&I-related educational program that included new educational materials and education outreach events including: an I&I brochure for residents, a comprehensive website, a survey used in 2012 to 2014, and educational videos. Public education regarding I&I will now be ongoing.
2010	• CRD staff commissioned a report, completed by Stantec Inc., showing potential management options for addressing private property I&I. The report included a summary of private property I&I programs used throughout North America, costs/effectiveness of these programs, and legal options for implementing programs in the region. A copy of this report is on the CRD website. • A workshop was held with municipal and regional staff to initiate discussion about options for implementing private property I&I programs, objectives, and potential barriers. It was agreed that the key objectives for a private property I&I program would be to: protect the environment, create system capacity, minimize costs, increase ownership responsibility and awareness, and minimize liability issues. A summary of this workshop is located in the Stantec report.

5. EDUCATION

CRD staff have taken steps to educate the public on the topic of I&I. The goals of this work are to:

- provide education showing where I&I comes from and the problems it creates so that when funding is required and/or rehabilitation work is proposed in local neighborhoods, the public have a better understanding of why the work is required, and
- encourage home owners to camera-inspect and maintain their underground sewer lateral, which will result in lower private property I&I.

Table 5.1: CRD Inflow & Infiltration Education Efforts to Date

Action	Description / Timeline
2020 and 2021	Private Property I&I: As a result of COVID-19, a number of planned education actions had to be put on hold. Efforts will resume in late 2021. Public Property I&I: Integrated Water Services and the Core Area I&I Program continue to produce monthly sewer use reports for each of the core area municipalities and First Nations (Section 2.2).
2019 and 2020	**Private Property Inflow & Infiltration** On January 23, the CRD had a booth at the 2020 Vision Victoria Real Estate Board conference and debuted the new I&I education approach to key stakeholders. The reception to the approach was exceptional. Of key significance: • Many realtors visited the booth and were interested in both the brochures and the detailed Generally Accepted Principals document. In general, they noted that the materials were both useful and relevant to them. • Five realtor offices invited the CRD to present at their “Lunch n Learns” or “Coffee Talks”, which realtor offices typically have each month. It is believed that the CRD could schedule similar talks for most real estate offices in the region as they are always looking for relevant content for these talks. • Tony Joe, a local radio personality, invited the CRD to have an extended interview related to the I&I education approach on “The Whole Home Show with Tony Joe”, a radio show on CFAX 1070 that focusses on real estate issues. It is a great sign that Tony Joe sees the value in the updated education approach because not only is he a realtor, he is a past president of the Victoria Real Estate Board and an Instructor for the British Columbia Real Estate Association. As a result of COVID-19, a number of planned education actions had to be put on hold. To move things forward, efforts will be made to target the key stakeholder groups (i.e., plumbers, home inspectors, realtors) potentially through targeted video’s, webinars, etc.
	Public Property I&I Integrated Water Services and the Core Area I&I Program worked together to develop monthly wastewater flow reports for the core area municipalities and First Nations.
2018 and 2019	Developed an updated education approach making it more relevant to home owners and related stakeholders, as summarized in Section 2.2. The rollout of the updated approach was initiated in the fourth quarter of 2019.

Action	Description / Timeline
2011 to Present	I&I was added to CRD outreach events where I&I materials were displayed along with those other CRD programs. In general, I&I was "featured" at 4 key events (e.g., home shows) per year and the materials made available upon request at an additional 10 events. From talking to CRD outreach staff, attending outreach events and talking to stakeholder groups, it is clear that I&I knowledge is low with the general public. Most people have little interest in the topic and say that they will deal with issues if they come up.
2010	The I&I program, in collaboration with the core area municipalities, created a brochure, two sets of videos to help explain I&I, and developed an I&I website. This information is valuable when staff are providing notification to neighborhoods of upcoming video inspection, smoke testing, sewer rehabilitation or other work related to I&I management. The overall approach was consistent with other municipalities around North America.

6. INFLOW & INFILTRATION RATES FOR THE CORE AREA

Regional I&I flow rates for the core area are generally analyzed every three years because there are not enough significant storm events to justify I&I analyses on an annual basis. In general, there are between 0-3 significant storm events per year. The most recent I&I results analysis was completed using data up to March 2021. The results are documented in this report.

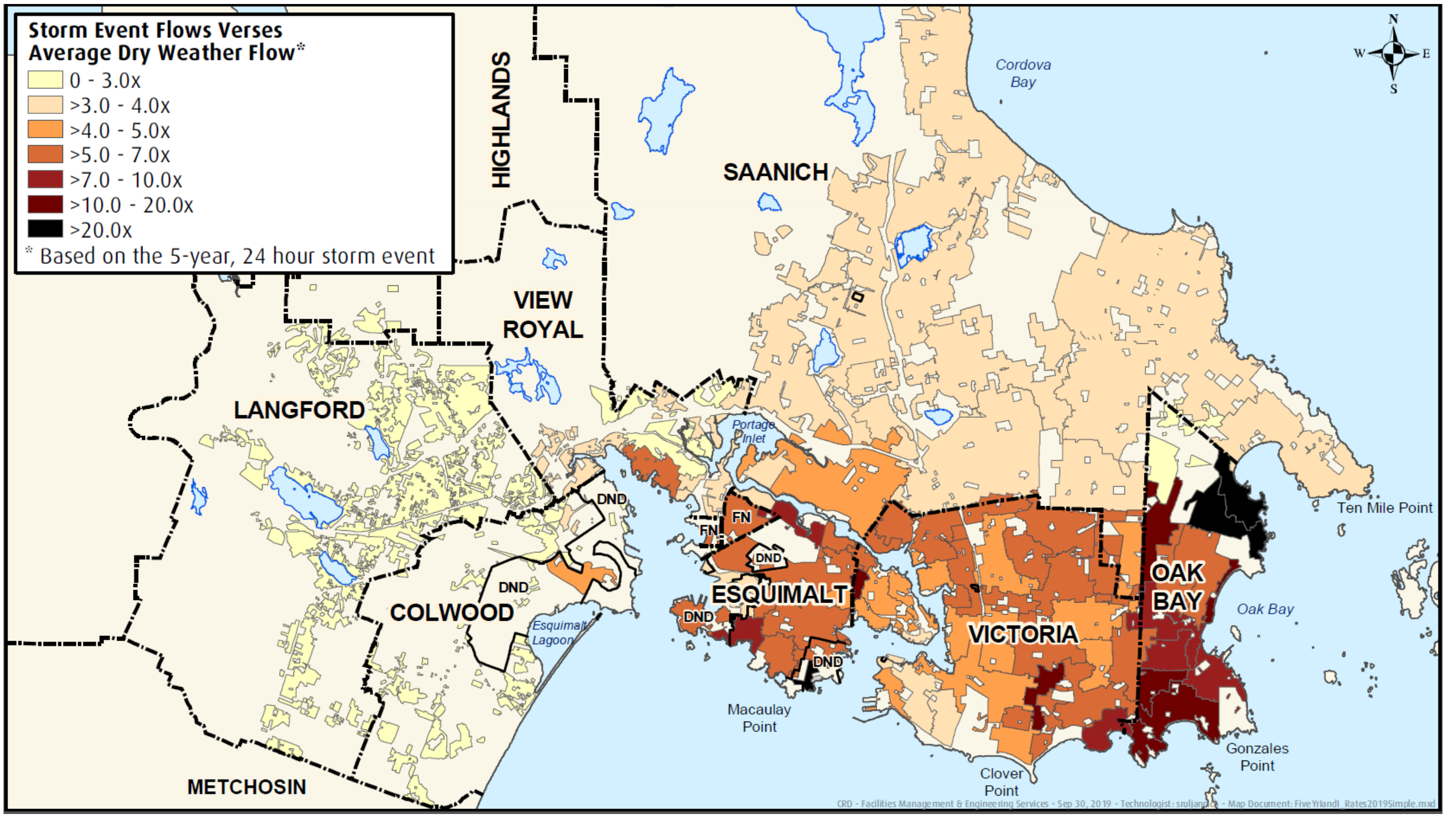
The results of the I&I analyses are summarized as follows:

- A map of the entire core area displaying the most recent 5-year peak I&I rates for individual catchments is located in Figure 6.1.

- The individual I&I rates within each municipality have been converted into an overall weighted average for each municipality and compared with previous years' estimated I&I rates (see Table 6.1). This table is useful in providing a performance measure benchmark for each municipality to track overall I&I trends, but it must be interpreted with caution because it summarizes a vast amount of data into single municipal averages. For instance, a single very high I&I sub-area could skew the overall municipal average, or a single year of erratic weather and/or flow data could lead to misleading results. Therefore it is prudent to allow sufficient time to measure the full effect of any I&I reduction work in addition to gathering, compiling and analyzing weather patterns and I&I rates to track overall trends.

- I&I tends to predictably increase as sewers age due to the deterioration of sewer material, types of sewer material , the environment and the installation practices of the day.

Figure 6.1: Inflow & Infiltration Rates Map for the Capital Regional District Core Area



CRD - Facilities Management & Engineering Services - Sep 30, 2019 - Technologist: sruljancic - Map Document: FiveYrlandI_Rates2019Simple.mxd

Table 6.1: Summary of Capital Regional District Core Area Municipal Peak 5-Year Inflow & Infiltration Rates

Municipality	Ave. Age of Sewers	Estimated 5-Year Inflow & Infiltration Rate [1] (L/ha/day)						5-Year Peak Flows [1] Compared to Average Dry Weather Flow (ADWF)
		2010	2012	2014	2016	2019	2021	
Colwood	19	10,309	8,540	7,965	8,777	8,777	17,403 [5]	2.6 x ADWF
Esquimalt	86	52,412	52,599	48,727	51,471	48,786	54,896	6.1 x ADWF
Langford	16	11,023	9,364	9,222	10,606	8,587	6,202	1.6 x ADWF
Oak Bay [2]	75	51,873	48,133	46,600	55,686	56,123	56,123 [3]	8.4 x ADWF
Saanich	47	15,514	13,613	15,427	15,223	14,369	15,353	3.7 x ADWF
Victoria	94	96,734	94,281	84,650	76,026	73,490	68,646	4.9 x ADWF
View Royal	34	12,322	12,294	13,216	14,525	11,541	17,299 [4]	3.5 x ADWF
First Nations	42	35,160	35,160	48,052	48,052	38,573	39,726	6.4 x ADWF

[1] Based on peak 24 hour flows.

[2] Excludes the combined sewer in the Uplands which have I&I rates over 200,000 l/ha/day

[3] Oak Bay's rate was not updated. The flows won't suitable for the calculations until the treatment plant conveyance system upgrades are complete in late 2021

[4] View Royal's increased rate is the result of better metering data.

[5] Colwood's rate increased in 2021 because it includes flows from DND Belmont, which is known to have elevated I&I. The data for prior years was not as accurate and excluded DND Belmont.

Notes related to Table 6.1:

1. Most of the changes in flow rates over time were the result of more accurate sewer metering or more complete sewer meter coverage. Exceptions to this are in Langford and Colwood where rates went down due to the installation of new sewers, and Esquimalt where I&I went down after significant sewer upgrade work in the mid-2000.
2. I&I rates are determined at each flow meter location and then interpolated into a weighted average over each particular municipality.
3. A 5-year storm event I&I flow rate is used, since the Municipal Sewage Regulation stipulates that a sewer system must be able to convey flow under this condition without an overflow.
4. In general, the rate of I&I tends to increase in proportion to the age of the system. Older systems usually need more work than newer systems. The primary goal of the I&I program is to reduce I&I to an optimum cost-benefit level. It is expensive to size wastewater facilities to accommodate vast amounts of I&I, but it can be equally expensive to rehabilitate or replace sewers to reduce I&I. Therefore, the optimal I&I level is the most cost-effective combination of I&I reduction and I&I accommodation.

7. SEWER ALLOCATIONS

CRD Bylaw 4304 (2020) includes maximum allowable sewer flows for each input into the core area trunk sewer system. Each input has an allocated average dry weather flow and an allocated peak daily flow. The process for setting up the allocations included the following:

- Each municipality and First Nation requested capacity at the treatment plant to meet their current and future needs.
- Reviews were carried out looking at:
  - Current flows and projected future flows (2045),
  - Current populations and projected future populations (2045), and
  - Land use.
- The purchased capacity for each municipality was divided between that municipalities catchments, as appropriate.
- Each of the allocations was assessed using the core area sewer model. Refinements were made as needed. Considerations included:
  - Capacity needs for the catchment,
  - Capacity of the core area trunk sewers to receive the flows, and
  - Overflows.

Table 7.1 compares measured peak 24 hour flows to the allocated flows from Bylaw 4304. The table is provided for information purposes only.

Table 7.1: Measured Flows vs Allocated Flows from Bylaw 4304

Allocation Point	**Allocated Average Dry Weather Flow** (ML/day)	**Measured Average Dry Weather Flow** (Jun + Jul + Aug, 2020)		**Allocated Peak Daily Flow** (ML/day)	**Peak 24-Hour Flow for a 5-Year Storm**	
		ML/day	**% of Allocated Capacity**		**ML/day**	**% of Allocated Capacity**
COLWOOD						
Total (Parson's minus Meaford)	**4.70**	**2.92**	**62%**	**18.8**	**8.20**	**44%**
ESQUIMALT						
Esquimalt Panhandle	0.12	0.10	87%	0.48	0.46	96%
Lang Cove Pump Station	1.28	0.63	49%	5.12	2.93	57%
Dockyard	1.01	0.48	48%	4.04	3.89	96%
Kinver	0.44	0.25	56%	1.76	2.25	128%
Pooley Place *(Flows are based on a correlation with an adjacent catchment. Catchment is not suitable for metering due to small size and multiple connections to the CRD system.)*	0.06	0.04	67%	0.24	0.21	87%
Devonshire	1.85	1.56	84%	7.40	10.00	135%
Wilson	0.37	0.25	69%	1.48	1.29	87%
Head	1.68	1.30	78%	6.72	6.75	100%
Anson	0.24	0.02	7%	0.97	0.63	65%
Total	**7.09**	**4.63**	**65%**	**28.36**	**28.40**	**100%**
LANGFORD						
Total *(Meaford)*	**14.12**	**7.48**	**53%**	**56.48**	**11.71**	**21%**
OAK BAY						
Windsor	2.92	1.30	45%	11.68	18.01	154%
Humber *(combined sewers)*	0.60	0.42	71%	2.40	4.29	177% [1]
Rutland *(combined sewers)*	0.37	0.31	83%	1.48	5.92	400% [1]
Currie Net *(Flows won't be suitable for comparing to the bylaw allocations until the treatment plant conveyance system upgrades are complete in late 2021.)*	0.97	2.04	211%	3.88	n/a	>125%
Currie Lift Station	1.62	1.35	83%	6.48	12.43	192%
Harling Point Pump Station	0.20	0.09	46%	0.79	2.00	255%
Total *(Flows won't be suitable for comparing to the bylaw allocations until the treatment plant conveyance system upgrades are complete in late 2021.)*	**6.62**	**5.51**	**83%**	26.48	**n/a**	**>175%**

Allocation Point	**Allocated Average Dry Weather Flow** (ML/day)	**Measured Average Dry Weather Flow** (Jun + Jul + Aug, 2020)		**Allocated Peak Daily Flow** (ML/day)	**Peak 24-Hour Flow for a 5-Year Storm**	
		ML/day	**% of Allocated Capacity**		**ML/day**	**% of Allocated Capacity**
SAANICH						
Marigold PS	13.19	9.89	75%	52.76	34.50	65%
City Boundary	5.88	2.71	46%	23.52	10.50	45%
Harriet	3.27	2.06	63%	13.08	9.36	72%
Townley	0.61	0.39	63%	2.44	2.07	85%
Haultain	0.57	0.18	31%	2.27	1.21	53%
Arbutus	7.08	5.93	84%	28.31	20.95	74%
Haro	0.79	0.18	23%	3.17	0.95	30%
Penrhyn Lift Station	0.93	0.79	85%	3.73	2.74	74%
Total	**32.89**	**22.12**	**67%**	**131.56**	**82.29**	**63%**
VICTORIA						
Cecelia	3.14	2.31	74%	12.57	11.70	93%
Chapman & Gorge *(Flows are based on a correlation with an adjacent catchment. Plans are in place to install a meter)*	0.35	0.99	281%	1.40	4.98	356%
Selkirk *(Flows are based on a correlation with an adjacent catchment. Plans are in place to install a meter)*	0.28	0.10	36%	1.11	0.39	35%
Langford - Vic West	0.19	0.10	51%	0.77	1.18	154%
Hereward	1.91	1.84	96%	7.65	7.20	94%
Sea Terrace *(The flume surcharges during large storms. Because of this, the Peak 24hr flows are based on a correlation with an adjacent catchment. Options are being explored to address this issue.)*	0.33	0.17	52%	1.32	1.50	114%
Trent Net	7.33	5.32	73%	29.32	40.8	139%
Hollywood	0.54	0.66	121%	2.16	7.00	323%
Olive	23.06	17.13	74%	92.24	57.87	63%
Clover Net *(The catchment is not suitable for metering due to small size and multiple connections to the CRD system. As a result, the flows are based on a calculation.)*	1.50	1.92	128%	6.01	7.68	128%
Total	**38.30**	**28.52**	74%	153.19	**140.31**	**92%**

Allocation Point	Allocated Average Dry Weather Flow (ML/day)	Measured Average Dry Weather Flow (Jun + Jul + Aug, 2020)		Allocated Peak Daily Flow (ML/day)	Peak 24-Hour Flow for a 5-Year Storm	
		ML/day	% of Allocated Capacity		ML/day	% of Allocated Capacity
VIEW ROYAL						
Craigflower Pump Station	3.54	1.92	54%	14.16	7.10	50%
Shoreline Trunk	0.14	0.12	85%	0.55	0.50	91%
Total	**3.54**	**2.04**	**58%**	**14.16**	**7.1**	**50%**
ESQUIMALT NATION						
Esquimalt Nation *(Flows are calculated. Plans are in place to install a meter)*	**0.07**	**0.06**	**79%**	**0.28**	**0.35**	**126%**
SONGHEES NATION						
Songhees Nation	0.59	0.48	81%	2.36	3.08	131%
Maplebank	0.010	0.005	50%	0.04	0.005	13%
Total	**0.63**	**0.48**	**77%**	**2.52**	**3.09**	**122%**

[1] The peak 24 hour flows for a 5-year storm cannot be calculated because the station routinely overflows and the overflow volumes aren't measured. If the overflow volumes were measured, the calculated peak 24-hour flow for a 5-year storm would be higher.

8. MUNICIPAL & FIRST NATIONS INITIATIVES

Colwood

Colwood diligently inspects its new underground infrastructure to manage and prevent I&I. In 2020, Colwood started to update its Sewer Master Plan and its sanitary sewer model (in progress). As part of the work, sewer flow data loggers were installed at several of pump stations three of Colwood's Municipal pump stations and the Department of National Defence's Belmont pump station. Colwood camera-inspected approximately 7,500 metres of sewer mains in 2020.

Esquimalt

Esquimalt completed an extensive infrastructure investigation between 2004 and 2016, including camera-inspection and smoke testing, relining of approximately half of its sewers, targeted repairs to manholes and separation of its combined manholes. This work increased the sewer system performance and reduced I&I.

In 2020 to mid-2021, Esquimalt worked on the following I&I related actions:

- Completed a detailed I&I report (currently draft) which includes a 10-year plan to address I&I concerns and reduce flows below 4x average dry weather flow. The action steps from the report will be combined with existing projects identified through camera inspection work and sewer/stormwater modeling work.
- Carried out spot repairs to main lines of both the storm and sanitary collection system due to structural failure. Locations included: Esquimalt Road, Lampson, Saxe Point, and Munro.
- Installed 10 new sanitary laterals, 13 new stormwater laterals and 2 catch basins.
- Repaired or replaced 17 sewer laterals and 11 stormwater laterals that were impacted by blockages or failures.

- Carried out work with Township forces and CRD Source Control to determine possible cross connections into the Gorge Waterway (2019 ongoing)
- Tender release in second half of 2021 for continued cleaning, inspection and service rating for remaining portions of the storm and sanitary collection systems. Completion of the work is expected in mid-2022
- Adoption of a Funding Model – late 2021/early 2022
  - Determine a funding mechanism that will provide funding for work to be carried out on private and public portions of laterals and public collection mains
- Adoption of Bylaw – late 2021/early 2022
  - The purpose of the activity is to provide a mechanism for the Township in order to deal with private services. Work will be focused on a review of the draft model bylaw from the CRD, cost for works and how the works will be carried out.
  - Determine a mechanism that will allow work to occur on private property and how the costs associated with these activities will be allocated between the various stakeholders involved.

Langford

Langford has a rapidly expanding new sewer system, diligently inspects new connections, and is incentivized to monitor and repair the sewer system to preserve sewer capacity for future growth. Since mid-2020, Langford carried out the following I&I related actions:

- Replaced 2 damaged manhole frames and covers,
- Inspected 45 sewer manholes for inflow and infiltration,
- rehabilitated 27 sewer inspection chambers,
- power-flushed 1100 metres of sewer main, and
- camera-inspected 2305 metres of sewer mains for infiltration purposes

Oak Bay

Oak Bay carried out numerous I&I related actions in 2020. The details are documented in Appendix G and is summarized below.

- Using conventional construction, replaced:
  - 86 metres of sewer main,
  - 2 sewer lateral,
  - 497 metres of storm main,
  - 9 stormwater manholes,
  - 2 storm drain laterals,
  - 1 combined sewer manhole, and
  - constructed 1 storm drain lateral (previously combined).
- Using trenchless technology:
  - pipe bursted 50 metres of sewer laterals, and
  - relined 1784 metres of sewer mains, 1799 metres of combined sewer main, and 447 metres of storm mains.
- Completed spot repairs at ~10 sections of sewer main and ~20 sections of storm main.
- Dye teste 106 laterals and found 23 cross connections, 14 of which have been fixed.
- Repaired a number of sewer laterals.
- Initiated a RFQ for the future design of works to add a new storm drain for Runnymede Place, which currently doesn't have a storm drain and is thus fully cross-connected.
- Storm main catchment modeling work in two catchments.
- Contracted a consultant to build a sanitary sewer model for the municipality (in progress).
- A number of additional infrastructure projects and studies / investigations (see Appendix G)
- Completed the 5 year program to CCTV Oak Bay's sanitary sewers.
- Completed year 5 of 10 to CCTV Oak Bay's storm sewer.
- Developers completed additional sewer and storm main work (see Appendix G)

Note that some of this work overlaps calendar years and thus may be documented in I&I Annual Reports for consecutive years.

Saanich

Saanich replaces and renews its sanitary sewer infrastructure through its capital and maintenance programs.

The following capital and maintenance activities were completed in 2020/2021:

- camera inspections and assessments of 5,656 metres of sanitary sewer main,
- replacement and installation of 2,717metres of sanitary sewer, including 198 new sewer service connections with inspection chambers,
- repair of 42 sewer service connections, including 16 of which required full pipe replacements; 9 new inspection chambers were installed,
- repair of 1 manhole and replacement 1 manhole,
- spot repair at 5 locations in the sanitary sewer network,
- pipe relining of 1,197 metres of sanitary sewer main including lateral reinstatement, and lining of 83 sewer service connections,
- smoke testing within the Brett Lift Station catchment; including 2,935 metres of sanitary sewer main and 216 sanitary service connections. Seven (7) repairs were made to eliminate issues related to I&I at the station.

The following planning initiatives were completed in 2020/2021:

- updating and calibration of Saanich's sanitary sewer model, including a flow monitoring program for key locations,
- developed a smoke testing operating procedure and program, and
- development of a no-corrode sanitary sewer service connection inspection and replacement program.

Work currently in progress includes:

- camera inspections and assessment of 22,930 metres of sanitary sewer main,
- camera inspection program planning for all sanitary sewer checklist lines,
- removal of three lift stations at the end of their service life in favour of 17 sewer service connections on a new low pressure system,
- updating Saanich's sewer master plan, and
- operational review of the Wetherby Lift Station, including flow monitoring and smoke testing of the catchment area.

Victoria

Victoria continues to manage its sewer repair and replacement work in its sewer master plan, which was fully updated in 2018. Highlights of the I&I-related work carried out in 2020 are summarized as follows:

- 2 (two) FloDar flow metres with special sensors were installed that allow peak flows to be monitored during surcharge conditions.
- 13,600 metres of sanitary sewer mains were camera inspected by City of Victoria crews, and 11,324 metres of sanitary sewer mains were inspected by contractors. Under the same contract, 887 sanitary sewer laterals were also inspected.
- 47,900 metres of sanitary sewer mains were cleaned by City crews.

- 2,246 metres of sanitary sewer mains were lined using cured in place technology under the City's annual lining contractor. As part of this contract, 2 sanitary sewer vents and 2 sanitary sewer flush tanks were replaced with the standard terminal manholes.
- 4 sanitary sewer manholes were replaced by City crews as part of ongoing system maintenance.
- 196 metres of sanitary sewer mains were repaired by City crews following assessment of main condition.
- 55 sanitary sewer laterals were repaired and 88 sanitary sewer laterals have been replaced by City crews.
- 24 sanitary sewer laterals were relined by T-liner technology with the focus on sealing the main/lateral interface. As part of this work 17 inspection chambers were also installed.
- 410 linear metres of sanitary sewer main have been replaced by open trench excavation.
- Around 650 sanitary sewer manholes were inspected with a 3D camera with Manhole Assessment Certification Program level 2 reports generated for each.
- Successfully commenced the Disaster Mitigation and Adaptation Fund program under a federal grant to upgrade select sewer, storm drain and water main infrastructure over the next 9 years to address challenges due to natural hazards (e.g., earthquakes, climate change). The design and construction work started in late 2020 and will be continuing until 2028.
- Applied for the Investing in Canada Infrastructure Program grant to fund design and construction of new alignment of sanitary sewer mains and to separate the combined manholes where both the sanitary sewer and storm drain lines run side by side. This program will reduce I&I.
- Had a comprehensive I&I reduction report prepared by Urban System Ltd that will be presented to council later this year.

In addition, the City continues to address and evaluate the I&I issue associated with private properties. This includes:

- During the building permits phase, all new developments are required to obtain the separate storm drain connection and consider rainwater management system on private property.
- All permits associated with renovations are required to confirm their connections to the City's storm drain system via inspections or dye tests to determine if the property may require a new storm drain connection.

View Royal

View Royal continues its sewer maintenance and repair program which includes camera inspections, sewer flushing and flow monitoring. In 2020 View Royal has completed the following sewer work related to I&I:

- Upgraded the Thetis Cove pump station which included the addition of a flow meter,
- Repaired one residential cross connection,
- Repaired one sewer manhole,
- Capped abandoned sewer main that was contributing I&I to View Royal sewer system, and
- Camera-inspected and flushed 1429 metres of sewer gravity main.

Esquimalt Nation

In 2018, the Esquimalt Nation hired a consultant to inspect their sewer system and prepare a report containing recommendations for maintenance, repairs, and I&I reduction. In 2019 and 2020, the following actions were taken:

- removal / capping of four unused sewer laterals that were noted as sources of I&I,
- a mainline point repair,
- grouting of a manhole to address I&I, and
- renewal of the Nation's pump station

Songhees First Nation

The Songhees Nation continues its program related to sewer maintenance and repairs. Initiated in late 2015, Songhees completed a study to investigate I&I sources along with a detailed design for remediation. Most of the recommended work has not been completed yet, however the work is ready for tender and awaiting funding from Indigenous Services Canada.

Capital Regional District

Section 2 of this report summarizes the key actions for the Core Area I&I program. In addition to this, CRD staff carried out the following I&I related actions on the core area regional sewer system:

- continued with conveyance system upgrades related to the treatment plant project (i.e., Trent forcemain connector, Arbutus storage tank),
- relined 1,113 metres of regional sewers (Northwest Trunk), and
- camera-inspected 13,395 metres of regional sewer

9. SUMMARY

The purpose of this report is to provide an update on work related to I&I in the core area from 2020 to mid-2021. The work supports commitments located in Section 5 of the CALWMP, which addresses the *Management of Infiltration and Inflow and Control of Wastewater Overflows.* The report included:

- summary of special projects carried out by the Core Area I&I Program,
- summary of overflow events from 2020 and mid-2021,
- status of efforts to address I&I from private property, and
- I&I related updates from each of the core area municipalities.

Appendix A:
LWMP Commitments Related to I&I

CAPITAL REGIONAL DISTRICT
CORE AREA LIQUID WASTE MANAGEMENT PLAN
(Consolidated Version incorporating all applicable amendments, February 2015)

SECTION 5
MANAGEMENT OF INFILTRATION AND INFLOW AND CONTROL OF WASTEWATER OVERFLOWS

GOAL

Condition 17(1)(a) of Schedule 1 of the Municipal Sewage Regulation (MSR) requires that if infiltration and inflow (I&I) causes daily flows to be greater than 2 times the average dry weather flow (ADWF), the discharger must address "how I&I can be reduced as part of a Liquid Waste Management Plan" and condition 17(2) outlines the treatment and discharge requirements for such flows.

The goal of the I&I program is therefore to comply with this requirement of the MSR by developing and implementing a strategy aimed at reducing the amount of rainwater and groundwater entering the core area's sanitary sewer system from both the publicly owned and privately owned parts of the system in order to reduce and eventually eliminate overflows from the system.

How the Capital Regional District (CRD) proposes to substantially meet the requirements of Condition 17(2) is addressed in Sections 4 and 6 and in the draft operational certificate in Section 12.

COMMITMENTS

The CRD and the participating municipalities commit to the following actions to reduce I&I sufficiently to reduce maximum daily wet weather flows to less than four times the average dry weather flow by 2030:

1. Continue flow monitoring in each municipality to further refine priority areas for remediation.

2. Develop, by the end of 2011, and submit to the Ministry of Environment, comprehensive inflow and infiltration management plans for the core area that will:
    a) Identify and evaluate options and opportunities that promote the minimization of groundwater and rainwater I&I into municipal sanitary sewer systems, including I&I originating from service laterals (private and public sections of sewer connections).
    b) Identify needed changes to legislation and legal authority to enable options and strategies.
    c) Identify opportunities for the inspection of private sewers connected to municipal sewers:
        (i) as part of the municipal process in evaluating and issuing renovation and building permits for serviced properties; and/or
        (ii) at the time of property transfer; and/or
        (iii) targeted inspections.
    d) Require the repair or replacement of private sewers that have cross-connections between storm sewers and sanitary sewer or are identified as being in poor condition.

3. Update, by the end of 2011, and enforce sewer use bylaws to prohibit the construction of rainwater and groundwater connections to sanitary sewers.

4. Implement the overflow reduction plans contained in the sanitary sewer overflow management plan, which was submitted to the Ministry of Environment in June 2008. These plans are summarized as follows:

Table 5.1
Prioritized Order of CRD Overflow Reduction Plan
(Updated based on current information)

Priority No.	O/F Name	Action Plan	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Monterey Avenue MH0130	Complete and commission Trent pump station	2008 (Complete)	$500,000
2.	Macaulay Point Pump Station	Complete installation of standby power	2008 (Complete)	$800,000
3.	Harling Pump Station	Install a screen on the overflow pipe	2008 (Complete)	$10,000
4.	Shoreline Drive MH0340	Commence with capacity deficiency study and identify upgrade options	2010	$50,000
5.	Penrhyn Lift Station	Investigate pump and genset capacity	2010	$600,000
6.	Humber Combined Sewers	Oak Bay plans to separate the sewers in the Uplands area	2015	To be determined (Oak Bay cost)
7.	Rutland Combined Sewers	Oak Bay plans to separate the sewers in the Uplands area	2015	To be determined (Oak Bay cost)
8.	Head Street MH0040	Twin the NWT from Macaulay Point to MH0055	2015	$20,000,000
9.	Sea Terrace MH0055	Twin the NWT from Macaulay Point to MH0055	2015	as above
10.	Broom Road	Extend Trent forcemain down to Clover Point	2017	as above

Table 5.2
Prioritized Order of Colwood Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	SCADA Upgrade	Upgrade the SCADA system to collect flow data from all pump stations.	2008 (Complete)	$10,000
2.	CCTV Inspection	Continue to inspect all new sewers that are installed to ensure they are well constructed	Annually	$15,000
3.	Sewer System Maintenance	Continue to clean all mains and manholes, and repair as necessary.	Annually	$50,000
4.	Lift Station Maintenance	Continue to maintain all lift station components to ensure that they run efficiently.	Annually	$72,500

Table 5.3
Prioritized Order of Esquimalt Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Sewer Relining	Relining and repairs to sewer mains rated poor and poorest	Completed	n/a
2.	Combination Manhole Separation	• 148 manholes remain to be separated • 29 manholes to be separated in 2008 • Five manholes separated per year from 2009 to 2025	2025	$950,000
3.	Grafton Pump Station Upgrade	New electrical power supply, kiosk and controls	2008 (Complete)	$38,000
4.	Grafton Pump Station Upgrade	Pump replacement	2012	$40,000
5.	Sewer Main Replacement	Replacement of undersize sewer main on Craigflower Road between Tillicum Road and Lampson Street	2009 (Complete)	$250,000
6.	Municipal Wide Smoke and Dye Testing	Smoke and dye testing underway to identify cross connections in attempts to reduce I&I in the future. The full scope of the project has not yet been determined.	2010	unknown

Table 5.4
Prioritized Order of Langford Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Sewer Master Plan Upgrades	Continue with infrastructure upgrades as identified in the Sewer Master Plan.	Ongoing	$0.2-0.5 Million
2.	CCTV Inspection	Continue to video inspect all new sewers that are installed to ensure that they are well constructed.	Annually	$15,000
3.	Manhole Inspection	Continue to visually inspect manholes to ensure that they do not leak.	Annually	$15,000
4.	Pump Station Maintenance	Continue to maintain all pump station components to ensure that they run efficiently.	Annually	$200,000
5.	Sewer System Maintenance	Continue to keep the sewers clean and free from defects.	Annually	$25,000

Table 5.5
Prioritized Order of Oak Bay Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Uplands Sewer Separation	Complete the separation of combined sewers in Uplands.	2015	$12,000,000 (est.)
2.	South Oak Bay I&I Rehab Project	Continue with the phased rehabilitation project in the Windsor catchment area.	2010	$1,000,000 (est.)
3.	Hydraulic Model	Continue to complete a hydraulic model of the entire collection system.	2014	$90,000 (est.)
4.	CCTV Inspection	Continue to video inspect sewer mains.	Annually	$25,000
5.	Pump Station Maintenance	Continue to maintain all pump station components to ensure that they run efficiently.	Annually	$30,000
6.	SCADA Upgrade	Upgrade the SCADA system to collect flow data from all pump stations. Typically one station per year is added to the Oak Bay SCADA system.	2016	$180,000 (est.)
7.	Sewer System Maintenance	Continue to keep the sewers clean and free from defects.	Annually	$237,000
8.	Manhole Inspection	Continue to visually inspect manholes to ensure that they do not leak.	Annually	$15,000

Table 5.6
Prioritized Order of Saanich Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Dysart Pump Station	Complete construction of the new Dysart pump station.	2008 (Complete)	$2,500,000 (est.)
2.	The following pump stations will be upgraded: Vantreight Lift Station Murray #1 Pump Station Murray #2 Pump Station Arundel Pump Station Glenwood Pump Station Ashley Pump Station Dunkirk Pump Station Colquitz Pump Station Gorge Pump Station	Rebuild pump station and add a new standby generator.	2009-2015	$500,000 Annually

Table 5.7
Prioritized Order of Victoria Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	James Bay I&I Pilot Project	Commence with the rehabilitation of sewer mains, laterals and manholes in James Bay.	2010	$3,000,000
2.	Hydraulic Model	Continue to complete a hydraulic model of the City's entire sanitary sewer collection system.	2009	$100,000
3.	Overflow Elimination	Investigate, monitor and abandon, if possible, existing known overflow locations.	2010	$100,000
4.	Combined Manhole Separation	Investigate, monitor and initiate a program to separate combined manholes.	2015	$400,000

Table 5.8
Prioritized Order of View Royal Overflow Reduction Plan

Item No.	Work Name	Description	Estimated Year of Completion	Estimated Cost ($2008) to Complete
1.	Upgrade Pump Stations	Upgrade pump stations where required to improve pump performance, provide standby power and collect better data.	2017	$140,000
2.	CCTV Inspection	Continue to video inspect all new sewers that are installed to ensure that they are well constructed.	Annually	$20,000
3.	Manhole Inspection	Continue to visually inspect manholes to ensure that they do not leak.	Annually	$5,000
4.	Pump Station Maintenance	Continue to maintain all pump station components to ensure that they run efficiently.	Annually	$120,000
5.	Sewer System Maintenance	Continue to keep the sewers clean and free from defects.	Annually	$40,000

APPENDIX C

Excerpt from the Capital Regional District Core Area Liquid Waste Management Plan – Sanitary Sewer Overflow Management Plan, June 2008.

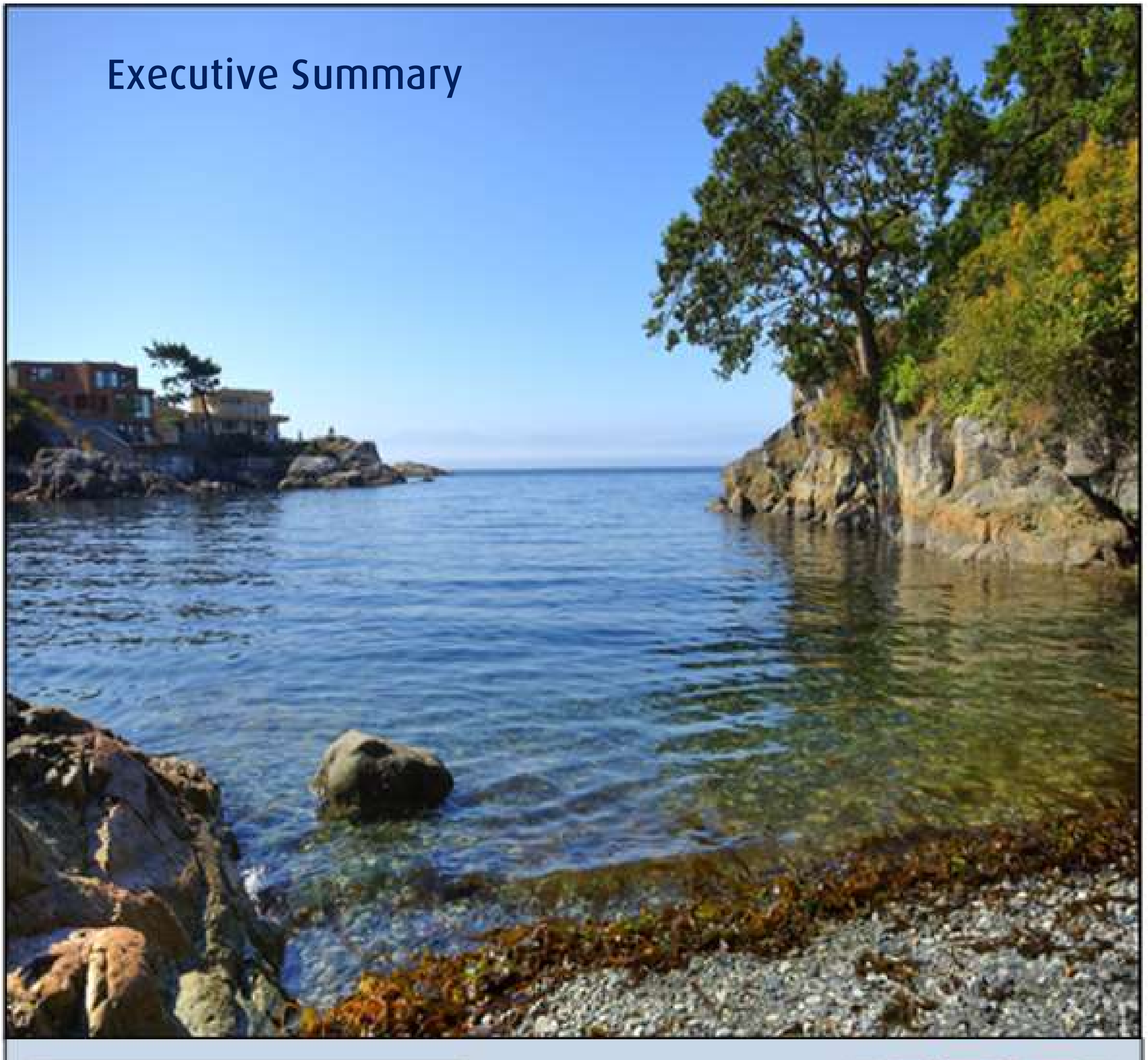
Appendix B:

EXCEUTIVE SUMMARY: CORE AREA I&I MANAGEMENT PLAN: 2017 UPDATE

Capital Regional District

Core Area Inflow & Infiltration Management Plan

2017 Update



Executive Summary

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CORE AREA INFLOW & INFILTRATION MANAGEMENT PLAN

EXECUTIVE SUMMARY

Purpose

The purpose of the plan is to guide the Capital Regional District (CRD) and its municipal partners towards Inflow and Infiltration (I&I) reduction in a responsible, cost effective, integrated and well-planned manner. The primary objective of the plan is to reduce overflows and I&I to less than four times average dry weather flow (4xADWF), based on a five year return period, at Clover Point and the Core Area Wastewater Treatment Plant at McLoughlin Point by 2031.

Background

The core area municipalities are actively managing inflow and infiltration (I&I), a term that describes rainwater and groundwater that mistakenly gets into the sanitary sewer system. Inflow refers to rainwater that enters the sewer through plumbing cross connections and infiltration refers to groundwater that seeps into the sewer through cracks, faulty joints, etc. A certain amount of I&I is unavoidable and is accounted for in routine sewer design. However, too much I&I results in excessive sewer flows which can lead to:

- leaking sewers and overflows that can contaminate the environment and create public health concerns;
- backing up of sewage into buildings and homes that can destroy belongings and require expensive restoration;
- increasing operation and maintenance costs to convey and treat the increased flows; and
- consuming sewer capacity which could require expensive premature upgrades to the system.

The content of the Core Area I&I Management Plan is organized in the following sections: 1) Overview; 2) Overflows; 3) Asset Management; 4) Climate Change; 5) Public Property I&I; 6) Private Property I&I; 7 to 17) Municipal Plans; and 18) Monitoring & Verification.

Regulatory Context

The core area wastewater system is governed by the Core Area Liquid Waste Management Plan (LWMP). This plan was first approved by the Ministry of Environment in 2003. Since that time, there have been a number of amendments to the plan, the most recent being Amendment No. 11 (approved in 2016).

Section 5 of the plan relates to I&I and overflows and includes the following commitments:

> *The CRD and the participating municipalities commit to the following actions to reduce I&I sufficiently to reduce maximum daily wet weather flows to less than four times the average dry weather flow by 2030:*
>
> 1. *Continue flow monitoring in each municipality to further refine priority areas for remediation.*
>
> 2. *Develop, by the end of 2011, and submit to the Ministry of Environment, comprehensive inflow and infiltration management plans for the core area that will:*
>   - *Identify and evaluate options and opportunities that promote the minimization of groundwater and rainwater I&I into municipal sanitary sewers, including I&I originating from service laterals (private and public sections of sewer connections)*
>   - *Identify needed changes to legislation and legal authority to enable options and strategies*
>   - *Identify opportunities for the inspection of private sewers connected to municipal sewers:*
>   - *i. as part of the municipal process in evaluating and issuing renovation and building permits for serviced properties; and/or*
>   - *ii. at the time of property transfer, and/or*
>   - *iii. targeted inspections*

  - *Require the repair or replacement of private sewers that have cross-connections between storm sewers and sanitary sewers or are identified as being in poor condition.*

3. *Update by the end of 2011, and enforce sewer use bylaws to prohibit the construction of rainwater and groundwater connections to sanitary sewers.*

4. *Implement the overflow reduction plans contained in the sanitary sewer overflow management plan, which was submitted to the Ministry of Environment in June 2008.*

Overflows

In 2014, the CRD submitted an updated core area overflow management plan to the Province. The plan documents the CRD's overflow related commitments and summarizes the significant work carried out related to overflows.

Asset Management

Asset management programs for sewer collection systems generally focus on the planned replacement of infrastructure based on remaining service life. Municipalities need to demonstrate that they are following the Asset Management BC Framework to qualify for federal gas tax funding.

Climate Change

Over the next five years, the CRD will carry out actions supporting a vulnerability assessment of CRD sewer infrastructure due to climate change. The actions include updating the core area sewer model, running the sewer model using climate change scenarios, and providing recommendations based on the results.

Public Property Inflow and Infiltration

I&I and overflow quantification helps municipalities to understand the condition and/or performance of their sewer systems. Quantified measurements can be compared to benchmarking standards and allow municipalities to track I&I performance. The most useful quantification methods are repeatable and follow a standardized approach. Examples of I&I quantification methods proposed in this plan include: statistical analysis of sewer flow data to calculate I&I rates, quantifying overflows based on given storm events, ranking structural integrity of sewer pipes based on closed circuit television (CCTV) inspections, counting cross-connections through smoke testing, documenting manhole condition and calibrating system performance using hydraulic models.

The public property I&I reduction plans are consistent with the systematic approach noted in the Infraguide for "Infiltration/Inflow Control/Reduction for Wastewater Collection Systems". Infraguide was a partnership between the Federation of Canadian Municipalities, the National Resource Council and Infrastructure Canada. It created best practice reports for municipal infrastructure. The guide proposes that I&I reduction programs be divided into the following three phases:

- Phase 1 - involves flow monitoring and data collection. The data is used to identify catchments that should be targeted for sewer investigation work.
- Phase 2 - involves sewer investigation work to identify specific sources of I&I. The data is used to create rehabilitation plans and to prioritize I&I rehabilitation work.
- Phase 3 - involves sewer rehabilitation work. The rehabilitation work is based on investigation data from Phase 2. If investigation data is not yet available, then archetype I&I rehabilitation programs should be used.

Archetype I&I rehabilitation programs were developed to provide a framework under which any given sewer catchment can be evaluated and related to an actionable plan to move forward with I&I assessments and sewer rehabilitation. These programs are to be used as planning tools. They should be interpreted from a strategic planning level and are suitable for establishing long-range budgets and for steering the development of targeted I&I reduction programs.

Private Property Inflow and Infiltration

The I&I Management Plan (2012) contained a five-year plan for implementing a common private property I&I approach for the core area. The plan was to consult with stakeholders and the public from 2012 to 2014, recommend an approach in 2015 and implement that approach in 2016. Significant effort was made to come up with a common approach. By 2014, it was clear that a common approach wasn't appropriate as the core area municipalities have different I&I rates, different issues and require different solutions. Three of the core area municipalities have older sewers and elevated I&I and they would benefit from strong programs to reduce I&I. The other four municipalities have newer sewers and have low I&I. These municipalities would prefer to focus on I&I prevention activities. The I&I Subcommittee agreed that each municipality should implement their own custom approach to suit their needs and should draw on the significant research and support that the CRD has provided.

In late 2014, the CRD Board directed that a sample model bylaw related to the inspection of private sewer laterals connected to municipal sewers be prepared. The sample bylaw was built using past I&I Subcommittee feedback and content from the Pinna Report (2014) which documented the best I&I related language from existing Canadian and American bylaws. It underwent legal review and I&I Subcommittee review for general acceptability. The sample model bylaw was presented to the Core Area Liquid Waste Management Committee on May 13, 2015. The Core Area Liquid Waste Management Committee recommended that the sample bylaw be discussed with the I&I Subcommittee to determine how best to move it forward. The I&I Subcommittee decided that it would be best to incorporate the powers from the sample model bylaw into the existing municipal sewer use bylaws. Subsequently, a gap analysis was carried out comparing the powers from existing municipal sewer bylaws to the draft sample model bylaw and presented to the member municipalities through the I&I Subcommittee.

The next steps for addressing private property I&I include:

- assisting municipalities with the further development of private property I&I reduction plans;
- supporting the implementation of the powers from the sample model bylaw for private property I&I into existing or new municipal sewer bylaws;
- developing common public education materials for use by key industry stakeholders (i.e. plumbers, realtors and home owners);
- updating the general education approach to focus on homeowner protection (i.e. basement flooding) and environmental protection and how I&I plays an integral role; and
- continued collaboration with Metro Vancouver and the National Water and Wastewater Benchmarking Initiative's I&I Task Force.

Municipal Inflow and Infiltration Plans

Each of the core area municipalities has participated in the development of their own individual municipal I&I plans. The municipal plans are organized into eight sections:

1. *Overview*
2. *Catchments* - A list and map of the long-term flow monitoring catchments that will form the basis for evaluation of I&I rates and I&I management planning
3. *Inflow & Infiltration Data* – Summary of historical data collected, current data collected, summary of I&I analyses results, and flow data analyses
4. *Sewer Infrastructure Maintenance & Capital Work* – summary of routine sewer work, notable work completed between 2012 and 2015, and notable work planned for 2016 to 2020
5. *Asset Management* – high level municipal tools, approaches, etc.
6. *Bylaws* – Contains a comparison of the key powers suggested by the CRD Private Property I&I Model Bylaw to those found in each of the municipality's existing sewer bylaws
7. *Budget* – Summary I&I budget related information
8. *Summary* - A high level summary and a graph showing projected peak wet-weather flow (PWWF) relative to 4xADWF for the entire municipality from 2011 to 2031

Monitoring and Verification

Monitoring and verification of I&I Management Plan objectives will be achieved by using the following metrics:

1. Comparison of peak wet weather flow (PWWF) with 4xADWF at Clover Point and the proposed wastewater treatment plant. This will include graphs comparing projected PWWF and ADWF verses actual rates recorded over time.
2. Flow monitoring of all catchments to track I&I rates paying extra attention to measuring flows before and after targeted I&I reduction work to verify results.
3. Tracking overflows by location, frequency, duration and receiving environment sensitivity rating to monitor trends and verify results.
4. Completion of detailed and specific I&I management strategies for each catchment to replace the archetype plans.
5. Reporting of efforts and costs applied towards I&I management on a regular basis.

The CRD will continue to provide annual reports on the I&I program to the Core Area Liquid Waste Management Committee. Every second year the I&I analyses results will be updated, as is the current practice, and an I&I benchmarking template will be filled out for each of the core municipalities. The benchmarking template is currently in development and will include a number of performance measure criteria to help gauge the level of effort each municipality is applying to I&I management.

Forecasted Inflow and Infiltration Reduction

Additional work will be needed to meet the LWMP commitment of reducing wet weather flows below 4xADWF at Clover Point and the McLoughlin Point Treatment Plant by 2031. However, the gap between 4xADWF and peak wet-weather flow (PWWF) is decreasing, which is significant as it takes a substantial investment of time and resources to reverse the natural trend of I&I increasing with sewer age.

Colwood, Langford, Saanich and View Royal already meet the 4xADWF performance target. This is largely due to having young sewers built with modern materials and good installation practices. These municipalities will need to focus on I&I prevention in order to continue to meet the performance target.

Esquimalt, Oak Bay, and Victoria have older sewers which tend to have elevated I&I rates. If we extrapolate out current I&I rates, it is evident that these municipalities will need to focus on I&I reduction to meet their commitments not to exceed the 4xADWF performance target. This will require increased focus and funding on I&I reduction to achieve their reduction targets. Financial support (i.e. grants) from senior government would help to accelerate the I&I reductions. It is worth noting that:

- Esquimalt rehabilitated all of its sewers and manholes that required structural repairs in the early 2000's. It has also separated almost all of its combined manholes. Esquimalt's next steps for addressing I&I will involve actions related to I&I from sewer laterals and stormwater sewer upgrades.
- Oak Bay's I&I reduction work focused on developing a plan for the separation of the combined sewers in the Uplands area. Oak Bay finalized the separation plan in 2017. This was Oak Bay's highest I&I related priority and was required as part of a LWMP commitment. Oak Bay also completed the significant task of collecting sewer flow data for each of its outstanding catchments using portable meters. Oak Bay's next steps for I&I reduction will be to implement the Uplands' separation project, to complete the collection of sewer camera inspection data for the municipality and to update its sewer master plan based on the results of the camera inspections.
- Victoria has collected sewer flow data for its outstanding catchments, and has also performed camera inspections and smoke testing throughout the entire municipality. The data will be analyzed and actions put into Victoria's sewer master plan. Updating a sewer master plan is a substantial project. Victoria had to delay the update of its sewer master plan until the location of the core area treatment plant was finalized because some of the locations considered for the plant would have resulted in dramatic changes to the plan. Work on the sewer master plan commenced in late 2016 after the regional treatment plant location was finalized.

The CRD is committed to assisting individual municipalities in the development of suitable private property I&I initiatives. Such initiatives could accelerate a municipality towards meeting its performance targets as it is estimated that 50% of I&I enters the sewer system on private property. Currently, there are no significant private property I&I initiatives in the core area; however, the research needed to develop such commitments is complete.

In addition, it is anticipated that significant progress will be made through the continuation and further development of I&I related education, stakeholder engagement, regulatory mechanisms, permit requirements, time of home sale options and through targeted pilot programs.

Key Future Actions

The next steps for addressing private property I&I include:

- supporting the implementation of the powers from the sample model bylaw for private property I&I into existing sewer municipal bylaws or into a new bylaw;
- assisting municipalities with the development and implementation of municipality specific private property I&I reduction plans;
- developing common public education materials for use by key industry stakeholders (i.e. plumbers, realtors and home owners);
- updating the general education approach to focus on homeowner protection (i.e. basement flooding) and environmental protection and how I&I plays an integral role; and
- continued collaboration with Metro Vancouver and the National Water and Wastewater Benchmarking Initiative's I&I Task Force.

The next steps for addressing public property I&I include:

- identifying "semi-combined" sewers in the core area and developing plans to address them;
- taking leadership on I&I benchmarking and taking action to introduce nationally;
- updating the core area sewer model, running the sewer model using climate change scenarios, and providing recommendations based on the results; and
- ongoing I&I metering, analyses and program development.

Conclusion

The Ministry of Environment reviewed and approved Amendment No. 11 of the Core Area LWMP. The LWMP included four commitments related to I&I and overflow management which are fulfilled by the I&I Management Plan.

The plan is purposeful and guided by a number of federal, provincial, regional and municipal regulatory documents and best practices. It provides the framework for how I&I can be quantified and establishes priority programs and approaches for each municipality and the CRD to follow. A strategy has been developed for moving the issue of private property I&I forward and the whole program will be monitored, verified and reported out using standard metrics and templates.

All core area municipalities assisted in the preparation of the plan and the specific actions and programs were developed based on current CRD and municipal funding levels for I&I and sewer service budgets. Modelling the results of implementing this plan show that the goal of reducing I&I to 4xADWF at Clover Point and the wastewater treatment plant is achievable but will require additional effort.

Appendix C:

EXCEUTIVE SUMMARY: SANITARY SEWER OVERFLOW MANAGEMENT PLAN: 2014 UPDATE

CAPITAL REGIONAL DISTRICT
CORE AREA LIQUID WASTE MANAGEMENT PLAN

SANITARY SEWER OVERFLOW MANAGEMENT PLAN: 2014 UPDATE
EXECUTIVE SUMMARY

On July 3, 2014, the Minister of Environment approved the Capital Regional District's Amendment No. 9 to the Core Area Liquid Waste Management Plan (LWMP) subject to four conditions being met by December 31, 2014. Condition No. 2 to the Minister's approval requires that the CRD submit a *Wet Weather Flow Management progress report that includes an update on the progress made to date in achieving the LWMP commitment to eliminate sanitary and combined sewer overflows*. This progress report was written to satisfy that requirement.

Section 5 of the LWMP entitled "*Management of Infiltration and Inflow and the Control of Wastewater Overflows"* includes the individual overflow reduction plans for the CRD and each of the core area municipalities.

Background

Rainwater and groundwater that mistakenly enters the sanitary sewer system is referred to as inflow and infiltration (I&I). Inflow refers to rainwater that enters the sewer system through improper plumbing connections such as cross-connections with storm drains. Infiltration refers to groundwater that seeps into the sanitary sewer through cracks or joints in the sewer pipe. A certain amount of I&I is unavoidable and is accounted for in routine sewer design. However, when I&I exceeds design allowances, sewer capacity is consumed, and may result in overflows, risks to health, damage to the environment, and increased conveyance costs.

In the core area, the overall length of the sewer system can be broken down as follows: 45% municipal sewers; 40% private property laterals; 10% public property laterals; 5% regional sewers. Municipalities and regional districts tend to proactively inspect and fix their sewers. Conversely, private property owners rarely inspect or perform maintenance on their sewer laterals unless they are adversely impacted by a problem.

Since 2001, the CRD has collected valuable sewer flow monitoring data for the core area. Initially, the monitoring was done with a small number of portable flow meters. The monitoring has since expanded to include over 90 permanent meters and 20 portable meters with the CRD analyzing the data collected. The results are documented in I&I analyses reports which are submitted to the Core Area Liquid Waste Management Committee annually. In addition, the CRD has prepared a number of reports for the Province as required by the LWMP including: biennial update reports (2005, 2007, and 2009), the Overflow Management Plan (2008) and the I&I Management Plan (2012).

The *Core Area Sanitary Sewer Overflow Management Plan* (2008) was developed by the CRD in collaboration with representatives from the core area municipalities engineering departments. The document includes the mapping of the known sewer overflow locations in the core area (including pump stations, combined manholes and sewer relief points), rating core area shorelines based their sensitivity to sewer overflows, summarizing overflows from 2000 to 2007, and documenting prioritized overflow management plans for the CRD and each of the core area municipalities.

The *Core Area Inflow and Infiltration Management Plan* documents an approach for addressing I&I in the core area to the year 2031. The plan was developed by the CRD in collaboration with representatives from the core area municipalities engineering departments. In the plan, the core area is divided into 108 long-term monitoring catchment areas. Each catchment area is flow monitored and the data is analyzed for I&I. Catchments that exceed the agreed upon I&I rate are investigated (i.e., camera inspections / smoke testing) and the data collected is used to determine what work needs to be completed. Finally, the rehabilitation work is prioritized and carried out based on available budget. The I&I Management Plan also contains a sub-plan for developing and implementing an approach to address private property I&I starting in 2016.

As of 2014:

- I&I rates have been collected for all 108 I&I Management Plan catchments.
- All of the catchments in Colwood, Langford, Saanich, or View Royal have relatively low I&I.
- Most catchments in Esquimalt, Oak Bay, and Victoria's catchments have elevated I&I. Many of these catchments have been or will be investigated. From 2005 to 2010, Esquimalt inspected its entire sewer system and repaired all of the sewers and manholes that were in poor condition.
- Work is still being carried out to implement a private property I&I approach by 2016.

Between 2008 and 2013, the following significant I&I related work items have taken place in the core area:

- Esquimalt completed a $6.75 million upgrade of the sanitary collection system which included the relining of over 30% of Esquimalt's gravity sewers and separation of combined manholes.
- Victoria completed the James Bay I&I Reduction Pilot Study.
- The *Core Area Inflow and Infiltration Management Plan* was completed in 2012
- Methods were developed to generate sewer flow data from data already collected at municipal pump stations. This results in consistent, relatively inexpensive long-term flow monitoring data.
- I&I has been included at over 17 CRD outreach events per year since 2011. At these events the public was encouraged to complete a 4-question I&I related survey. I&I education material includes a brochure, two sets of videos to help explain I&I, and an I&I website.

Overflows (2008 – 2013)

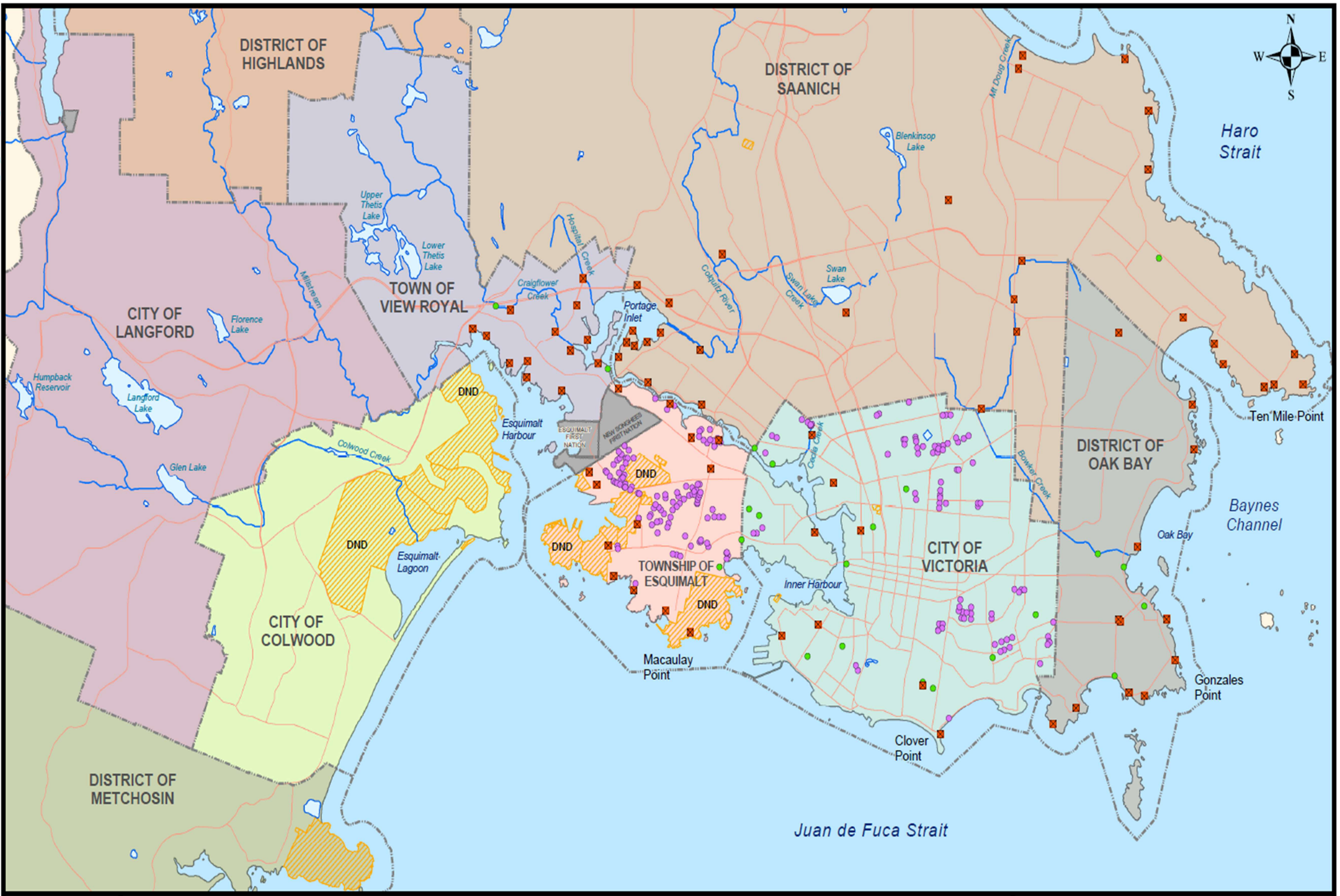
The CRD and core area municipalities have identified all of their known sewer overflow locations, which are summarized in Table ES-1 and Figure ES-1. It must be emphasized that, even though there are a large number of known overflow locations, the majority of them are never used or are infrequently used.

Table ES-1: Number of Known Potential Overflow Points

Jurisdiction	Pump Stations [1]	Relief Points [2]	Combined Manholes [3]	Total
CRD	14	8	0	22
Colwood	0	0	0	0
Esquimalt	11	0	~48	59
Langford	0	0	0	0
Oak Bay	6	0	Uplands is a combined collection system	6 plus Uplands
Saanich	28	0	0	28
Victoria	7	16	98	121
View Royal	12	0	0	12
Total	78	24	146	248

1. Sanitary pump station overflows are those that have a designed overflow point included within or just upstream of the pump station.
2. Relief point overflows include overflow pipes designed into the collection system that spill into storm drains or nearby waterways.
3. Combined manhole overflows are those where both sanitary and storm pipes are located within the same manhole but are separated by a concrete dividing wall. All of these manholes were installed as a cost-saving measure in the 1960-70s, as it was cheaper to install one manhole instead of two.

Most I&I related overflows take place in the regional sewer system during large storm events when operators monitoring the sewer flows selectively allow overflows to deep sea outfalls with low sensitivity receiving environments. This is done to preserve sewer capacity for areas that would otherwise overflow into high sensitivity receiving environments (creeks, basement flooding, etc.). The I&I that causes these overflows comes from the upstream municipal sewers and private property laterals. Table ES-2, summarizes the sewer overflows in the core area from 2008 to 2013.



Summary of Core Area Known Potential Overflow Points

Figure: ES-1

June 10, 2007 - Technologist: JPB - Map Document: Core_OF_Combined_Overview_March2008.mxd

Table ES-2: Frequency of Overflows Classified by Cause and Receiving Environment Sensitivity

Jurisdiction/Cause of Overflow		2008			2009			2010			2011			2012			2013		
Total Annual Rainfall (mm)		619			662.5			814			865			876			741		
		Receiving Environment Sensitivity of where Overflows were Discharged [1]																	
		Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Capital Regional District																			
Cause	1. Power outage				2						2						2		
	2. Pump station failure	1		1	1			7			3						1		
	3. Blocked pipe																		
	4. Storm event <5-yr.	7		2	32			17			16						8		1
	5. Storm event >5-yr.							7		1									
	6. Upland combined sewers	4			15			13			11						14		
	TOTAL	15			50			45			32						26		
Colwood																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe																		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			0			0			0			0			0		
Esquimalt																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe																		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			0			0			0			0			0		
Langford																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe										1						2		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL										1						2		
Oak Bay																			
Cause	1. Power outage				3														
	2. Pump station failure																		
	3. Blocked pipe																		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			3			0			0			0			0		
Saanich																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe																		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			0			0			0			0			0		
Victoria																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe																1		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			0			0			0			0			1		
View Royal																			
Cause	1. Power outage																		
	2. Pump station failure																		
	3. Blocked pipe																		
	4. Storm event <5-yr.																		
	5. Storm event >5-yr.																		
	TOTAL	0			0			0			0			0			0		

Note: Low, Moderate, and High ratings of receiving environment sensitivity were determined by Seaconsult Marine Research Ltd.

Wet Weather Flow Management Progress Update

The CRD and core area municipalities are on track with their overflow management plans with the following highlights.

The CRD commissioned the Trent pump station in 2008 which eliminated overflows to Bowker Creek Prior to commissioning, there were ~10 overflows per year into Bowker Creek.

Colwood programmed its Supervisory Control and Data Acquisition (SCADA) system to generate sewer flow data from its pump stations.

Esquimalt separated approximately 100 combined manholes (of 148), relined all poor and poorest condition sewer mains, and smoke tested the entire municipal sewer system.

Langford ensured that each of its pump station either has a backup generator or can be powered with Langford's portable standby generator.

Oak Bay added 7 of its 9 pump stations to SCADA and implemented policies that require the upgrade or replacement of sewer / stormwater laterals, when homeowners apply for major building permits, etc. or when cross connections are identified by the municipality. In the LWMP, Oak Bay has a commitment to separate its combined sewers by 2015. The timeline below describes Oak Bay's status and plan going forward.

- **Up to 2010**: Oak Bay had a plan in place that would have resulted in the Uplands combined sewers being separated by 2015. The approach was estimated to cost approximately $7.5M (excluding private property works) and Oak Bay had successfully secured a $5 million dollar grant toward this work. The work was anticipated to be complete by the end of 2015. However, many Uplands residents resisted this plan on account of each house needing to install a sewer sump pump to convey its sewage into the municipal low pressure sewer main. As a result, in 2010, Oak Bay council decided to have staff investigate other alternative approaches for sewer separation in the Uplands.

  - **2010 to 2014**: Oak Bay collected detailed data (municipal records, etc.) on the Uplands sewers and hired a land surveyor to collect additional information.

  - **2014 to 2016:** Oak Bay plans to:

    1. Retain a consultant to prepare detailed plan options.
    2. Consult with the public on the options.
    3. Select a preferred option.
    4. Tender construction contracts to start the separation of the sewers.

Saanich upgraded 5 pump stations and is in the process upgrading 5 more.

Victoria completed the James Bay I&I Reduction Pilot Project, which compared the effectiveness between various types of sewer rehabilitation for reducing I&I and is in the process of camera inspecting and smoke testing the entire municipality by the end of 2016.

View Royal has been upgrading one pump station every two years including the addition of backup generators and is in the process of camera inspecting the municipalities' sewers.

Conclusions

On July 3, 2014, the Minister of Environment approved the Capital Regional District's Amendment No. 9 to the Core Area Liquid Waste Management Plan subject to four conditions being met by December 31, 2014. Condition No. 2 to the Minister's approval requires that the CRD submit a *Wet Weather Flow Management* *progress report that includes an update on the progress made to date in achieving the LWMP commitment to eliminate sanitary and combined sewer overflows*. This progress report was written to satisfy that requirement.

During the period from 2008 to 2013, the municipal sewer collection systems experienced a total of seven overflows. These included three overflows resulting from pump station failures and four overflows attributed to blockages in sewer pipes related to new construction. The municipal sewer systems were able to convey all peak flows, including infiltration and inflows from storm events, into the regional trunk sewer system for discharge to the marine environment via deep sea outfalls.

During the same time period, CRD regional trunk sewers experienced a total of 193 sewer overflows, of which 100 were caused by I&I flows received from municipal sewers and another 70 overflows were directly attributed to combined sewer flows coming from the Oak Bay Uplands combined sewer systems during significant storm events. The remaining 23 overflows were the result of power outages, pump station failures, or pump station upgrades in the regional system.

All but one of the CRD regional system overflows were discharged through deep sea outfalls to marine environments of low sensitivity. The only overflow to a medium or high sensitivity receiving environment occurred during a summer storm when the Trent pump station was shut down for maintenance.

The LWMP (2010) Section 5 contains the overflow reduction plan commitments for the CRD and each of the core area municipalities. These individual plans identify specific infrastructure work items including inspections, studies and upgrades to regional and municipal pump stations and sewer systems.

The CRD and the participating municipalities have completed or initiated many of the overflow reduction tasks committed to in the LWMP. I&I must be further reduced by completing all tasks to limit maximum daily wet weather flows to less than four times the average dry weather flow by 2030.

Oak Bay's commitment to separate its combined sewers in the Uplands, which collect and convey both sewage and storm water to the CRD regional pump stations at Humber and Rutland, remains outstanding.

The CRD will continue to monitor the status of the overflow reduction plans for CRD and the participating municipalities of Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria, and View Royal. These plans will be evaluated and updated as required.

The core area treatment plant project includes infrastructure upgrades that should further reduce the frequency I&I related overflows in the core area.

Appendix D:

EXAMPLE OF MUNICIPAL MONTHLY SEWER REPORTS

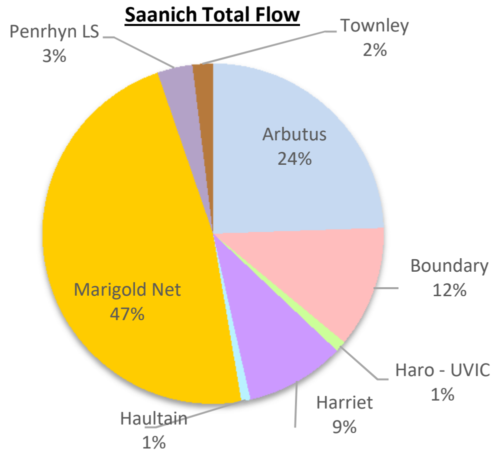
CRD IWS
Core Area Wastewater System
Monthly Wastewater Flow Report for Saanich - November 2020

Disclaimer: The data used in this report is considered preliminary. It may be further corrected in the annual cost requisition report.

1. Monthly Wastewater Flow Data: Nov 2020

This data summarizes the volume of flow measured from catchments contributing to Saanich's total flow (map on page 3).

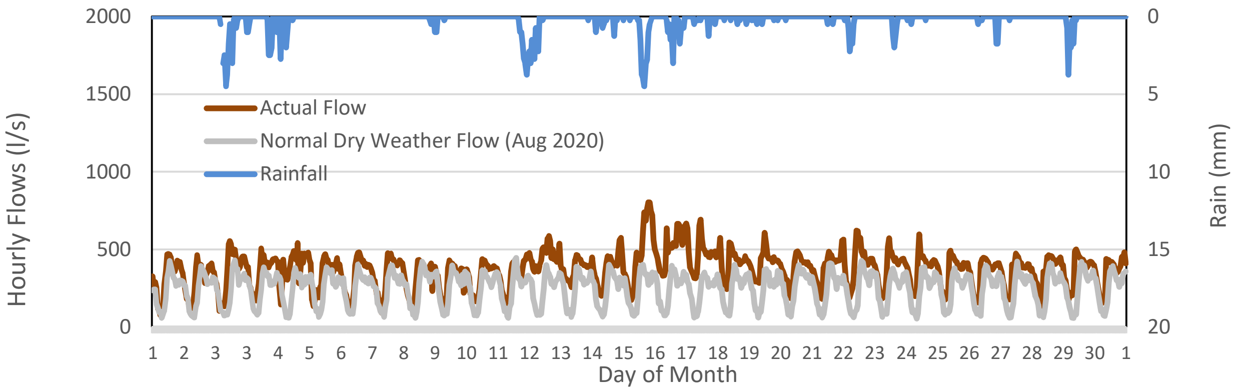
Flow Meter Name	Total Monthly Flow	
	m^3	%
Arbutus	235,905	24%
Boundary	111,578	12%
Haro - UVIC	10,113	1%
Harriet	90,688	9%
Haultain	8,351	1%
Marigold Net	457,052	47%
Marigold PS	*511,005*	
(Minus Hartland Leachate)	*- 53,953*	
Penrhyn LS	32,241	3%
Townley	18,717	2%
Monthly Flow	**964,645**	**100%**



SAANICH FLOW = Marigold Net + Boundary + Harriet + Townley + Haultain + Arbutus + Haro + Penrhyn

2. Saanich Hourly Sewer Flows Nov 2020

This graph shows actual flow (brown) and rainfall (blue), per day, for the month and compares it to normal dry weather flow (grey).



3. Key Wastewater Flow Stats: Nov 2020

Metric	Flow (m^3) [1]
Total Monthly Flow	964,645
Average Daily Flow	32,155
Minimum Daily Flow	25,752
Peak 24hr Flow (PWWF) [2]	47,453
Peak 1hr Flow [3]	69,441
Average Dry Weather Flow (ADWF)[4]	22,118
Estimated Daily Domestic Flow [5]	16,608

Overflows (monitored by CRD): Nov 2020

Location	Date
Finnerty Outfall	None

[1] Excludes overflows that may have occurred (overflow volumes are not measured).

[2] Calculated as maximum rolling 24 hr flow for the month.

[3] Expressed as 24 hour flow (peak 1 hr flow x 24).

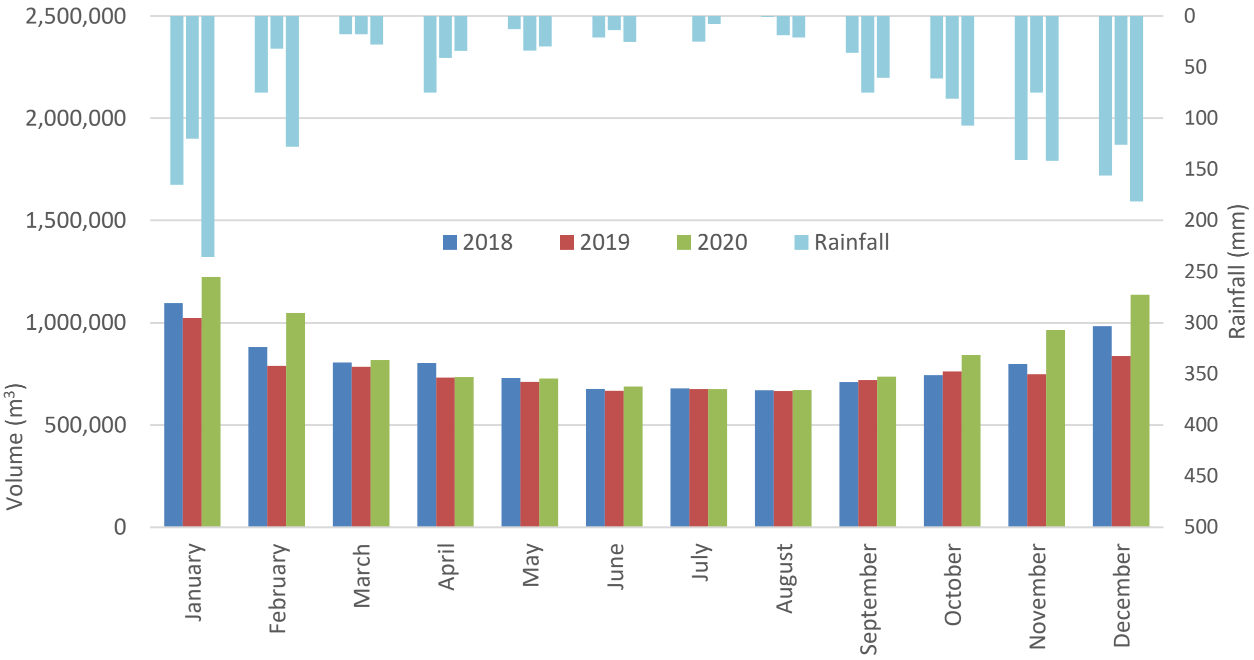
[4] Average daily flow from most recent Jun 1 to Aug 31 data. Includes groundwater infiltration over that period.

[5] Calculated as ADWF minus summer groundwater (70% of minimum hourly flow x 24 hours).

Disclaimer: The data used in the monthly wastewater flow report may be further corrected in the annual cost requisition report.

4. Monthly Wastewater Flow: Historical vs. Current

This graph shows the total Saanich flow for each month and compares it with previous years.



5. Inflow & Infiltration Flow Summary: Nov 2020

Key I&I Metrics	Value [1]
Total Monthly Flow (m^3)	964,645
Estimated Domestic Flow for Month (m^3) [2]	498,244
I&I Volume for Month (m^3) [3]	466,401
I&I Volume for Month (% total flow)	48%
Peak 24hr Flow (PWWF) [4]	2.1 x ADWF
Peak 1hr Flow [5]	3.1 x ADWF

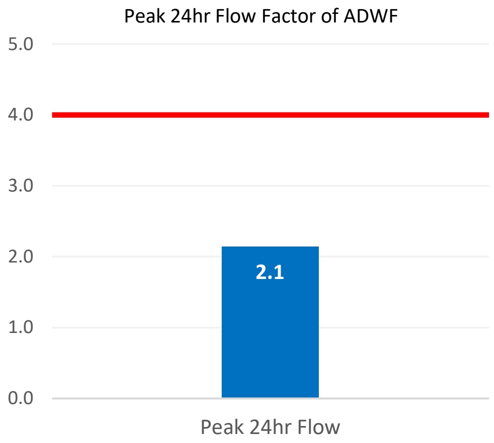
[1] Excludes overflow volume

[2] Determined by (Est. Daily Domestic flow from section 3.) x (number of days per month)

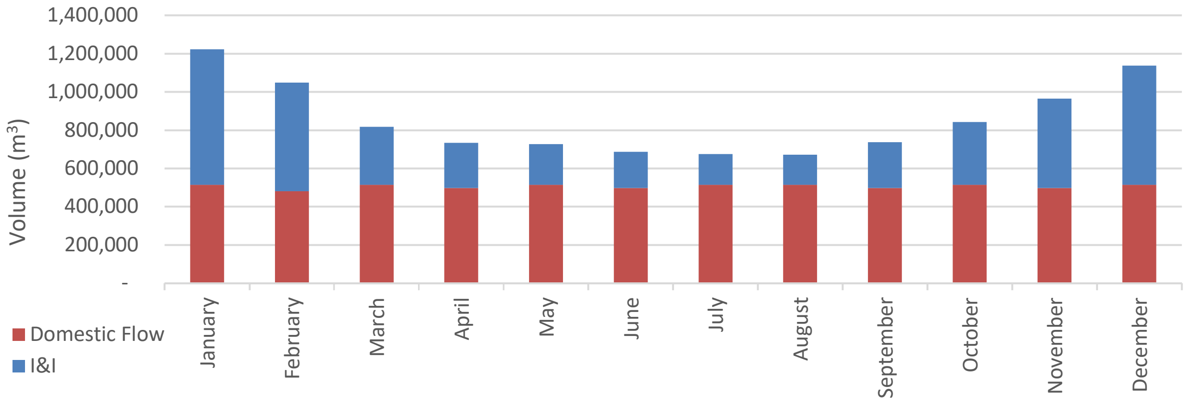
[3] Determined by subtracting Estimated Domestic Flow from Total Monthly Flow

[4] Determined by dividing Peak 24hr Flow from section 3. by ADWF

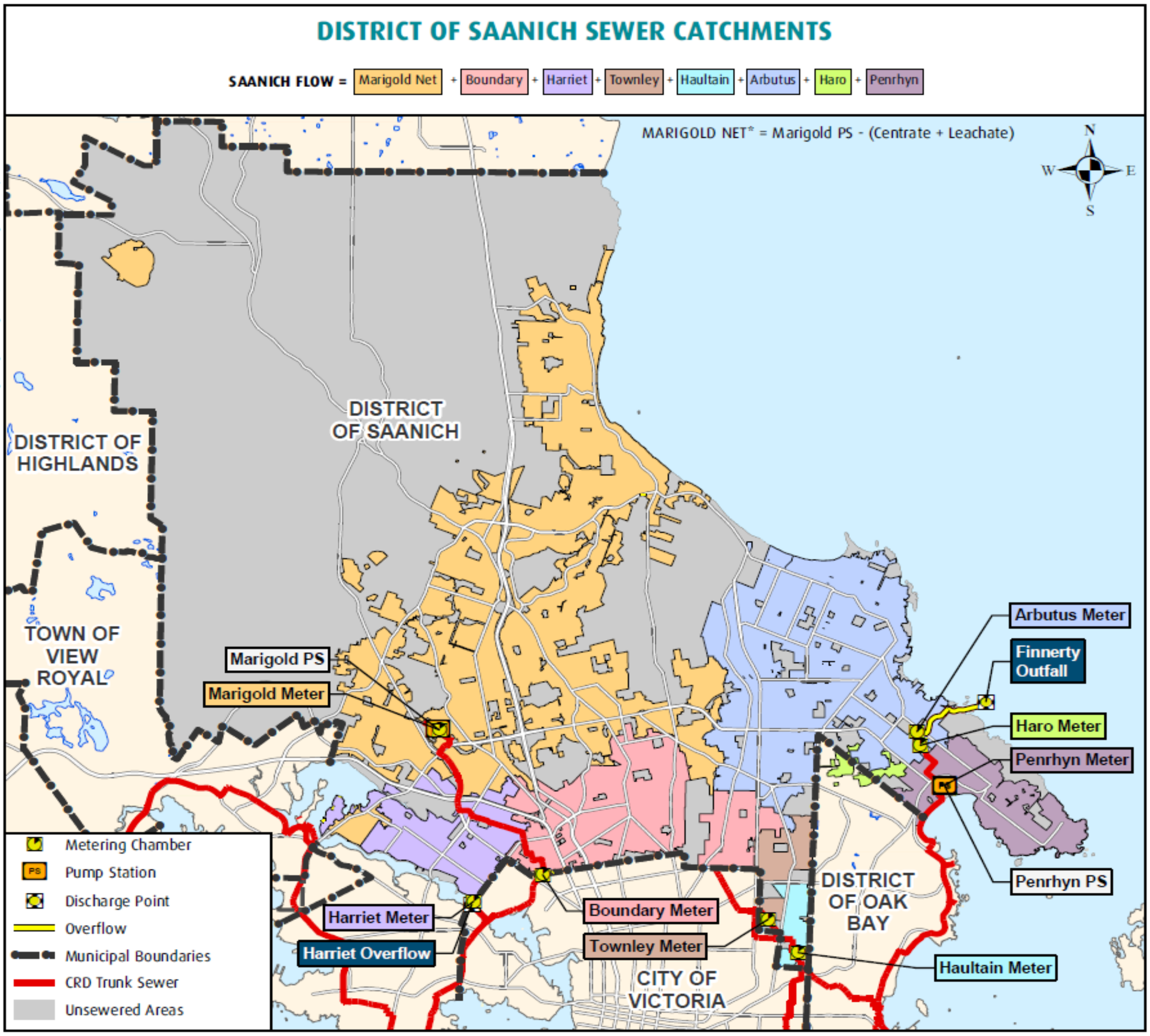
[5] Determined by dividing Peak 1hr Flow from section 3. by ADWF



6. Monthly Flows: I&I and Domestic Flow (2020)



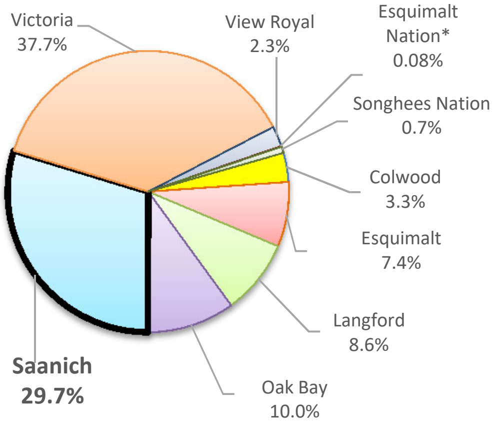
Disclaimer: The data used in the monthly wastewater flow report may be further corrected in the annual cost requisition report.



7. Regional Flow Data: Nov 2020

Participant Area	Total Monthly Flow	
	m^3	%
Colwood	108,796	3.3%
Esquimalt	241,596	7.4%
Langford	280,509	8.6%
Oak Bay	326,535	10.0%
Saanich	**964,645**	**29.7%**
Victoria	1,224,481	37.7%
View Royal	75,982	2.3%
Esquimalt Nation*	2,725	0.08%
Songhees Nation	23,902	0.7%
Total	**3,249,171**	**100.0%**

*Flows are calculated based on engineering estimates



Disclaimer: The data used in the monthly wastewater flow report may be further corrected in the annual cost requisition report.

Appendix E:

MUNICIPAL PUMP STATION FLOW DATA ASSESSMENT MEMO

KERR WOOD LEIDAL
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Technical Memorandum

DATE: May 7, 2021

TO: James McAloon, Engineering Technician
Capital Regional District, Parks & Environmental Services

FROM: Jason Vine, M.A.Sc., P.Eng.

RE: **MUNICIPAL PUMP STATION SCADA DATA**
Data Assessments for Flow Measurement Purposes
Our File 0283.421

Introduction

The Capital Regional District (CRD) prioritises the collection and use of sewer flow data from municipal pump stations for use in I&I studies. Some of this data is collected using permanent mag meters and clamp-on meters owned by the municipality. Some of the data is generated by the CRD I&I program using data collected by the municipal SCADA (Supervisory Control and Data Acquisition) systems. In a few municipalities, the SCADA system data is not suitable for generating flow data.

The quality and reliability of the data varies greatly between pump stations. The data generated by the I&I program is specifically generated for use in I&I analyses. However, end users often request flow data for use in planning, modelling, and operational needs for which the data may not be suitable. The purpose of this memo is to document the expected accuracy of each pump station's flow data so that end users can better understand if it meets their needs. The memo can also be used by municipalities to determine if additional effort is warranted to improve data quality.

This document summarizes the results of a desktop grading assessment of the sewer flow data recorded from the CRD and Core Area municipal SCADA systems. Appendix A contains more detail on the inflow calculation methodology, while Appendix B contains the individual station assessment sheets.

Purpose/Disclaimer

The intention of this document is to provide **general** guidance to the CRD municipalities on the suitability of the **method** used to derive flow data for each pump station. This document and analysis does not include any specific data vetting or verification. As such, it is important that end users vet data prior to use.

The assessment of each station dataset is provided as a single score, based on our experience and observations of the bulk of the data that was available from January 1, 2016 to December 31, 2020 (as available). The scope of this project did not include the resources required to provide vetted data or conduct verification of any of the information that was supplied by each municipality. Information such as wet well levels, dimensions, pump operations, calculated flows or any other unique characteristics of any given station have not been verified in the field.

It is our hope that this document will provide end-users with a starting place to select promising datasets for further analysis as the need arises. Kerr Wood Leidal (KWL), the CRD and member municipalities do not guarantee the accuracy of any of the source data and resultant flow calculations from this analysis. Should an end-user decide to pursue using source data or calculations from any given station, it is the responsibility of the end-user to verify the accuracy of the information.

Grading Methodology

Data for each station (wet well level, pump status, and flow meter when available) was reviewed from January 1, 2016 to December 31, 2020 for each station (as available). As most stations do not have a dedicated flow meter, inflow calculations using wet well level and pump status (Method 1) were setup in order to judge the overall quality and suitability of the data. Please refer to Appendix A for a more detailed explanation of these calculations and the various associated issues. In summary, these methods are:

Table 1: Pump Station Flow Methods

Method	Description
Magmeter	Full-pipe, high accuracy magnetic flow meter
Clamp-On	Clamp-on ultrasonic of doppler flow meter
1	Standard pump station inflow calculations using pump status & wet well setpoints
2*	Custom approach for pump stations that pump infrequently
3*	Custom approach for pump stations that pump for extended periods of time during storm events
Methods 2 and 3 could be implemented in the future to improve the score on any given station, but have not been completed for this assessment.	

KWL and the CRD in concert developed a scoring system for ranking the pump station data, according to the following table.

Table 2: Flow Method Grades (Typical, Results Vary)

Grade	Description		
A	Reliable Flow Data	**A**	Magmeters or sites with field verified data
		A-	Clamp-on ultrasonic or doppler meters
B	Suitable for General Uses including I&I Analysis	**B+**	Standard pump station calculations with excellent source data
		B	Standard pump station calculations
		B-	Standard pump station calculations but pumps operate infrequently at night (poor low flow resolution)
C	Niche Use Only – Contains Significant Data Quality Issues	**C+**	Poor data resolution due to polling / timestamp issues
		C	Unreliable during storms. Could be addressed with method 3 and a site visit
		C-	Unreliable during storms and is complicated (e.g. storage tank). Would require a substantial effort or a flow meter to address
D	All Data is Unreliable	**D**	Would require substantial effort or a flowmeter to address
F	Data Unusable	**F**	Data Unusable
In many cases it would be possible to raise a station score with additional analysis and/or monitoring equipment.			

Summary of Station Grades (by Municipality)

Colwood

There is currently no usable data from the City of Colwood pump stations. The CRD I&I program is currently exploring options for addressing this.

Esquimalt

Table 3: Esquimalt PS Grades

Station	Grade	Description
Canteen	B-	Standard pump calculations, poor low-flow resolution
Constance	B-	Standard pump calculations, poor low-flow resolution
Craigflower	B	Standard pump calculations
Forshaw	C	Unreliable during storms, requires Method 3 & Site Visit
Garthland	C-	Unreliable during storms, complex analysis required
Grafton	C	Unreliable during storms, requires Method 3 & Site Visit
Kinver (CRD Magmeter)	A	Magnetic Flow Meter
Lampson	B-	Standard pump calculations, poor low-flow resolution
Luscombe	B-	Standard pump calculations, poor low-flow resolution
Sea Haven	B-	Standard pump calculations, poor low-flow resolution
Uganda	B	Standard pump calculations

Langford

A detailed assessment and data review of each station has not been conducted for Langford, as the City indicated to the CRD that their stations have magmeters. This would generally grade their stations as “A”. However, in some cases it is understood storage tanks may be present, in which case the end user must be aware of the impact tank operation may have on masking the true peak I&I volume at a site (by storing excess flow until it can be discharged at a later time).

Oak Bay

Table 4: Oak Bay PS Grades

Station	Grade	Description
Bowker	B-	Standard pump calculations, poor low-flow resolution
Cedar Hill X-Road	B	Standard pump calculations
Haro	B-	Standard pump calculations, poor low-flow resolution
Mrs. Dukes	B-	Standard pump calculations, poor low-flow resolution
Satellite	B-	Standard pump calculations, poor low-flow resolution

Saanich

There is currently no usable data from the District of Saanich pump stations. The CRD I&I program is currently exploring options for addressing this.

Victoria

A detailed assessment and data review of each station has not been conducted for Victoria, as the City indicated to the CRD that their stations have clamp-on meters. This would generally grade their stations as “A-“. While not ideal, it is understood that sampling resolution of the data is hourly volume.

View Royal

Table 5: View Royal PS Grades

Station	Grade	Description
Atkins	B	Standard pump calculations
Glenairlie	C-	Unreliable during storms, complex analysis required
Hallowell	B	Standard pump calculations
Heddle	A	Magnetic Flow Meter
Helmcken Bay	B	Standard pump calculations
Helmcken Park	B+	Standard pump calculations, excellent source data
Hospital	D	All data unreliable, substantial effort / flow meter req’d
Midwood	A	Magnetic Flow Meter
Norquay	B-	Standard pump calculations, poor low-flow resolution
Packers	B	Standard pump calculations
Price Bay	A	Magnetic Flow Meter
Stewart	D	All data unreliable, substantial effort / flow meter req’d
Stoneridge	B-	Standard pump calculations, poor low-flow resolution
Talcott	B-	Standard pump calculations, poor low-flow resolution
Thetis Cove	B-	Standard pump calculations, poor low-flow resolution
View Royal	B	Standard pump calculations
Wilfert	B	Standard pump calculations

Pump station assessment forms are included in Appendix B.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

Reviewed by:

Jason Vine, M.A.Sc., P.Eng.
Associate

Chris Johnston, P.Eng.
Vice-President

jv

Encl.: Appendix A – Use of Data for the Purpose of Inflow Calculations
Appendix B – Pump Station Assessment Sheets

Statement of Limitations

This document has been prepared by Kerr Wood Leidal Associates Ltd. (KWL) for the exclusive use and benefit of the intended recipient. No other party is entitled to rely on any of the conclusions, data, opinions, or any other information contained in this document.

This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

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Revision History

Revision #	Date	Status	Revision Description	Author
0	May 7, 2021	Final	Final Issued to Client	JV

OQM CERTIFIED

Appendix A

Use of Data for the Purpose of Inflow Calculations

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Technical Memorandum

DATE: May 7, 2021

TO: James McAloon
Capital Regional District, Parks & Environmental Services

FROM: Jason Vine, M.A.Sc., P.Eng.

RE: **MUNICIPAL PUMP STATION SCADA DATA**
Use of Data for the Purpose of Inflow Calculations
Our File 0283.421

Introduction

The member municipalities of the Capital Regional District (CRD) each operate a number of sanitary sewage pump stations. Various planning, modelling, and operational needs can benefit from flow information obtained from these sites. Some sites have dedicated flow monitoring equipment but most do not. Under certain conditions, recorded wet well level and pump status data can also be utilized to calculate the flow into the station.
This document summarizes the methodology of using data recorded from the CRD and Core Area municipal SCADA (Supervisory Control and Data Acquisition) systems to calculate inflow.

Inflow Calculation Methodology

In its simplest form, inflow calculation is no more complicated than timing how long it takes to fill a bucket with a stopwatch. The “bucket” in this case is the volume of storage in a pump station wet well between the lead pump start elevation and the stop elevation. The “stopwatch” is the SCADA system, that records the start and stop times. Every “fill” cycle of the wet well is timed, and a series of these cycles produces the time series of inflow into the wet well. This is the simplest form of inflow calculation, requiring the least amount of data and assumptions. Utilizing the draw down time combined with an estimate of the previous inflow can also be used to estimate the pumping rate of each pump during each cycle. A long-term running average of the pumping rate can provide a useful indicator of how each pump is performing. When the pump station is sized appropriately for the inflow, this can provide an accurate flow estimate during storm events. For the purpose of this assignment, we call this “Method 1”.

More complex calculations can also be performed to take advantage of additional data or conditions, including:

- Utilizing every recorded change in wet well level during a fill cycle, as opposed to waiting for a fill cycle to complete before performing the calculation. This produces more data, useful at night when a wet well takes several hours to fill, but at the expense of more noise in the data set. This is “Method 2”.
- Utilizing the previously estimated pumping rate, combined with the wet well level, to estimate the inflow into the station during long run times (when a station is not otherwise able to pump down the wet well during a long storm event). We call this “Method 3”.

Method 1 was used exclusively in our initial assessment of the adequacy of the data for inflow calculations. In the future, should a municipality wish to improve the data grade for a pump station, Methods 2 and 3 could be part of the toolkit for doing so.

Factors that Impact Accuracy

Unfortunately, there are many factors that can negatively impact the accuracy of using SCADA data for inflow calculations. Some of these factors produce results that are obviously wrong, whereas others produce results that look correct but can be out by 100% or more.

The following table lists the more common factors that can impact the suitability and accuracy of using SCADA data for inflow calculations.

Table 1: Examples of Factors Impacting Accuracy

Factor	Issue	Typical Error
Relatively Minor Impacts		
Wet Well Dimensions	Accuracy of assumed wet well cross section	2% (i.e. 2cm on 2.4m ∅ well)
Internal Piping	Volume of internal piping within the pump cycle range is not typically considered	1% (i.e. Twin 150mm ∅ headers on 2.4m ∅ well)
Pump Controller	Ultrasonic Accuracy	0.25%
Pump Controller	Float Switch Accuracy	2% (i.e. 2cm on 2.4m ∅ well)
Potentially Significant Impacts		
SCADA Polling Interval	Long polling interval with timestamps not generated locally at the station	20% (i.e. 30 seconds on each side of a 5-minute fill cycle) 100% (i.e. missed cycles)
Major Impacts		
Incoming Sewers	Use of incoming sewer for storage during wet well cycle	100% +

As the above table states, accuracy of a few percent is possible when the SCADA system provides accurate pump start/stop timing, and the normal wet well operating range does not impinge on the incoming sewer(s). This is the ideal case for using SCADA data for inflow calculations.

The impact of SCADA polling speed (if the timestamps are generated at the time of polling) can vary and is often the deciding factor for determining suitability of the SCADA data for inflow calculations. The introduced error will vary randomly each cycle, and in extreme cases entire pump cycles can be missed. The impact of this is usually obvious as it produces very "noisy" looking data, or often inflow data that appears to have very poor vertical resolution (caused by the course sampling intervals of 30 seconds, 60 seconds, 90 seconds, etc.)

The last and most significant impact is caused when the incoming sewer(s) backs up during each pump cycle (i.e., position of the inflow pipe in the wet well is located between the pump start and stop levels).

This is sometimes done intentionally to increase the storage volume (and hence reduce the number of pump cycles). This is further complicated by the fact that the available storage in the incoming sewer is not constant, rather it varies throughout the day as the incoming sewer flow takes up varying amounts of pipe depth. This problem is potentially very significant, as failing to recognize this condition often produces data that “looks right”, but can be out by 100% or more. In the absence of record drawing information confirming the incoming sewer elevations, the impact of an incoming sewer can often be detected by observing how the wet well level varies during each fill cycle. By reviewing the wet well data in the middle of the night when flows tend to be their lowest and are relatively constant, the consistent presence of a “kink” in the fill cycle will usually indicate an incoming sewer impact.

Purpose/Disclaimer

The intention of this document is to provide **general** guidance to the CRD municipalities on the suitability of the **method** used to derive flow data for each pump station. This document and analysis does not include any specific data vetting or verification. As such, it is important that end users vet data prior to use.

The assessment of each station dataset is provided as a single score, based on our experience and observations of the bulk of the data that was available from January 1, 2016 to December 31, 2020 (as available). The scope of this project did not include the resources required to provide vetted data or conduct verification of any of the information that was supplied by each municipality. Information such as wet well levels, dimensions, pump operations, calculated flows or any other unique characteristics of any given station have not been verified in the field.

It is our hope that this document will provide end-users with a starting place to select promising datasets for further analysis as the need arises. Kerr Wood Leidal (KWL), the CRD and member municipalities do not guarantee the accuracy of any of the source data and resultant flow calculations from this analysis. Should an end-user decide to pursue using source data or calculations from any given station, it is the responsibility of the end-user to verify the accuracy of the information.

Pump Station SCADA Data

In order to analyze the historical data supplied by the CRD, the wet well level, pump start/stop status, and discharge flow meter (when available) data was imported into FlowWorks (www.flowworks.com). FlowWorks includes a pump station inflow calculation routine for “Method 1”, that can utilize the pump start/stop data to perform the “timing the bucket fill” methodology, which simplified assessing the very large. An additional benefit is that the processed data and calculations remain on FlowWorks. As such, the work required to generate future flow data is greatly reduced.

The following table summarizes the channel names and descriptions for future reference:

Table 2: FlowWorks Channels

Channel Name	Meaning	Units	Note
Flow Rate	Raw magmeter flow data (if available)	L/s	
Pump X Status	Raw pump status (1=on, 0=off)	None	X = pump number = 1, 2, etc.
Wet Well Level	Raw ultrasonic wet well level	m	Local depth, not elevation
PRX	Estimated pumping rate from FlowWorks	L/s	X = pump number = 1, 2, etc.
QAll 5Min	Inflow from the fill cycle timing calculation	L/s	Interpolated 5-minute interval
Miscellaneous channels	Combined pump status, Delta T Pump Status, PX Status Copy, QAll, QAll Filtered, QFOX		FlowWorks internal channels used in pump inflow calculations

KWL also received various tables, drawings, and emails from the municipalities documenting wet well dimensions.

Appendix B contains assessment worksheets for each station. Not all information that would ideally be available was, (some of the information would need to be collected via site visits which were not included in the scope of this assignment). The documents are designed to be progressively filled out in the field as more information becomes available. The primary input fields that are required include:

- Wet well shape and dimensions;
- Number of pumps;
- Lead pump start and stop elevations (visually interpreted from the wet well data that was received for each station);
- Existence of a flow meter and/or storage tank on site;

KERR WOOD LEIDAL ASSOCIATES LTD.

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Revision History

Revision #	Date	Status	Revision Description	Author
0	May 7, 2021	Final	Final Issued for Client	JV

Appendix B

Pump Station Assessment Sheets

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Bowker PS (from Jun'19)
Owner	Oak Bay
Date	2020/12/22

FLOW METHOD GRADE

C

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ __m 4.8 m X 2.8 m __________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

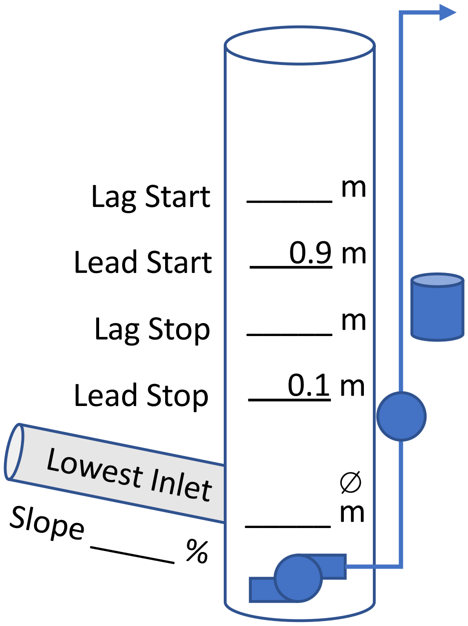
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.9 m

Lag Stop _____ m

Lead Stop 0.1 m

Lowest Inlet

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Notes

Prior to June 2019 the wet well set points were Lead Start = 0.95 m and Lead stop = 0.0 m

B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Cedar Hill X Rd. PS
Owner	Oak Bay
Address	
Date	2020/12/22

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.5 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

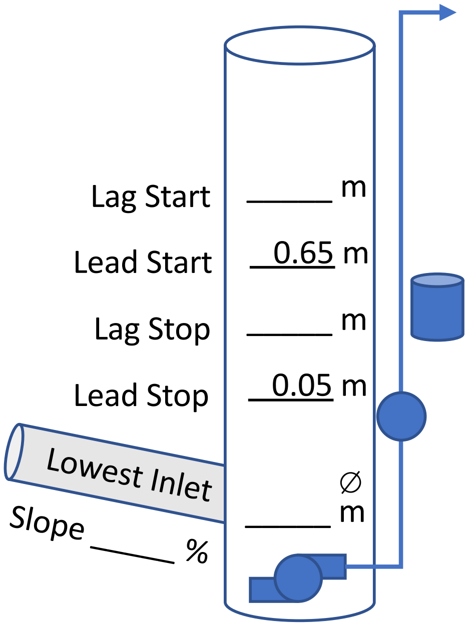
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 0.65 m

Lag Stop ______ m

Lead Stop 0.05 m

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Haro PS
Owner	Oak Bay
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

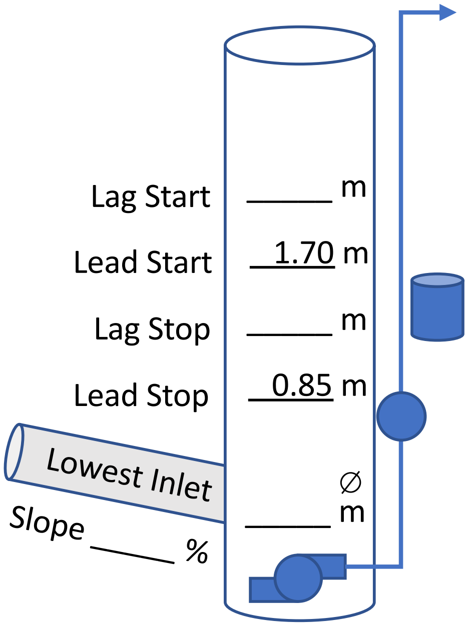
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.70 m

Lag Stop ______ m

Lead Stop 0.85 m

Lowest Inlet ∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Mrs. Dukes PS
Owner	Oak Bay
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.07 m ______ m X ______ m ____________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model__________________

Sensor Model __________________

Starters

☐ Soft Starters

____ secs

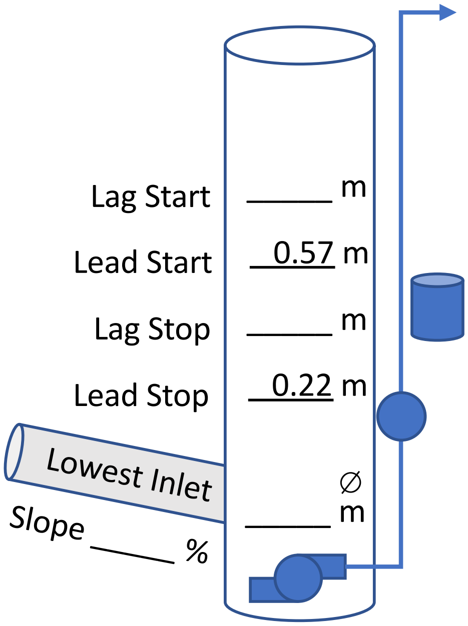
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.57 m

Lag Stop _____ m

Lead Stop 0.22 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

Pump Station SCADA Flow Assessment Worksheet

Station Name	Satellite PS
Owner	Oak Bay
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.4 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

____ secs

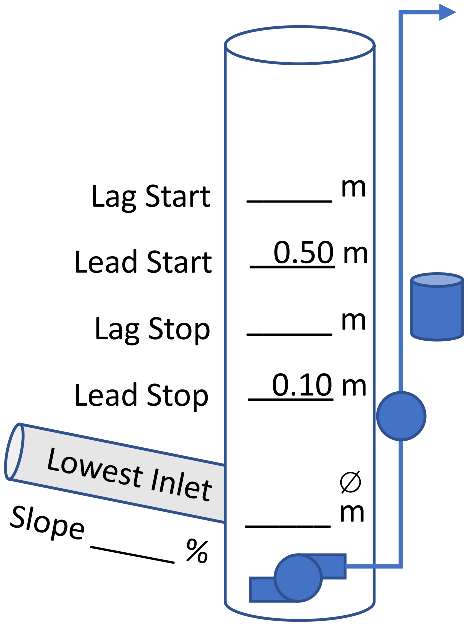
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.50 m

Lag Stop _____ m

Lead Stop 0.10 m

_____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Canteen PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m 2.13 m X 2.13 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

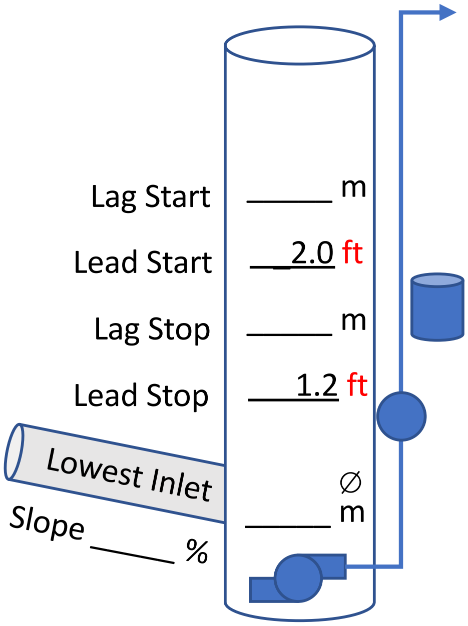
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 2.0 ft

Lag Stop ______ m

Lead Stop 1.2 ft

Lowest Inlet ∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity _________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Constance PS
Owner	Esquimalt
Address	
Date	2020/12/16

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.15 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

____ secs

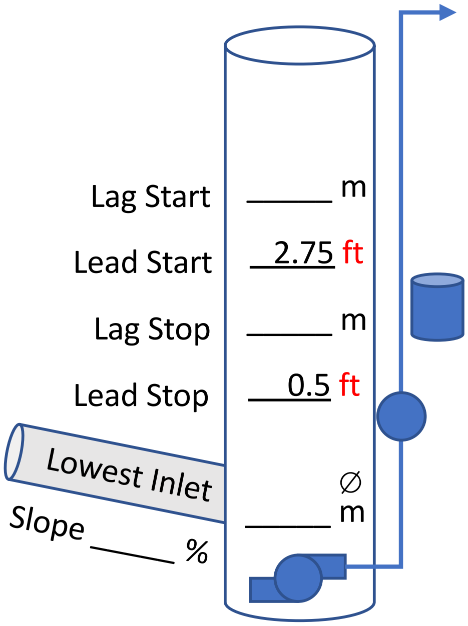
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 2.75 ft

Lag Stop _____ m

Lead Stop 0.5 ft

Lowest Inlet ∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Craigflower PS
Owner	Esquimalt
Address	
Date	2018/02/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

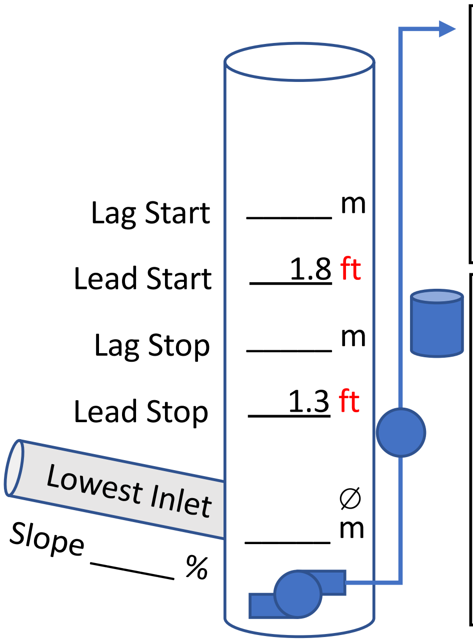
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.8 ft

Lag Stop _____ m

Lead Stop 1.3 ft

Lowest Inlet

Slope _____ %

∅ _____ m

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

CRD

Pump Station SCADA Flow Assessment Worksheet

Station Name	Forshaw PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

C

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m 3.53 m X 3.0 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

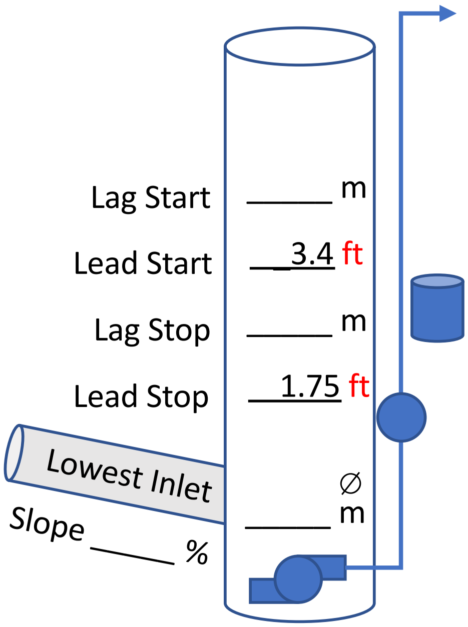
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 3.4 ft

Lag Stop ______ m

Lead Stop 1.75 ft

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Garthland PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

C-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m 2.03 m X 1.52 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

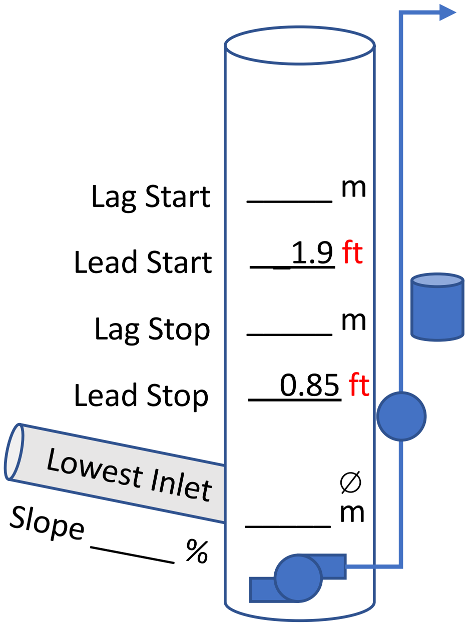
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.9 ft

Lag Stop ______ m

Lead Stop 0.85 ft

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank [✓ Y] / N

Impacting Calcs [✓ Y] / N

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Grafton PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

C

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.03 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

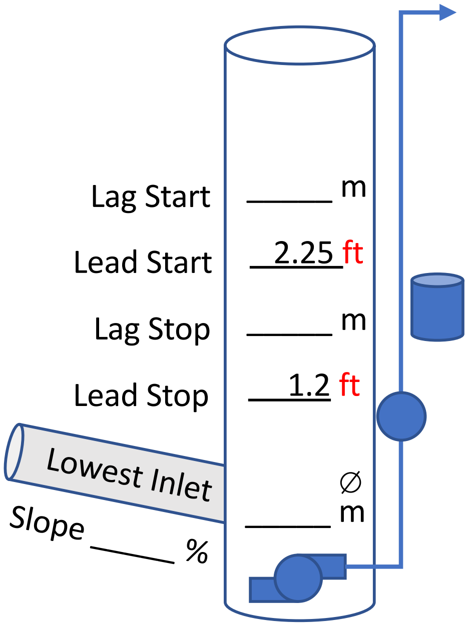
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 2.25 ft

Lag Stop _____ m

Lead Stop 1.2 ft

Lowest Inlet ∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Kinver PS
Owner	Esquimalt
Address	
Date	2018/02/19

FLOW METHOD GRADE
A
(CRD Mag)

Source of Flow Data Used for Assessment

Calculated Flow Method: 1 2 3

Magmeter ☒ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m _3.08__ m X _1.5__ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model__________________

Sensor Model ___________________

Starters

☐ Soft Starters

_____ secs

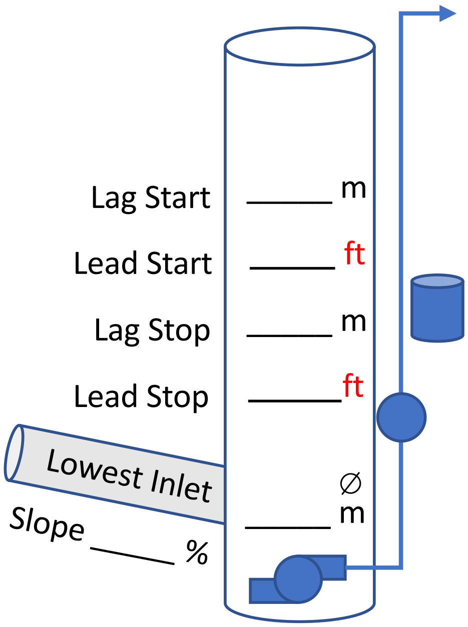
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start ______ ft

Lag Stop ______ m

Lead Stop ______ ft

______

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank [✓ Y] / N
Impacting Calcs [✓ Y] / N

Existing Flowmeter
None / [✓ Mag] / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

CRD

Pump Station SCADA Flow Assessment Worksheet

Station Name	Lampson PS
Owner	Esquimalt
Address	
Date	2018/02/20

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

____ secs

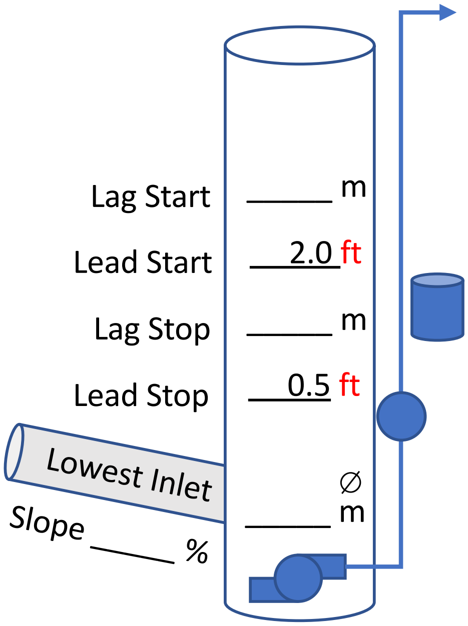
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 2.0 ft

Lag Stop _____ m

Lead Stop 0.5 ft

Lowest Inlet

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Notes

It is believed some flows bypass this pump station, Esquimalt to confirm.

	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Luscombe PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

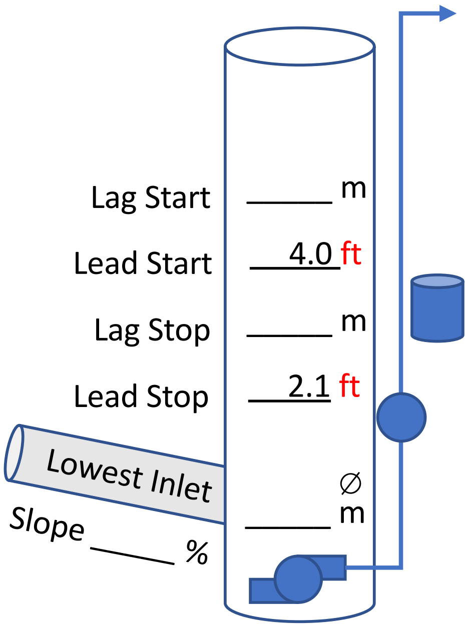
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 4.0 ft

Lag Stop _____ m

Lead Stop 2.1 ft

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

CRD

Pump Station SCADA Flow Assessment Worksheet

Station Name	Sea Haven PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

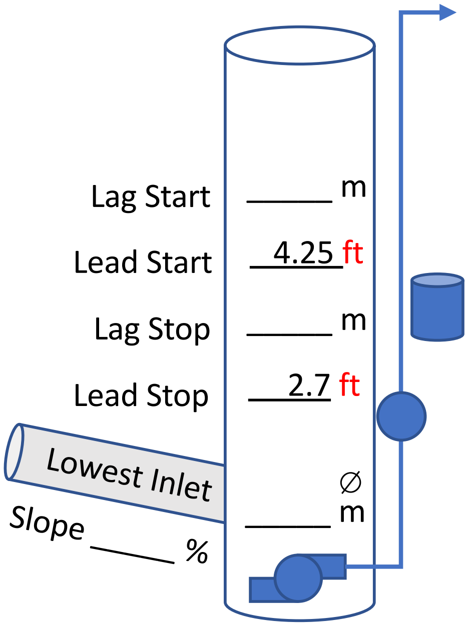
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 4.25 ft

Lag Stop _____ m

Lead Stop 2.7 ft

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

Pump Station SCADA Flow Assessment Worksheet

Station Name	Uganda PS
Owner	Esquimalt
Address	
Date	2020/12/22

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m 4.6 m X 2.44 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

____ secs

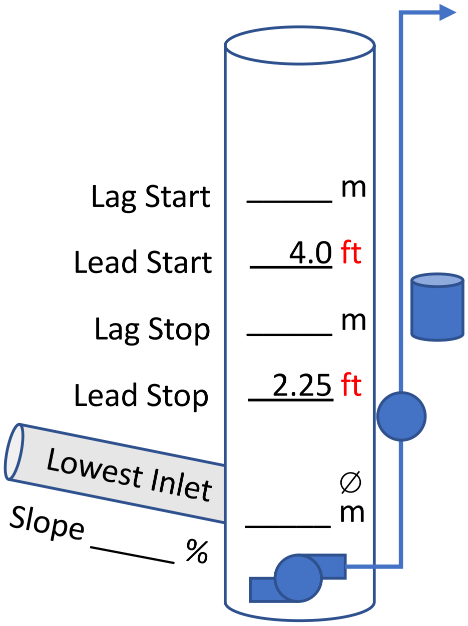
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 4.0 ft

Lag Stop _____ m

Lead Stop 2.25 ft

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Atkins PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 2.44 m

☐ Rectangular _____ m X _____ m

☐ Irregular ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

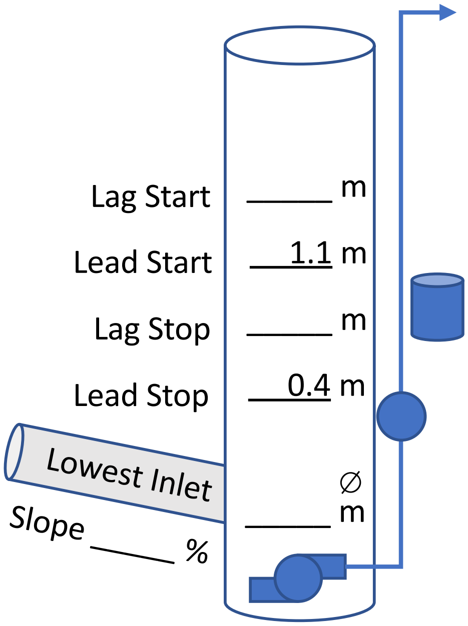
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.1 m

Lag Stop _____ m

Lead Stop 0.4 m

Lowest Inlet ∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Glenairlie PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

C-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.23 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

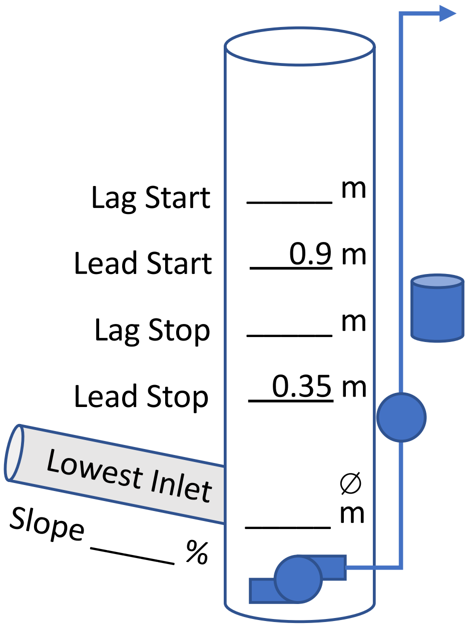
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.9 m

Lag Stop _____ m

Lead Stop 0.35 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Hallowell PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.4 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

☐ VFD

SCADA Recording

Pump Start/Stop

☐ Event Recorded

☐ Polling Interval _________secs

Wet Well Level

☐ Event Recorded

☐ Polling Interval _________secs

☐ Deadband _________m

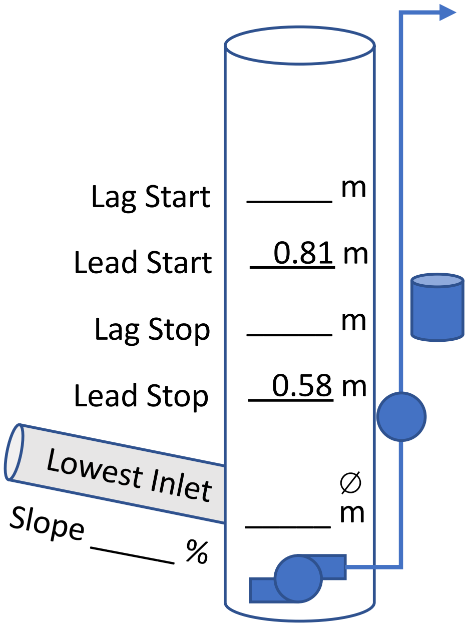
Flow Meter

☐ Event Recorded

☐ Polling Interval _________secs

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.81 m

Lag Stop _____ m

Lead Stop 0.58 m

∅ _____ m

Lowest Inlet

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Heddle PS
Owner	View Royal
Address	
Date	2019/07/02

FLOW METHOD GRADE

A

Source of Flow Data Used for Assessment

Calculated Flow Method: 1 2 3

Magmeter ☒ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 1.2 m

☐ Rectangular _____ m X _____ m

☐ Irregular ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

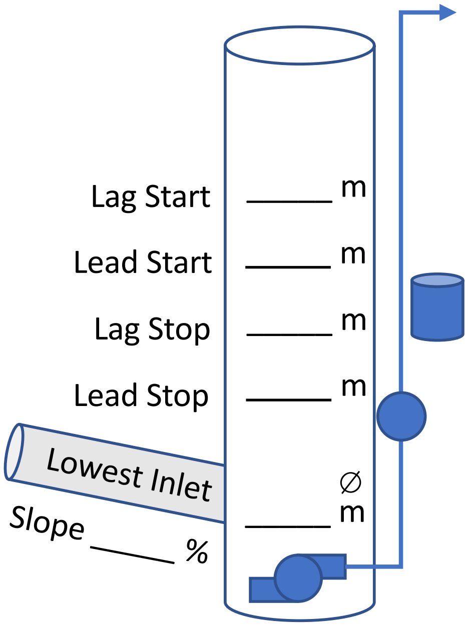
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start _____ m

Lag Stop _____ m

Lead Stop _____ m

Lowest Inlet ∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / [✓ Mag] / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Helmcken Bay PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

____ secs

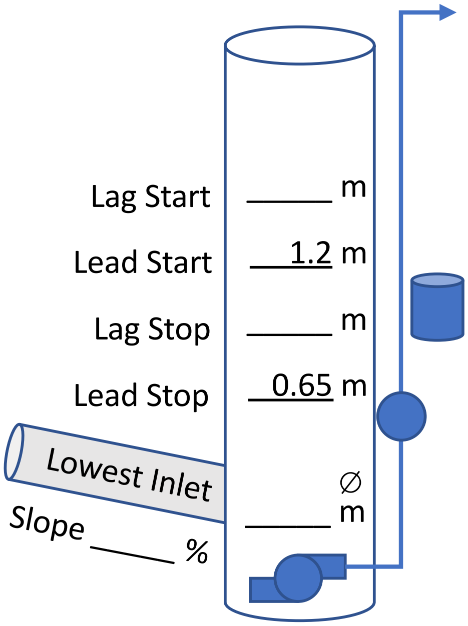
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.2 m

Lag Stop _____ m

Lead Stop 0.65 m

_____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Helmcken Park PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B+

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

____ secs

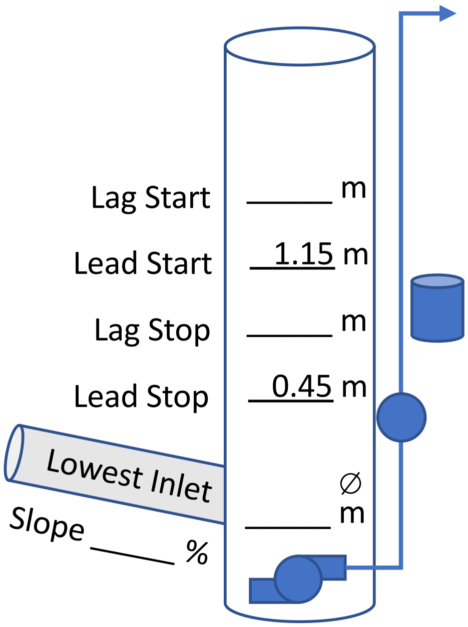
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.15 m

Lag Stop _____ m

Lead Stop 0.45 m

Lowest Inlet

∅

_____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

CRD

Pump Station SCADA Flow Assessment Worksheet

Station Name	Hospital PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

D

Source of Flow Data Used for Assessment

Calculated Flow Method: 1 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ___m   3.0 m X 4.75 m   ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

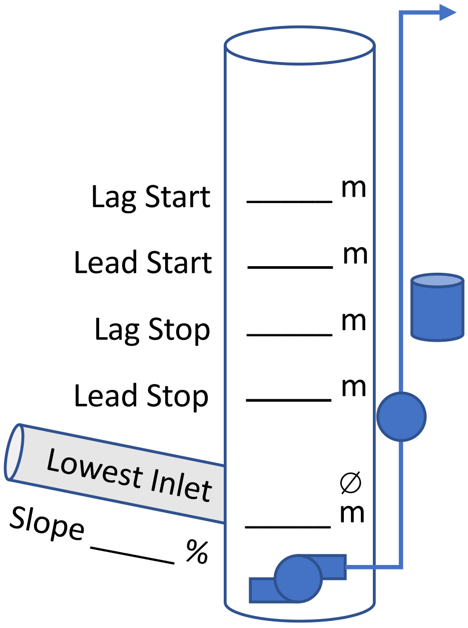
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 2 [✓ 3] 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Midwood PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

A

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.23 m ______ m X ______ m ____________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model____________________

Sensor Model ____________________

Starters

☐ Soft Starters

_____ secs

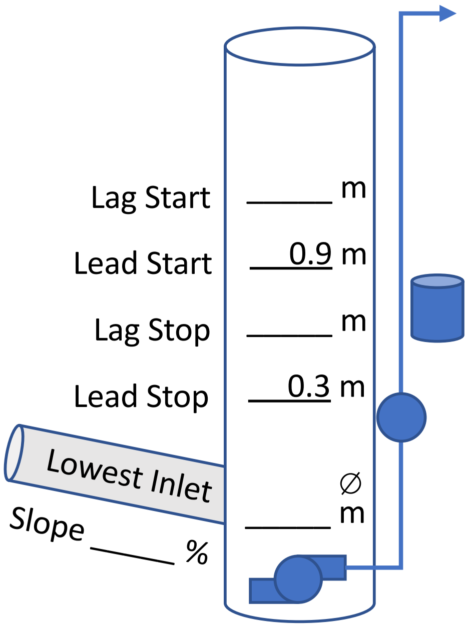
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 0.9 m

Lag Stop ______ m

Lead Stop 0.3 m

Lowest Inlet

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / [✓ Mag] / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Norquay PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.2 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

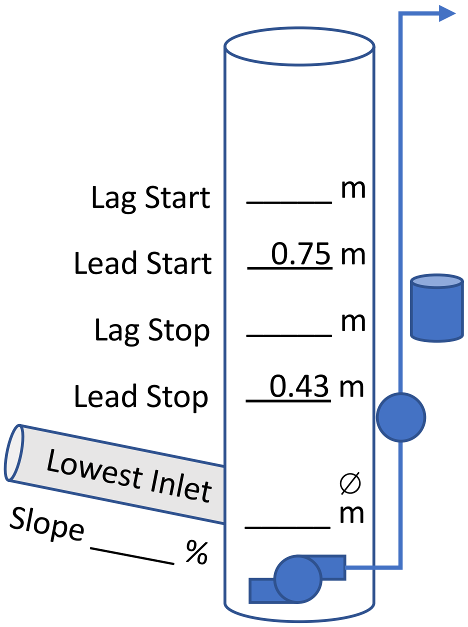
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.75 m

Lag Stop _____ m

Lead Stop 0.43 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Packers PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.44 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

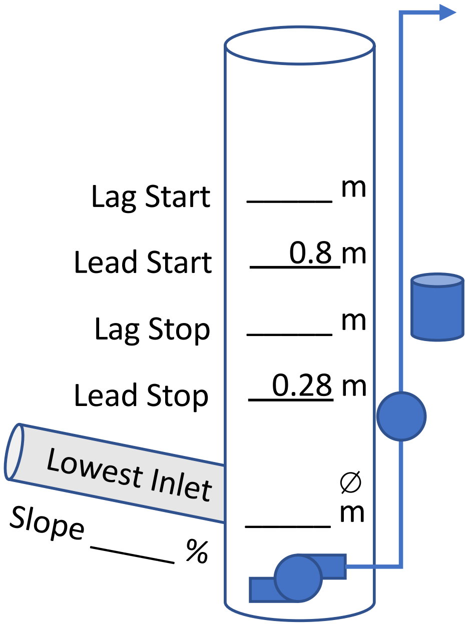
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.8 m

Lag Stop _____ m

Lead Stop 0.28 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Price Bay PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

A

Source of Flow Data Used for Assessment

Calculated Flow Method: 1 2 3

Magmeter ☒ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.5 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

☐ VFD

SCADA Recording

Pump Start/Stop

☐ Event Recorded

☐ Polling Interval

_________secs

Wet Well Level

☐ Event Recorded

☐ Polling Interval

_________secs

☐ Deadband

_________m

Flow Meter

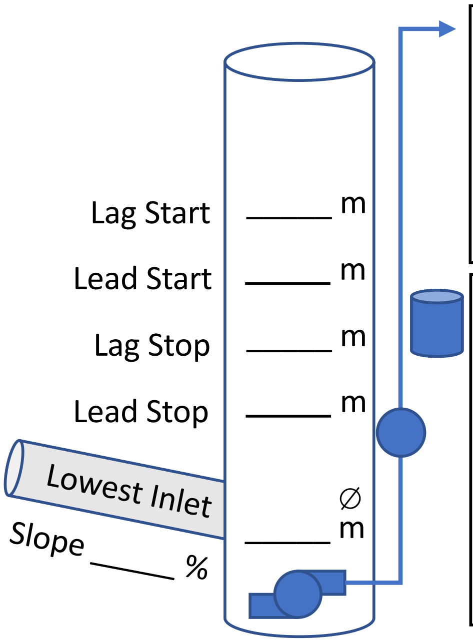
☐ Event Recorded

☐ Polling Interval

_________secs

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / [✓ Mag] / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity _______

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Stewart PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

D

Source of Flow Data Used for Assessment

Calculated Flow Method: 1 2 3

Magmeter ☒ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.2 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

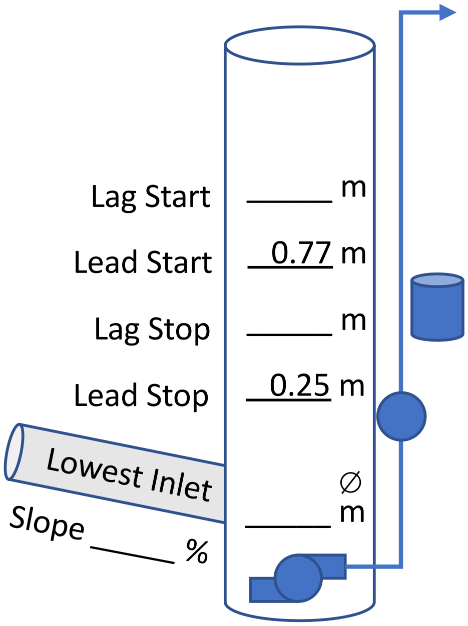
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.77 m

Lag Stop _____ m

Lead Stop 0.25 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / [✓ Mag] / Clamp-on

\# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Notes

This site has a magmeter but the data is not consistent and requires further review before use

B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Stoneridge PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

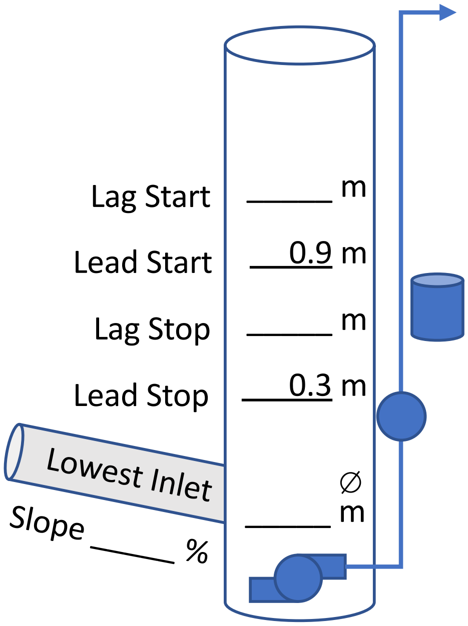
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 0.9 m

Lag Stop ______ m

Lead Stop 0.3 m

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Talcott PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.83 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

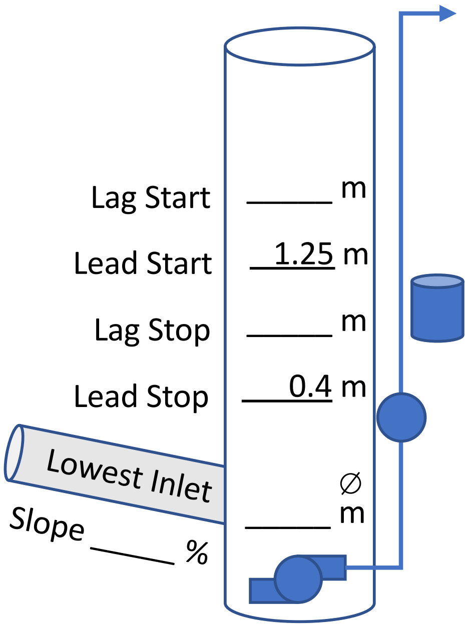
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.25 m

Lag Stop _____ m

Lead Stop 0.4 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Thetis Cove PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B-

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.2 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

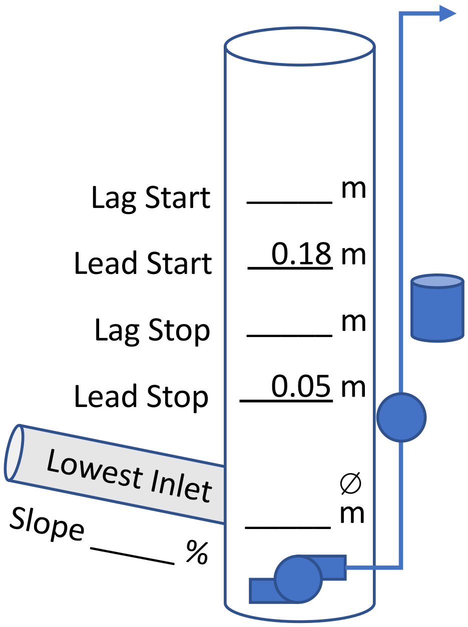
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval _________secs	☐ Polling Interval _________secs	☐ Polling Interval _________secs
	☐ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 0.18 m

Lag Stop _____ m

Lead Stop 0.05 m

∅ _____ m

Slope _____ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade	Description	
A	Reliable Flow Data	
	A	Magmeters / field verified data
	A-	Clamp-on meters
B	Suitable for general uses including inflow & infiltration analysis	
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C	Niche use only. Contains significant data quality issues	
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D	All data is unreliable. Would require substantial effort or a flowmeter to address.	
F	Data unusable	

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	View Royal PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☐ Circular ☒ Rectangular ☐ Irregular

∅ ____m 2.435 m X 2.435 m __________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

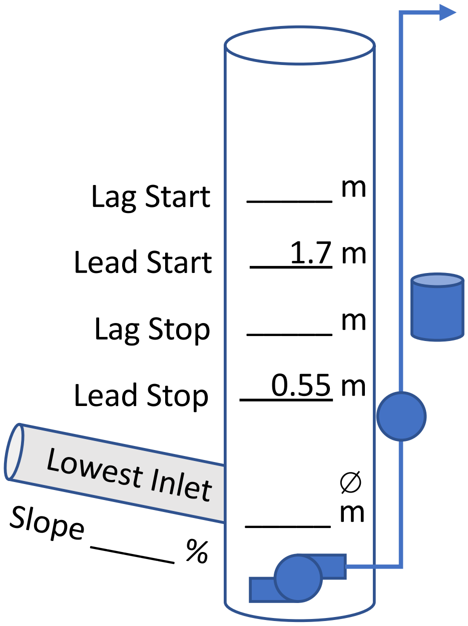
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.7 m

Lag Stop ______ m

Lead Stop 0.55 m

Lowest Inlet

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

APPENDIX B

Pump Station SCADA Flow Assessment Worksheet

Station Name	Wilfert PS
Owner	View Royal
Address	
Date	2020/01/20

FLOW METHOD GRADE

B

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.44 m ______ m X ______ m ____________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

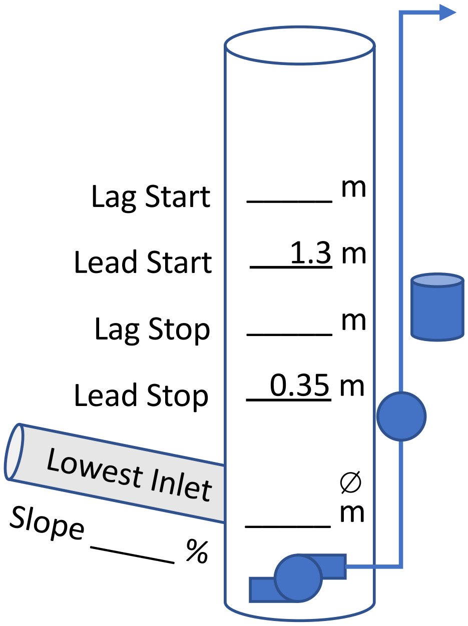
☐ VFD

SCADA Recording

Pump Start/Stop	Wet Well Level	Flow Meter
☐ Event Recorded	☐ Event Recorded	☐ Event Recorded
☐ Polling Interval __________secs	☐ Polling Interval __________secs	☐ Polling Interval __________secs
	☐ Deadband __________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.3 m

Lag Stop ______ m

Lead Stop 0.35 m

∅ ______ m

Slope ______ %

Pumps to:

☐ Gravity Sewer

☐ Pressure Sewer

☐ Common Forcemain

Storage Tank Y / [✓ N]

Impacting Calcs Y / [✓ N]

Existing Flowmeter

None / Mag / Clamp-on

# of Pumps 1 [✓ 2] 3 4

Pump Capacity ________

Flow Method Grade (typical, results vary)

Grade		Description
A		Reliable Flow Data
	A	Magmeters / field verified data
	A-	Clamp-on meters
B		Suitable for general uses including inflow & infiltration analysis
	B+	Standard PS calcs with excellent source data
	B	Standard PS calcs
	B-	Standard PS calcs but pumps operate infrequently at night
C		Niche use only. Contains significant data quality issues
	C+	Poor data resolution due to polling / timestamp issues
	C	Unreliable during storms. Could be addressed with Method 3 and a site visit
	C-	Unreliable during storms and is complicated (e.g. storage tank). Would require substantial effort or a flow meter to address
D		All data is unreliable. Would require substantial effort or a flowmeter to address.
F		Data unusable

Calculated Flow Methods

(Using SCADA Level and Pump On/Off data)

Method	Description
1	Standard PS inflow calculations
2	Custom approach for PS's that pump infrequently
3	Custom approach for PS's that pump for extended periods of time during storm events

Appendix F:

OAK BAY INFLOW & INFILTRATION WORK:
2020 TO MID-2021

Oak Bay Capital Project Details for 2020

Please note the 2019 annual report captured some of 2020 work (up to end of June 2020). Because this report is for 2020, some of the previous listed items in 2019's compilation will be restated in this report.

Conventional Construction

- Completed in 2020: Conventional sewer main replacement on Central Avenue. Removed and replaced 86m of failing 200mm vit sanitary sewer pipe with 250mm PVC SDR 35 pipe. Removed and replaced one 1050mm sewer manhole and one sanitary lateral was replaced.
- Completed in 2020: Conventional storm drain replacement on Heron St. Removed and replaced up to 265m of 250mm storm drain with PVC SDR 35 pipe. Removed and replaced 7 1050mm storm manholes. Replaced 2 storm drain laterals. Replaced 1 sewer lateral and constructed 1 storm drain lateral (previously combined). In addition, replaced up to 245m of 100mm CI watermain pipe with 150mm PVC pipe. Installed an additional hydrant and replaced 20 copper water services with PEXB pipe.
- Completed in Dec 2020: Conventional storm drain project on Kings Road. Abandon 390m of failed 200mm storm drain and install up to 232m of 250mm PVC SDR 35 pipe. Propose to construct/replace up to 27 storm laterals.

Trenchless Technology

- CIPP:
    - 1784 m Sewer mains lined
    - 1799 m Combined Sewer main lined
    - 447 m Storm mains lined
    - 2 new Storm MH's and replaced 1 Combined Sewer MH.

  Note: Actual CIPP work, which started Jan 2020 and was completed by spring 2020, was for Oak Bay's 2019 CIPP Lining Contract. The length of pipes lined was included in Oak Bay's 2019 I & I annual report submitted to the CRD. Below is a summary of the work by the CIPP contractor.

- Pipe Bursting:
    - 1327 Beach Drive- Oak Bay Marina: Pipe burst approximately 50m of 100mm Sewer lateral at the Oak Bay Marina at Oak Bay's cost. Sewer was leaking.

RFQ's/RFP's for infrastructure

- Cadboro Bay Road/Thompson Ave Intersection: Sent out Request for proposal to upgrade 45m of 200 mm sewer main and 81m of 200 mm storm drain in vicinity. In addition, the proposal includes a watermain replacement (KWL won contract and is designing the project). End of 2020 this design was at 90% completion.
- Runnymede Place: Sent out RFQ to survey Runnymede Place for future design of new sewer, storm and water mains on Runnymede Place road right of way (plan is to abandon sewer in an easement). Currently, no storm main exists in this vicinity; project will reduce combined systems/cross connections in the area. This work is tied to a subdivision development at 2031 Runnymede Ave. Survey has been completed.
- Armstrong Ave: Completed design for watermain and storm drain on Armstrong Ave. For the watermain portion, 120 m of 100 mm CI watermain will be abandoned and 170 m of 300 mm Steel

water main will be replaced with 300 mm PVC. Twelve copper services with be replaced with PEXB. Water main construction is scheduled to start July 2021.

- Burdick Avenue: Completed design for watermain & storm drain. Currently, watermain construction is underway: Replace 230 m of 100 mm CI main with 200 mm PVC and replace 23 copper services with PEXB. Project started March 1, 2021.
- Victoria Avenue: Completed design for watermain & storm drain on Victoria Avenue. Approx. 380 m of road, storm and water.

Studies/Investigations

- 2020 Estevan Storm Catchment and Eastdowne Sewer Catchment Models: District reviewed McElhanney's final draft and models were completed in 2020. Modeling data was used to establish 2021 storm main work.
- 2020: Partial storm modelling for Dover Road storm main (between Nottingham Rd & Devon Rd) to ensure capacity adequate prior to lining. Storm main was adequate.
- May 2020: 2180 Pentland Road storm main in easement- Crews attempt to clean and flush due to significant tree roots in the easement. Dye tests storm systems for properties in the area. Assess potential for pipe bursting.
- 2020 Investigating/surveying/recording Storm Manholes as part of our Asset Management program.

Sewer Master Plan

- SSMP contract was awarded to GeoAdvice Engineering on October 20, 2020. Kickoff meeting was held November 12, 2020. The consultant started working immediately after this meeting. Activity in 2020 was the District responding to the data request list – GIS info, record drawings, reports, etc. in addition, the District receives monthly updates from GeoAdvice.

2020 Developer's work

- 19 King George Terrace Development
    - 93 m New PVC 300 mm Storm Main + 2 Manholes. (replaced old 150 mm pipe) & 1 lawn basin.
    - 98 m CIPP lining of 200 mm Sewer main.
    - 1 house combined sewer replaced with new SS & SD.
    - New lot with new SS & SD.
- 1561 York Development
    - 25 m of 250 mm storm main (new installation; no existing pipe).
    - 2x Drain Manholes.
    - 1x Catch Basin.
    - New PVC sewer and storm laterals for new house.
- 1416 St. David Development
    - 46 m of new 200 mm PVC sewer on St David.
    - Terminal Sewer Cleanout.
    - Eliminated house combined sewer. New sewer and storm lateral installed for property.

Ongoing Programs

- 2020 CCTV Program: Sewer (year 5 of a 5 year program), Storm (year 5 of a 10 year program). Kerr Wood Leidal working on 2019/2020 condition assessment of sewer and storm mains.
    - CCTV SS = 5756 m with related sewer main flushing.
    - CCTV SD = 13,217 m with related storm main flushing.

- 2020 CCTV Spot Repairs:
    - Approximately 20 pipe sections in various Storm main pipes
    - Approximately 10 pipe sections in various Sewer main pipes

- 2020 CCTV investigative work:
    - 55 m of 375 mm storm drain(concrete) adjacent to 2114 Neil Ave.
    - 120 m of 200 mm storm drain (tile) in Yale St.
    - 70 m of 150 mm storm drain (clay tile) on Victoria Ave.

Public Works Annual and 6 month flushing program: Ongoing

- Policies/dye testing:
    - Ongoing policy to cap old sewer services at the main when new house relocates sewer service.
    - Ongoing policy to dye tests storm drains before most plumbing /building permits issued.
    - 2020 Dye Testing: 106 dye tests were completed by Public Works and 23 cross connections were discovered.
    - To date 14 of the 23 cross connections have been fixed.
    - Of the 106 Dye tests, 10 tests were inconclusive.
    - To date 3 of the 10 inconclusive tests have had new sewer and/or storm laterals installed.

- 2020 Sewer and/or Storm lateral applications on Public Property (Jan to Dec):
    - House with new sewer and storm services installed: 31
    - Houses with sewer laterals replaced: 10
    - Houses with new storm laterals installed or replaced: 34
    - Houses with new Uplands Combined system: 5
    - Inspection Chambers installed: 160

- 2020 building/plumbing permits related to sewer and/or storm on private property (Jan to Dec):
    - Work permits on private property related to sewer and storm services : 8
    - Work permits on private property related to sanitary sewer: 10
    - Work permits on private property related to storm sewer: 60
    - Work permits on private property related to combined systems: 2

- Storm Water Management Systems:
    - 2302 Windsor installed a SWMS with overflow into storm main.
    - 2560 Esplanade installed a SWMS. No storm main in vicinity.
    - 1416 St David installed a SWMS with overflow into storm main

- 2020 Storm repairs /maintenance
    - 1260 Beach Drive: SD lateral repair.

- 2849 Burdick: Storm main repair & sewer lateral repair.
- Estevan Ave: storm main repair.
- Harlow: Storm main repair.
- 3060 Midland: Storm lateral into rock pit.
- 2188 Oak Bay Ave: hole in storm main repaired adjacent to storm lateral.
- 2695 Thompson: Storm main repair.
- Catch basins: 8 CB repairs, 7 new CB installations
- Storm MH’s: 3 new MH’s , 1 MH repair.
- Cutting & Flushing: Cavendish and Beach storm main, Byng St storm main and in easement, Musgrave Storm main.

2020 Sewer: repairs/maintenance

- 2095 Lansdowne: Repair sewer main where sink hole was noted. Large boulder was on sewer main.
- 2080 Chaucer: Sewer main & sewer lateral repairs.
- King George Terrace/Beach Drive: Sewer main & sewer lateral repairs.
- Spot repairs on Sewer main on Lansdowne & Westdowne prior to lining work.
- 1477 Oak Bay Avenue: Sink hole; repaired sewer main.
- 2445 Cotswold: Sewer main and sewer lateral repair.
- 2695 Topp: Sewer lateral repair.
- Linkleas & Central: Sewer main and lateral repairs.
- Sewer MH’s : 1 new MH , 2 MH repairs

Appendix G:

DOWNSPOUTS DISCONNECTION PROGRAMS & BEST PRACTICES FROM ACROSS CANADA

Memo: Downspouts Disconnection Programs

Date: Updated July 2021 (Original March 2020)

To: Jim McAloon, Capital Regional District

From: Pinna Sustainability Inc.

1 Memo purpose

1.1.1 Purpose

In the Capital Regional District (CRD), some roof drains are connected directly to the sanitary sewer system (i.e. areas with combined sewers or semi-combined sewers, and individual buildings with roof drain cross-connections).[1] These connections quickly drain substantial amounts of rainwater into the sewer system, which can contribute to basement flooding and sewer overflows to the environment. There is potential to disconnect some of these downspouts from the sewer system in a safe and cost-effective manner.

Some local governments across Canada already have programs that encourage homeowners to disconnect their downspouts from the sewer system. When properly implemented, these programs are simple and effective for reducing inflow and infiltration (I&I), overflows and basement flooding.[2] Disconnections should only be carried out when it is safe to do so as the flows need to be properly directed away from building foundations to prevent flooding.

This memo outlines best practices and existing programs currently in place across Canada for disconnecting downspouts. The overall intent is to help better understand when disconnecting downspouts is appropriate as a tool for reducing I&I and to show how other municipalities have done it successfully.

1.1.2 Background

Downspouts are vertical pipes that drain rainwater captured in roof eavestroughs away from the foundation of the building. Typically, downspouts direct rainwater from roofs to one of three locations: a storm sewer system, a combined storm and sanitary sewer system, or onto the ground where it can naturally seep in. Disconnecting downspouts from the public sewer system and directing the collected rainwater onto the property can minimize the risk of sewer overloads.[3] The Canada Mortgage and Housing Corporation calculates that disconnecting a downspout on an average Toronto home with a 140-square-metre roof could divert close to 100,000 litres of stormwater from the sewer system every year.[4]

Additional economic and environmental benefits of disconnecting downspouts include:

- Reduced likelihood of basement flooding due to unsanitary sewer backups.

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[1] A semi-combined system is defined as sanitary sewers receiving combined private sewer laterals or that have extensive private-side cross-connections (Liquid Waste Services Department – Metro Vancouver).

[2] http://www.ibc.ca/qc/home/risk-management/mitigation-techniques/downspouts

[3] https://www.toronto.ca/services-payments/water-environment/managing-rain-melted-snow/basement-flooding/mandatory-downspout-disconnection/

[4] http://www.mondaq.com/canada/x/160218/Environmental+Law/Downspout+Disconnection+Why+Bother

- Less stormwater in the sewer system, reducing the likelihood of untreated water overflowing into local bodies of water.
- A reduced chance of flash flooding in rivers.
- A reduction in energy requirements to run sewer and wastewater treatment systems.
- Improved water quality and cleanliness of watercourses, and water that infiltrates into the ground.

1.1.3 Approach

Information was gathered through a desktop scan of organizations and resources, as well as telephone interviews with selected municipalities conducted in winter 2020.

2 Best Practices

2.1 Summary of best practices

Downspout disconnection programs have been widely accepted by municipalities and industry organizations that support stormwater management. Organizations such as the Institute for Catastrophic Loss Reduction (ICLR)[5] and the Water Environment Research Foundation (WERF)[6] are among two leading organizations that recommend this practice. They, and others, state the two most common reasons for downspout disconnection are Volume and Water Quality.

- **Volume:** During heavy rain, the sewers can become overloaded, increasing the risk of basement flooding. Downspout disconnections reduce the volume of roof runoff that enters the sewer, and therefore is one way to protect homes – particularly when downspouts are installed with extensions and splashpads.
- **Water Quality:** When rain hits rooftops, it contains deposited pollutants which can then run into storm drains that are directly connected to waterways. The use of disconnected downspouts results in these pollutants being reduced as stormwater infiltrates through the ground and is taken up into plant roots.

Furthermore, **climate projections** for the Capital Regional District anticipate more precipitation in fall, winter and spring, and that heavy rainfall events could result in 30 to 40% more rain on the wettest days by the 2050s to 2080s.[7] Other organizations and jurisdictions are also pointing to downspout disconnection programs as a cost-effective means of increasing sewer capacity in light of changing climatic conditions.[8]

The following section outlines several best practice guides and resources that show various perspectives on downspout disconnection.

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[5] https://www.iclr.org/flooding/

[6] https://www.werf.org/liveablecommunities/toolbox/downspout.htm

[7] https://www.crd.bc.ca/docs/default-source/climate-action-pdf/reports/2017-07-17_climateprojectionsforthecapitalregion_final.pdf

[8] https://www.amo.on.ca/AMO-PDFs/Events/18/Presentations/Tuesday/StormwaterRobert-Muir-Tuesday-AMO-16x9-REVISED.aspx

Standard Council of Canada

Guideline on basement flood protection and risk reduction

Target Audience: Industry and local governments

Summary of Tool: This guideline was prepared by a Technical Committee on Basement Flood Protection with the purpose of assisting relevant stakeholders in the mitigation of basement flood risk for new and existing National Building Code of Canada (NBCC) Part 9 residential buildings. The tool was developed in part due to the current basement flood risk and changing climate conditions across Canada. Section 5 behavioural measures briefly discusses the need to clean and maintain downspouts, including routine removal of leaves and other debris. Section 6.4 highlights specific recommendations for application to eavestrough and downspouts.

Application for CRD: This tool provides detailed considerations for best practices in removing downspouts, including but not limited to grading considerations, drainage and extensions, discharge points, considerations of neighbouring properties. This guideline could be a useful tool for referencing in CRD and municipal policies or bylaws, or for developing CRD-specific guidelines.

Institute for Catastrophic Loss Reduction

Protect your home from basement flooding

Target Audience: Public

Summary of Tool: The purpose of this handbook is to provide homeowners with steps that they can take to protect their home from basement flooding. It includes both simple and free steps, as well as those that cost money and may be more complicated. The handbook walks a homeowner through the various steps that they should take when considering how to better protect their home from floods, including talking with their municipality about programs to reduce basement flooding, talking to their insurance provider and working with a plumber to investigate their home. It then goes into further detail on how they can act on their own, to protect their home, questions they may have for a plumber and how to measure their risk of basement flooding. The first recommendation in this handbook is to act on your own – including disconnecting your downspouts, adding extension pads and splash pads. The handbook provides a high-level overview of the benefits of downspout disconnection and considerations to take prior to embarking on the task of removing your downspout (e.g., should be at least 1.8 metres from home, talk to your municipality prior to disconnection).

Application for CRD: The ICLR handbook is a useful tool that could be used with the public and/or adapted specifically for the CRD. It has a range of information that is relevant and action focused.

City of Mississauga

How to get disconnected

Target Audience: Public

Summary of Tool: This handbook provides homeowners with a four-part process for disconnecting their downspouts. The handbook outlines a step-by-step process that is written in simple language and includes supporting images and graphics. The Insurance Bureau of Canada (IBC) references this handbook on their website when providing resources and discussion tips for disconnecting downspouts.

Application for CRD: This handbook could be adapted to provide residents of the CRD with simple and informative information on how to disconnect downspouts, including considerations for before and after the disconnection.

Insurance Bureau of Canada
Website – Risk Management – Mitigation Techniques – Downspouts
Target Audience: Public

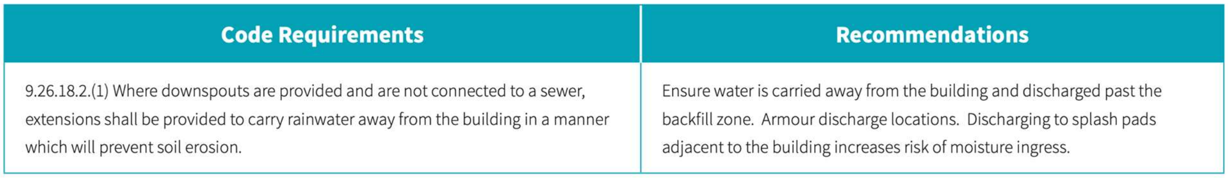
Summary of Tool: This website provides a high-level overview of the benefits of disconnecting downspouts and five tips for disconnecting downspouts – it also links to the City of Mississauga *How to get disconnected* handbook.

Application for CRD: This website could be used as a reference point or a link to be shared with residents who become involved in a downspout disconnection program in the CRD.

BC Plumbing Code
Target Audience: Plumbing and drainage contractors and building officials

Summary of Tool: Regulation that "sets out technical provisions for the design and installation of new plumbing systems to protect health and prevent water or sewer damage."[9] Piped conveyance of roof runoff is considered part of the plumbing system and must conform with the BC Plumbing Code (see code requirements shown in the table below). Best practices recommend separating drainage coming from impermeable surfaces (including roof runoff) from the foundation drainage, and ensuring it is discharged past the backfill zone.[10]

Table 8.1 *Code requirements and associated "best practice" recommendations for impermeable surface drainage discharge*



Code Requirements	Recommendations
9.26.18.2.(1) Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the building in a manner which will prevent soil erosion.	Ensure water is carried away from the building and discharged past the backfill zone. Armour discharge locations. Discharging to splash pads adjacent to the building increases risk of moisture ingress.

Application for CRD: All communication and guidance material developed by CRD and municipalities must align with the BC Plumbing Code.

3 Downspout Disconnection Programs in Canada

3.1 Summary of selected programs throughout Canada

Local governments across the country have implemented downspout disconnection programs as a control measure to help reduce the amount of stormwater runoff entering the storm and/or sanitary sewer systems. These programs are particularly important and prevalent where the sewer system is still combined. Downspouts programs have been implemented through various mechanisms (regulatory, voluntary or rebate). Table 1 outlines examples of existing downspout programs and information related to their respective approaches and cost.

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[9] http://www.bccodes.ca/plumbing-code.html

[10] https://www.bchousing.org/research-centre/library/residential-design-construction/Builder-Guide-Site-and-Foundation-Drainage

***Table 1**. Summary of selected programs throughout Canada*

Municipality	Approach	Link
Halifax	Homeowners in Halifax are responsible for knowing where their property line is, and to ensure that private water, wastewater and stormwater systems are not carrying inappropriate flows. Encourage dissipation on property where feasible. Mandatory to disconnect from sanitary sewers, but may obtain a permit to connect to the stormwater system (where stormwater systems exist). **Voluntary**	Halifax
Kingston	The City of Kingston has made downspout discharge to the sanitary sewer illegal, by way of a by-law. As per the City of Kingston website, it will soon start enforcing disconnection of downspouts from the sanitary system. **Regulatory****(By-law 2008-192)	Kingston
Toronto	It is mandatory for all property owners in Toronto to ensure their downspouts are disconnected from the City's sewer system. **Regulatory**** No longer offering free program, so cost is between $100-$1000.	Toronto
Region of Peel	At the time of this memo, the Region of Peel is **moving from a voluntary to mandatory approach** – see additional details below.	Peel Region
Hamilton	Voluntary program encourages residents to disconnect their downspouts to reduce the amount of stormwater that enters storm or combined sewers. **Voluntary**	Hamilton
Windsor	Due to recent flooding, the City of Windsor implemented a mandatory downspout disconnection policy. The program targets residential homes only. **Regulatory**** (By-Law 26-2008) City Downspout Disconnection Service, free of charge.	Windsor
Edmonton	The City of Edmonton website provides information on downspout disconnection, but offers no rational for the program. **Voluntary** Flood Prevention Program offers one-on-one inspections free of charge (2013)	Edmonton

**Municipalities with regulatory disconnection programs do offer exemptions on case-by-case basis. Residents apply through an exemption process and demonstrate that disconnecting their downspout is either hazardous or not technically feasible.

To understand more about the different programs across the country, and how the CRD may benefit from their experiences, a series of telephone interviews and information emails were sent out. Table 2 highlights the key insights from these conversations.

Table 2. *Key insights from telephone interviews*

Municipality	Program Information	Successes	Challenges	Liability	Additional Key Insights
Halifax	No specific downspout program – within their I & I Reduction program. In their Rules & Regulations there are private property requirements regarding downspout disconnection to eliminate the connection from the wastewater system. There are requirements per their design specifications that, for renovations or new construction, property owners are not allowed to connect downspouts to the combined system nor to the underground stormwater system.	Communication of the requirements are primarily with developers / builders etc.		The way that they limit liability is by having rules and regulations and following those – including building specifications. As a customer or builder, you must follow the rules. In some cases, the rules / regulations are a bit grey and, in those areas, the municipality works to decide what strategy they will take if it becomes an issue. In general, they are very risk adverse.	They have considered implementing a municipal wide Downspout Disconnection Program but haven't yet decided that it is the most appropriate course of action. In some new subdivisions, they have developed super-sized storms systems so do allow downspouts to be connected. It is important to have a clear goal in mind, and consider what will be the biggest 'bang for your buck' – suggested investigating other options (noted in Section 3). Recommended doing a survey of homes / geographic areas to understand how many downspouts there are, and what you are up against. Could use google street view – doesn't have to be costly. This will allow you to take some educated guesses – and perhaps do some modelling of flow data.
Kingston	No specific disconnection program – however, the City of Kingston has made downspout discharge to the sanitary sewer illegal, by way of By-law 2008-192.	There is a lot of on the ground education with residents – the utility will do a site visit / free consultation.	Gaining trust from residents that the program is supported by the utility – a lot of residents think there is a catch to the program. To negotiate this, utility works	They have haven't had any issues with liability – residents are required to sign a release, and that contains legal language. Liability would be directed to the	The program is marketed in the Spring / Fall through radio ads, and newspaper ads. from the sanitary sewer – this data has shown success.

Municipality	Program Information	Successes	Challenges	Liability	Additional Key Insights
	Only a small percentage of homes in Kingston have downspouts (5%) In 2012, had a budget of $200,000 and approx. 100 participants. In 2019, had a budget of $1,000,000 and between 300-500 a year. Program involves: - Installation of a new backwater sewer valve on your sanitary sewer lateral - Installation of a new sump and sump pump with backup pump systems - Capping of a foundation drain connection to the sanitary sewer lateral - Redirection of a sump pump discharge away from the sanitary sewer	Often, they will do 3-4 site visits a day. Flow monitoring data is available for a subdivision where 80% of the homes have disconnected.	with plumbers to encourage the program. A second challenge is finding an appropriate location to direct surface water – a lot of the soil is clay like and not permeable. To negotiate this, workshops on landscapes / managing surface water are conducted to help residents understand how to manage their lawns and where the surface water should go.	plumber who installs the device, and the building inspector.	
Region of Peel	Currently revamping their downspout disconnection program to move from a voluntary to mandatory approach. Region of Peel is only responsible for the sanitary system (separated system) – so when they implement the mandatory system they will only disconnect downspouts connected to sanitary. Voluntary program hit a limit – people are very keen to participate the day after a flood but not usually	Voluntary program was as successful as it could be – but limited funds and resources.	One challenge with voluntary program was the lack of education – it was for a simple cut / cap program and some residents didn't do their extensions correctly – causing feuds between neighbours. There was no way to do flow monitoring for the voluntary program – as the houses were so dispersed.	Anticipate that through the mandatory program, liability will be an issue – will mitigate this by informing residents of their choices / keeping them informed along the way – and then having them sign off on what work is to be done / the rebate they will receive. If issues of liability come up, they will deal with them as they come.	Recommend staying away from a voluntary program. If possible, do up front research – go out and do an inventory of all the downspouts in the area so you know what you are working with. Start treating them as an asset – and roll into asset management program. Also suggested that having a clear goal will support the work – i.e. is it to free up capacity within the system, or is it to reduce basement flooding – having a

Municipality	Program Information	Successes	Challenges	Liability	Additional Key Insights
	when it is something that they have to decide to do / or not.				goal will ensure that all the details are easier to decide upon. Mandatory program will be geographically delineated with council – work will be done by Region of Peel – up to $2500 per home will be spent by the Region. If you do choose to go with a voluntary program – make sure that the expectation is set – understand that many people will not participate in the program.
Edmonton	Program has been in place since the early 1980s with a more focused approach happening in the early days (i.e. people going out to certain areas / homes) the 'Roof Leader Disconnection' program is now voluntary and part of a larger bundle of I & I related programs.	At the beginning the program was well received – not sure % of people that participated.	Communication to residents is a challenge – educating them on drainage related matters. Currently do unidirectional communication – through website. Mailouts or forums would be tied to focused efforts in the community i.e. neighborhood renewal. Currently communication about the RLD program are homeowner initiated. There is no way to track success – no metrics were put in place (i.e. flow monitoring, % of homes disconnected etc.) so hard to say how successful they have been.	Identified that there is a risk association with in-fills or smaller lots, that the flow from downspouts would cause flooding in adjacent properties – doesn't know of any proactive measures to address this (i.e. waivers), and hasn't heard of issues (although suspects there must be some issues).	Always start with a clear goal. Put measures in place to track progress, both for the benefit of the CRD, but also to show homeowners how the program can benefit them. In addition, having metrics in place will inform the CRD as they make decisions and roll out information.

4 Considerations for a CRD program

The following key insights emerged throughout the process of reviewing best practices and speaking with municipalities across the country.

1. Multiple municipalities suggested that having **a clear goal** in mind was imperative to the development of any program aimed at I & I Reduction. Once a clear goal is set (i.e. to reduce basement flooding or to increase capacity within the system), then details and approaches that are required will be easier to decide upon.

2. Prior to beginning any program, set in place **measures to quantify** and show the success of the program – this will help to show benefits both to the municipality, but also to the residents who are participating in the program. Further, with data comes knowledge, and this knowledge can inform future decisions for the program.

3. To start the program, consider a **phased approach** where there is a focus on geographic areas that would be considered easy or low-hanging fruit. For instance, survey areas with google maps to identify concentrated areas of homes with connected downspouts; combine this with flow meter data to find neighbourhoods where the program should be targeted. Then, with experience and lessons learned – move to neighborhoods that may have more challenges. A phased approach was conducted in the City of Toronto.

4. To minimize **issues with liability**, prepare rules and regulations, as well as waivers to be implemented with the developers / builders / or home owners. In developing these materials, be aware that there may be unique cases, and prepare in advance for how to deal with them.

5. **Education and communication** with residents is fundamental to the success of the program – not only for building trust but also to ensure that residents have the knowledge of 1) how to safely disconnect their downspouts and 2) how to manage the surface water as a result of the disconnection.